Combination of Collaborative Projects and Coordination and Support Actions for Integrating Activities

Capacities – Research Infrastructures

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Detector Development Infrastructures for Particle Physics Experiments

DevDet

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Proposal abstract

Europe already has a preeminent position in particle physics. The Large Hadron Collider, which will start taking data already in 2008 at CERN in Geneva (Switzerland), is the world's flagship particle physics project. The CERN Council adopted unanimously "The European Strategy for Particle Physics" in July 2006, giving priority to the following future projects: the luminosity-upgraded LHC (SLHC), future Linear Colliders (ILC/CLIC), future accelerator-driven Neutrino facilities and B-physics facilities (Super-B project). The need for intensive R&D to develop these projects is a central element of the strategy. These projects aim to answer the most challenging outstanding questions in particle physics.

The "Detector Development Infrastructures for Particle Physics Experiments – DevDet" proposal constitutes an Integrating Activity with the aim of creating and improving the key infrastructures required for the development of detectors for these future particle physics experiments. It includes common software and microelectronics tools enabling these developments, project coordination offices for Linear Collider and Neutrino Facilities, test beam infrastructures (CERN and DESY) and irradiation facilities in several European countries, including trans-national access to them.

These facilities serve two additional purposes, an increased scientific co-operation between the four project communities, and an increased European integration of the efforts within each of them. Generic R&D within specific key technologies will also benefit of these facilities.

The proposal is very timely and will enable Europe to secure the lead in development of advanced instrumentation for particle physics. The project gathers the whole European particle physics community (87 institutes in 21 countries) and guarantees trans-national access for the benefit of approximately 8000 users in Europe and beyond. The facilities proposed are expected to increase the user community significantly.

Executive Summary

The Detector Development Infrastructures for Particle Physics Experiments – DevDet" proposal constitutes an Integrating Activity with three main objectives that are essential to European development of detectors for particle physics research at future accelerator facilities:

- The creation and improvement of key infrastructures required for the development of detectors for future particle physics experiments;
- The provision of trans-national access for European researchers to access these research infrastructures,
- Integrating the European detector development communities planning future physics experiments, and increasing the collaborative efforts and scientific exchange between them.

Background to DevDet

"The European Strategy for Particle Physics" adopted unanimously by CERN Council in July 2006 after a lengthy process of consultation throughout the European particle physics community identified four priority areas for the future of particle physics in Europe: the luminosity-upgraded Large Hadron Collider (Super-LHC), future Linear Colliders (ILC and CLIC), future accelerator-driven neutrino facilities (Super-Beams, Beta-beams or Neutrino Factories) and B-physics facilities (Super-B Factories).

The outstanding physics questions that these facilities aim to answer will build on an impressive programme of work in particle physics over many decades both in Europe and elsewhere. While, the LHC, which will start data taking in 2008, will partially answer some of these questions, there is a plan to upgrade this accelerator to increase its luminosity by a factor of ten in a machine labeled Super-LHC (SLHC). This machine would continue to address questions regarding electroweak symmetry breaking, the origin of mass, the existence of supersymmetry, the existence of new gauge bosons, extra dimensions or other new phenomena. The Linear Collider, will extend the discovery potential of the LHC and SLHC by searching for new physics at the TeV energy scale through high precision measurements, and is seen as a complementary machine to the LHC and SLHC. New generation Neutrino Facilities, such as a conventional Super-Beam, producing a high intensity neutrino beam from the decays of pions, a Beta-Beam, which is a neutrino beam from the decay of accelerated radioactive ions, or a Neutrino Factory that produces neutrinos from the decay of muons in a storage ring, will probe CP violations from neutrino oscillation experiments. Super-B factories will search for new physics by performing precision measurements of CP asymmetries from B-meson decays and from rare decays of heavy flavours (*b* and *c* quarks and τ leptons).

The development of detectors for these future facilities is extremely challenging since particle physics experiments are increasing in complexity within a harsher environment. Radiation hardness, data throughput rates, reduction of material in the detector, power dissipation, thermal and mechanical stability all need to be certified using beam tests. After determining the operational criteria of detectors, these are designed, prototypes are fabricated and tested in the laboratory and in dedicated beam tests. Readout electronics need to be integrated to the detectors and materials need to be tested for their mechanical, thermal and radiation hardness properties. Software for readout, simulation, reconstruction and alignment needs to be developed to be able to simulate, predict and validate the performance of the detectors. Detectors are irradiated at irradiation infrastructures to ensure that they can survive the harsh environments of high luminosity accelerators. Engineering teams ensure that the detector concepts can be integrated in larger experimental configurations and that the materials are adequately chosen for their mechanical, thermal and electrical properties. This detector development cycle needs to be sustained with high quality infrastructures. The goal of DevDet is to provide the necessary infrastructures so that the development of detectors in Europe can be carried out in a cost-effective and efficient manner. Through use and access to these common infrastructures the European particle physics community will also reach a new level of integrated approach, addressing the prioritised projects in particle physics, and increased exchange of methods, results and developments between detector development communities will benefit all.

Details of DevDet

The main goal of DevDet is to provide common infrastructures and organisation to achieve the detector R&D objectives for future particle physics experiments, according to the priority list of the European Strategy Document for Particle Physics.

- There are four networking and coordination Work Packages (COORD) covering: common detector software, the design of common microelectronics and solid state sensor technologies and two project and coordination offices for linear collider detectors and long baseline neutrino facilities.
- There are three work packages dedicated to the support (SUPP) of users at trans-national facilities, including trans-national access to CERN, access to DESY and access to six different irradiation facilities throughout Europe. Trans-national access is an essential part of DevDet since it opens up world-class facilities to the whole European detector R&D community.
- There are three work packages dedicated to the construction and upgrade of infrastructures, including the construction of irradiation facilities at CERN, the construction of an integrated detector test infrastructure at CERN, mainly dedicated to linear collider tests, and upgrades to existing beamlines at CERN and Frascati as needed for SLHC, neutrino and SuperB detector developments.

Expected Results and Users

The foreseen results of DevDet are listed below:

- Construction and upgrades of beamlines at CERN, DESY and Frascati to be able to carry out beam tests of particle physics detectors.
- Construction and upgrades of irradiation facilities at CERN.
- Trans-national access to test beams and irradiation facilities at CERN, DESY and other European laboratories.
- Development of common software tools for the simulation, reconstruction and alignment of detector elements in particle physics experiments and at beam tests.
- Development of radiation hard microelectronics and solid state sensor technology for the readout of detectors in particle physics experiments.
- Development of the “Project office for Linear Collider detectors” and the “Coordination office for long baseline neutrino experiments”.
- Increased integrated efforts and scientific exchange between European detector developers across project borders, allowing community building and increased European coherence in the field.

The Users of DevDet are as follows:

- Lead Users: Users from research institutes carrying out prototyping and construction of detectors for future particle physics experiments. There are roughly 8000 physicists involved in the experiments that are currently planned to be constructed or upgraded.
- Other Users: Industry developing particle detectors; other users from nuclear physics, astrophysics, medical physics and synchrotron communities.

List of Work Packages for DevDet Project

Work Package Number	Work PackageTitle
WP1	DevDet project management
WP2	Common software tools
WP3	Network for Microelectronic Technologies for High Energy Physics

Work Package Number	Work PackageTitle
WP4	Project office for Linear Collider detectors
WP5	Coordination office for long baseline neutrino experiments
WP6	Transnational access to CERN test beams and irradiation facilities
WP7	Transnational access to DESY test beam
WP8	Transnational access to European irradiation facilities
WP9	Construction of irradiation facilities at CERN
WP10	Test beam infrastructures for fully integrated detector tests
WP11	Detector prototype testing in test beams

Consortium:
87 institutes from 21 different countries. Many countries group their efforts into scientific consortia, joining the proposal as a single legal entity:

- Bulgaria, 2 institutes, 1 legal entity
- Czech Republic, 4 institutes, 1 legal entity
- France, 11 institutes, 2 legal entities
- Greece, 2 institutes, 1 legal entity
- Israel, 3 institutes, 2 legal entities
- Italy, 12 institutes, 1 legal entity
- The Netherlands, 1 national laboratory
- Poland, 4 institutes, 1 legal entity
- Spain, 6 institutes, 3 legal entities
- Sweden, 2 institutes, 1 legal entity
- Switzerland, 5 institutions, 1 legal entity

Other countries such as Germany (13 institutes) and United Kingdom (13 institutes) are still in the process of defining a clustering of their efforts. There are currently 50 legal entities signing the proposal. This is expected to decrease to 25 beneficiaries for the project phase.

Duration: 48 months

EC Contribution: 11 M€

Total Budget: 37.8 M€, of which 26.8 M€ are contributed by the partners from their own funding sources.

Total Manpower: 3263 Person Months.

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1: Scientific and/or technical quality, relevant to the topics addressed by the call

1.1 Concept and objectives

Introduction

DevDet addresses the creation and improvement of key infrastructures required for the development of detectors for future particle physics experiments and trans-national access to the facilities that provide these research infrastructures. In line with the European Strategy for Particle Physics[1] adopted unanimously by the CERN Council in July 2006 after a process of consultation throughout the European particle physics community, DevDet targets the communities preparing experiments at a number of key future accelerators: the luminosity-upgraded LHC (SLHC), future Linear Colliders (ILC and CLIC), future accelerator-driven neutrino facilities (Super-Beams, Beta-beams and Neutrino Factories) and B-physics facilities (Super-B Factories).

This proposal includes a very large consortium of 87 institutions and covers almost all detector R&D for particle physics in Europe. It aims to optimise the use and development of the best research infrastructures existing in Europe for the interest of the whole European particle physics community, in accordance with the overall objective of the Capacities-Research Infrastructures FP7 call from the European Commission. This proposal will allow Europe to remain at the forefront of particle physics research and take advantage of the world-class infrastructures existing in Europe for the advancement of research into detectors for future accelerator facilities.

The infrastructures covered by the DevDet project are key facilities required for an efficient development of future particle physics experiments, such as: test beam infrastructures (at CERN and DESY), specialised equipment, irradiation facilities (in several European countries), common software tools, common microelectronics tools and engineering coordination offices.

Background and origin of DevDet

The European Strategy for particle physics

After a process of consultation throughout the European particle physics community, the CERN council, in its official role of defining the future strategy and direction for European particle physics research, unanimously adopted a document describing “The European strategy for particle physics”[1] in July 2006. The strategy document covers both scientific and organisational issues, summarised as follows:

- **Scientific activities**: R&D for accelerators and detectors crucial for European Particle Physics in the next 5-year period (in parallel with LHC start-up and operation). In order of priority, the following future facilities are listed:
    - Super-LHC (SLHC), the luminosity-upgraded Large Hadron Collider;
    - Linear colliders (ILC and CLIC);
    - Future neutrino facilities (Super-Beams, Beta-Beams and Neutrino Factories);
    - Flavour physics facilities (Super-B Factories).

- **Organizational issues** emphasized:
    - Process of defining and updating the European strategy (through the CERN council and its bodies);
    - Coordination of work on a large scale;
    - Strengthening of the relationship between the European Research Area and the organisation and structures in European particle physics.

[1] http://council-strategygroup.web.cern.ch/council-strategygroup/Strategy_Statement.pdf

RECFA Coordination Group for Detector R&D in FP7 programs

Following the successful model of ESGARD, covering accelerator R&D in Europe, a European coordination group for Detector R&D has been organised under the auspices of RECFA[2]. For particle detector R&D, the activities are much more widely distributed amongst University groups than for accelerator R&D. The major stakeholders are the main experiments currently being planned for the above-mentioned facilities: SLHC, Linear Collider (e.g. EUDET collaboration), Neutrino Facilities and Flavour Physics Facilities. Therefore RECFA created in 2007 a Coordination Group[3] for Detector R&D in FP7 programmes, with representatives from the detector coordinators for these planned experiments (ATLAS, CMS, Linear Collider detectors, Neutrino detectors, flavour physics detectors) as well as representatives from the CERN and DESY laboratories and with contact to the accelerator community (ESGARD). DevDet is the first project coordinated by the RECFA Coordination Group and responds to the FP7-INFRASTRUCTURES-2008-1 call from the European Commission. Since most of the European particle physics detector R&D is focused and organised as part of the above collaborations or proto-collaborations, this Coordination Group allowed the widest possible consultation with the experimental community to define the DevDet proposal.

The National Contact Group

The National Contact Group is a reference group made up of national representatives. Given that detector R&D is a very widely distributed activity with many potential project partners, it is important to have discussion partners in each European country who can:

- help to identify the major detector R&D activities in each country;
- help to identify one (or a few) potential contract partners for EU proposals in the area of detector R&D (this would typically be a Funding Agency, a national laboratory taking on a coordination role within one country, or a leading institute);
- provide guidance to the Coordination Group during the proposal planning phase.

DevDet Proposal

The nominations of the RECFA coordination group for Detector R&D and the National Contact group are important elements in the implementation of the European strategy for particle physics. Both bodies are currently focusing their work on the DevDet proposal, which aims to provide a framework for coordination of Detector R&D in Europe, which is necessary to deliver the future particle physics programme for Europe. DevDet addresses the two main objectives of the European Strategy for Detector R&D: driving the scientific activities and the large scale coordination of resources for the detector R&D work in Europe. DevDet will ensure that Europe retains its world leading position in particle physics and that all European countries will have access to facilities to be able to carry out high quality research.

Table 1.1 shows an overview of the European priority projects, the timescales for the documents necessary for the approval and design of each project, their relation to the key detector R&D tasks that need to be achieved and how DevDet will ensure that these tasks can be carried out. The goal of DevDet is to provide common infrastructure and organisation to achieve these detector R&D objectives. There are four coordination Work Packages (WP): common detector software is covered in WP2, the design of common microelectronics and solid state sensor technologies is included in WP3 and two project and coordination offices are covered in WP4 (linear collider detectors) and WP5 (long baseline neutrino facilities). There are three work packages dedicated to the support of users at trans-national facilities: WP6 supports trans-national access to CERN, WP7 provides access to DESY and WP8 provides access to seven different irradiation facilities throughout Europe. Trans-national access is an essential part of DevDet since it opens up world-class facilities to the whole European detector R&D community. The last three work packages are dedicated to the construction and upgrade of

[2] Restricted sub-group of the European Committee for Future Accelerators, http://committees2.web.cern.ch/Committees2/ECFA/Welcome.html
[3] http://project-fp7-detectors.web.cern.ch/project-FP7-detectors/

infrastructures: WP9 is dedicated to the construction of irradiation facilities at CERN, WP10 will build an integrated detector test infrastructure at CERN, mainly dedicated to linear collider tests, and WP11 will carry out upgrades to existing beamlines at CERN and Frascati for SLHC, neutrino and SuperB detector testing.

European priority projects (focus on detectors)	Timescales	Current Phase	Key R&D issues	DevDet Work Packages to address R&D needs
SLHC = Upgrade of LHC detectors for increased luminosity in 2016	Technical Design Reports (TDR) in 2011	Wide R&D focusing on key technology developments; irradiation and test beam measurements	Electronics, simulations/software, irradiation and test beam measurements	WP2, WP3, WP6, WP8, WP9, WP11
Linear Collider Detectors for next large international accelerator project	Letter of Intent 2009, then towards TDR	System studies in test beam, individual tests ongoing (EUDET)	Simulations/software, integration, system tests in beams	WP2, WP3, WP4, WP6, WP7, WP8, WP10, WP11
Neutrino Detector Studies for future Neutrino Facilities	Conceptual Design Report to be concluded in 2012	Design studies ongoing, test beam studies next step	Simulation/software, integration, test beam measurement at low energy	WP2, WP3, WP5, WP6, WP11
Flavour Physics Detectors at SuperB Factories	Conceptual Design Report in 2007, Technical Design Report next	Design studies, test beam measurements next step	Simulation/software, test beams with low energy and high intensity	WP2, WP3, WP6, WP8, WP11

Table 1.1: Overview of European priority projects and their relation to Detector R&D

1.2 Progress beyond the state-of-the-art

<u>Introduction</u>

DevDet aims to address the infrastructures required for the development of detectors for future particle physics experiments and trans-national access to these facilities.

<u>Super-LHC</u>

The LHC is a particle accelerator creating high energy proton-proton collisions at a centre-of-mass energy of 14 TeV. Presently near completion, the LHC is due to start physics operation in 2008 and is on the verge of exploring this completely new energy domain in particle physics. This holds the promise of fundamental new discoveries such as the origin of mass, the discovery of particles predicted by supersymmetry, new forces mediated by new gauge bosons, processes associated with the existence of new dimensions of space, and even completely unexpected phenomena.

The Large Hadron Collider upgrade, otherwise known as Super-LHC (SLHC), is a project that aims to upgrade the luminosity of the LHC by an order of magnitude. This is the project with highest priority in “The European strategy for particle physics” document, which was unanimously approved by the CERN Council. The SLHC, with an expected 1 B€ budget, includes the upgrade of specific elements of the LHC accelerator, major upgrades in the accelerator injector complex, as well as upgrades to the experiments that will run at SLHC (ATLAS, CMS and LHCb), to provide the ultimate physics performance, matching this luminosity increase. It will result in a tenfold increase of the LHC luminosity that will allow the LHC to remain the most powerful particle accelerator in the world in the next two decades, and will exploit the physics potential of the LHC for new discoveries. The main aim of the SLHC component of DevDet is to develop the necessary infrastructures to carry out the R&D needed to deliver the detector systems that can operate successfully at the SLHC, in time for a decision on the approval of the SLHC project by 2011, allowing for a progressive implementation of the SLHC project over the years 2012 to 2016.

The upgrades to the LHC experiments (ATLAS, CMS and LHCb) comprise major changes in the forward detection region layout of the experiments, the central tracking and vertex detectors, the read-out electronics, trigger and the data acquisition systems. The first stage, matching this DevDet proposal timescale, has already been fully supported by the CERN Council, which approved an additional financial contribution for the period 2008-2011 at its meeting in June 2007 corresponding to approximately 152 M€, in addition to 5.2 M€ funding for the SLHC-PP EU Collaborative Project, coming from the European Commission.

The physics results, operational experience and theoretical knowledge gained from the first years of LHC running will provide input of paramount importance towards the detailed implementation of the LHC upgrade. At the same time, crucial technical issues related to the upgrade of the accelerator will have been solved in a convincing way and the SLHC accelerator project will be financed to a large extent from within the annual CERN budget, complemented by additional contributions from outside CERN. However, the upgrades to the experiments for high luminosity running will be mainly funded from institutes outside CERN. DevDet will provide the underpinning infrastructures needed for the institutions that will participate in detector R&D for the upgrades to the SLHC experiments.

Increasing the luminosity of the LHC will mean that the radiation levels in the experiments will increase substantially, so understanding the expected prompt dose rates on detector elements, material activation, radiation impact studies and radiation hardness of material and micro-electronics will be needed. The SLHC tracking systems require state-of-the-art solid-state sensor technologies, coupled to custom-designed deep-submicron radiation-hard electronics. The tracking detectors are located in a highly radioactive environment and in strong magnetic fields. Radiation hardness of detector elements will be explored by developing deep submicron radiation-hard electronics (WP3), construction of irradiation facilities and characterisation of detector materials (WP9), plus trans-national access to irradiation facilities at CERN (WP6) and other institutions in Europe (WP8). Furthermore, construction of fully integrated systems and individual detector elements will be tested at dedicated test beams (WP11). Common software tools for simulation, reconstruction and alignment of detector elements will be explored (WP2) to ensure that detector prototypes can be simulated and optimised, and that the SLHC processes and data can be simulated and analysed in an effective and timely manner.

The higher particle rates at SLHC will also require significantly increased detector granularities as well as high rate detection, electronics and data transmission applications. The upgrades of the inner tracking and vertex detectors and the ability to cope with data throughput are the principal focus of the upgrade programs. Research has started within radiation-hard silicon sensors, interconnect technologies, fast radiation-hard gas detector technologies, microelectronics, optoelectronics developments for high speed data links, trigger developments as well as Grid application developments. Many of the existing and also new groups in the LHC community are now involved in the detector R&D for the SLHC. Once constructed and installed, inner detectors are highly inaccessible. Therefore ultimate reliability and integration of the several hundred million channels is mandatory. Also other parts of the LHC experiments will need changes for example: muon systems in the forward direction, trigger and other types of electronics, machine interface systems. All of these topics will be explored at the test beam and irradiation facilities where potential technologies will be assessed, design work carried out, prototypes built and finally the selected technologies will be integrated and tested in full-size detector prototypes.

Linear Collider

Several of the existing puzzles in particle physics point to the TeV scale as the arena for new phenomena. While the LHC proton-proton collider is the ideal instrument for exploring new physics phenomena at this new energy domain, an electron-positron collider at the TeV scale will have the capability of extending the discovery potential through high precision measurements. These measurements will allow the detailed elucidation of the underlying structure of new phenomena and will provide the keys to describe new fundamental laws of nature.

Two potential future electron-positron linear colliders (LC) are presently under development within world-wide study groups: the International Linear Collider (ILC) and the Compact Linear Collider (CLIC). In Europe both projects are acknowledged as high-priority projects by the European High

Energy Physics community represented by the European Strategy Group for Particle Physics of the CERN council.

The ILC is based on super-conducting accelerator technology and has been designed for the energy range 0.5 - 1 TeV. It has been developed over the last 15 years with a strong and broad involvement of European institutes in a series of workshops initiated by the European Committee for Future Accelerators (EFCA). Collider and detector concepts are being developed under the management of the Global Design Effort (GDE) with the goal to be ready for construction around the beginning of the next decade. Recently a Research Director has been appointed to coordinate the development of ILC detectors.

To go beyond the 1 TeV scale, a new type of machine is under development known as CLIC. Its concept is based on a challenging technology of energy transmission from a low-energy drive beam to a high-energy beam and has the potential of reaching an energy as high as 3 TeV. The CERN Council Strategy Group supports the R&D efforts to develop this technology to push forward the high energy frontier. Although ILC and CLIC cover different energy domains, the particle detectors at linear both machines have R&D issues to be addressed in common and, moreover, the test beam infrastructure for detector tests can be carried out jointly at a European Vertical Integration Facility (EUVIF) (WP10).

At future high-energy electron-positron colliders the time structure and challenging background conditions mean that the detectors are an integral part of the overall design. Technology development and assessment for LC detectors is currently being co-funded by the EC through the EUDET Integrated Infrastructure Initiative in FP6. This successful project, now at its mid-term, defines and implements European infrastructure for research and development towards components of future LC detectors. An important aspect of EUDET, which is greatly appreciated by its partners, is the integration of partners and associates into a common scientific network, which makes common facilities available to others, facilitates the exchange of information and prepares for the future establishment of more formal collaborations.

The next logical step toward a LC detector design is to assess system aspects of the proposed detector concepts. This means that the interplay between detector components must be studied. The principle integrating factor in linear collider event reconstruction is the concept of “energy flow”. In this concept, already successfully used in the LEP era, reconstructed objects from different detectors are combined into physics objects such as leptons, photons, or jets. The calorimeters planned for the Linear Collider should allow even single hadrons to be identified and measured, and this opens up the quantitatively new possibility of “particle flow”.

It must thus be established how single measurements from the detector components complement each other to form these particle-flow objects. It must be determined how the system as a whole can be integrated mechanically, how services can be distributed and how data can be collected. This requires the definition of interfaces and their implementation. It also requires the development of strategies for data conditioning and reconstruction that correspond to the well studied physics requirements.

The European Vertical Integration Facility (EUVIF) proposes a unique infrastructure to integrate prototypes of LC detector components and expose them to particle beams with the required LC time structure and an appropriate energy range (WP10). It will present to users a flexible framework of infrastructure for services, data acquisition and prototype accommodation, in which complete vertical slices through future detectors can be tested. In this way, valuable data on system level performance can be established. The Linear Collider Project Office (WP4) will coordinate the work to be carried out and trans-national access to this facility will be provided through WP6. Further effort on common software tools (WP2) and micro-electronics for LC applications (WP3) is also included in the work plan.

Neutrino Facilities

The observation of neutrino oscillations is one of the most important discoveries in particle physics in the past decade and has shown the first evidence for physics beyond the Standard Model, implying that neutrinos have a non-zero mass and that the three known neutrino types can undergo quantum mechanical mixing. Mixing is achieved through a rotation matrix (the PMNS matrix), containing three angles that define the probability of mixing and a complex phase δ that could make neutrinos behave differently from anti-neutrinos (a phenomenon known as CP violation). It is thought that CP violation by neutrinos may be responsible for the matter-antimatter asymmetry of the universe through a process named leptogenesis that could have occurred in the early universe. Hence, the accurate measurement of all the parameters responsible for neutrino mixing and the potential discovery of CP violation is a priority of the neutrino programme, and could determine why we live in a universe dominated by matter, and in which anti-matter is highly suppressed.

Two of the mixing angles and two of the mass splittings have been measured in neutrino oscillation experiments, so the next generation of neutrino oscillation experiments will seek to measure the remaining mixing parameter (the mixing angle θ_{13}), which is already known to be much smaller than the other two. However, these experiments will have little or no sensitivity to matter-antimatter symmetry violation or to the mass hierarchy amongst neutrino mass states. The normal mass hierarchy is defined when the third neutrino mass state is heavier than the other two mass states and the inverted mass hierarchy is when it is lighter. So, it is essential that more sensitive neutrino oscillation measurements be carried out to measure θ_{13}, if it has not been measured, to determine the mass hierarchy and to measure whether the CP violating phase δ is different from zero.

Such future neutrino oscillation experiments would require a second-generation facility ready to begin operation in the second half of the next decade. Three types of facility have been proposed: the Neutrino Factory, in which electron and muon neutrinos and antineutrinos are produced from the decay of a stored muon beam, the Beta Beam, in which electron neutrinos (or anti-neutrinos) are produced from the decay of stored radioactive-ion beams; and Super-Beams, high intensity conventional neutrino beams from the decay of pions. These facilities are being studied and compared in a Design Study co-funded by the European Union named EuroNu. The study of future neutrino facilities also follows the recommendations of the European Strategy for Particle Physics.

Detectors for all future neutrino facilities will be studied under this proposal. At a Neutrino Factory with simultaneous beams of positive and negative muons, it is possible to perform both appearance and disappearance experiments, providing lepton identification and charge discrimination which is a tag for the initial flavour and of the oscillation. The “Golden” channel at a Neutrino factory is the appearance of wrong-sign muons and can be carried out with two 50-100 kT Magnetic Iron Neutrino Detectors (MIND) at 7500 and 4000 km distances. The “Silver” channel relies on the appearance of tau leptons, and would require a detector capable of identifying τ-decays, for example a magnetised emulsion cloud chamber, similar to the OPERA experiment currently in operation at the CERN to Gran SASSO (CNGS) neutrino beam. Reduction of the muon threshold and electron appearance (“Platinum” channel) can be achieved by using a Totally Active Scintillator Detector (TASD) or with a large magnetised Liquid Argon detector. A megaton scale Water Cherenkov detector is the baseline option for the Super-Beam and Beta Beam facilities. In addition, near-detector concepts at each of the facilities for absolute flux normalisation, measurement of differential cross sections and detector backgrounds need to be studied.

DevDet is a unique opportunity for the neutrino programme, since it provides a framework where R&D on all neutrino detector technological options can be carried out at dedicated test beams (WP11) and the work can be coordinated by the “Coordination Office for long baseline neutrino experiments” (WP5). The Coordination Office will liaise and share information with the other international activities, such as the EuroNu and Laguna EU funded projects, the Neutrino Factory International Design Study and the USA based Neutrino Factory and Muon Collider Collaboration, to ensure that work is carried out coherently and without unnecessary duplication. Reconstruction software tools (WP2) and development of electronics for neutrino experiments (WP3) shall also be pursued. Trans-national access to test beams will be provided through WP6.

SuperB Factories

By the end of this decade, the two B Factories (PEP-II at SLAC in Stanford, California and KEKB at KEK in Tsukuba, Japan) will have accumulated a total of 2 ab^{-1} of data. These facilities have confirmed spectacularly the Standard Model, in which the mixing of quarks is described by a unitary rotation matrix known as the CKM matrix, which defines the probability of mixing amongst quarks. A complex phase in the CKM matrix leads to a relation between the terms of this matrix (named the Unitarity Triangle because of its shape in the complex plane). Measurements of the asymmetries in B-meson decays have led to the determination of the parameters of the CKM matrix and the angles of the Unitarity Triangle. While LHCb will further explore CP violation from the decay of B-mesons at the LHC, many of the most important measurements pertinent to the Unitarity Triangle will still be statistics limited. An even larger data sample would provide increasingly stringent tests of three-generation CKM unitarity by performing precision measurements of CP asymmetries, branching fractions of rare B decays, and search for New Physics effects in rare decay kinematic distributions. A promising approach is to construct SuperB, a very high luminosity asymmetric B Factory, which will provide very large samples of b and c quark and τ lepton decays. This will allow stringent Unitarity Triangle tests, the ultimate precision test of the flavour sector of the Standard Model, and open up the world of New Physics effects in very rare B, D, and τ decays.

New Physics effects could manifest themselves through heavy particles contributing to loop amplitudes, time-dependent CP asymmetries and rare B decay modes. Substantial enhancements in these rates and/or variations in angular distributions of final state particles could result from the presence of new heavy particles in loop diagrams, resulting in clear evidence of New Physics. The SuperB data sample will also contain unprecedented numbers of charm quark and τ lepton decays, with detailed exploration of new charmonium states and limits on rare τ decays, particularly lepton-flavour-violating decays. One possible site for a SuperB Factory would be the Laboratorio Nazionale di Frascati, as has been shown in the recent publication of the Conceptual Design Report (CDR)[4].

Detector R&D needed to realise the concept of a SuperB factory detector would include an upgrade to detector concepts that were already used for the Babar and Belle experiments to cope with the increased luminosity. Access to test beam facilities (WP11), development of common electronics (WP3) and developing software tools (WP2) will be the main areas of activity.

Inter-relation between all DevDet work packages

The current structure of the DevDet proposal follows the development of the detector R&D life cycle for particle physics experiments. Detectors are designed and prototypes are constructed to test whether they meet the design criteria. Readout electronics need to be integrated to the detectors and materials need to be tested for their mechanical, cooling fluids compatibility, thermal and radiation hardness properties. Software for readout, simulation, reconstruction and alignment needs to be developed in parallel. The detectors and electronics are tested initially in the laboratory and then at dedicated test beams. Software is used to simulate and optimise the new detector concepts, and is validated based on the performance of detectors at test beams. If the detectors need to be certified for operation in a harsh radiation environment, they are irradiated at irradiation infrastructures (both charged and neutral particle irradiations are normally required) and tested once more in the laboratory and at dedicated test beams. Engineering teams ensure that the detector concepts can be integrated in larger experimental set-ups.

Figure 1.1 shows the typical work-flow related to the design and construction of detectors for a future facility. The relationship between the role of the different work packages within the DevDet proposal mimics this work-flow and motivates the proposed Work Package structure. The Project Office (WP4,

[4] "SuperB, a High Luminosity Super Flavour Factory, Conceptual Design Report," INFN/AE - 07/2, SLAC-R-856, LAL 07-15, March, 2007

WP5) coordinates and documents the construction procedure. The materials, qualified at the irradiation facilities (WP6, WP8-9), and the microelectronic components (WP3) are assembled into the detector and software tools (WP2) are required to simulate the performance and to carry out the data analysis.

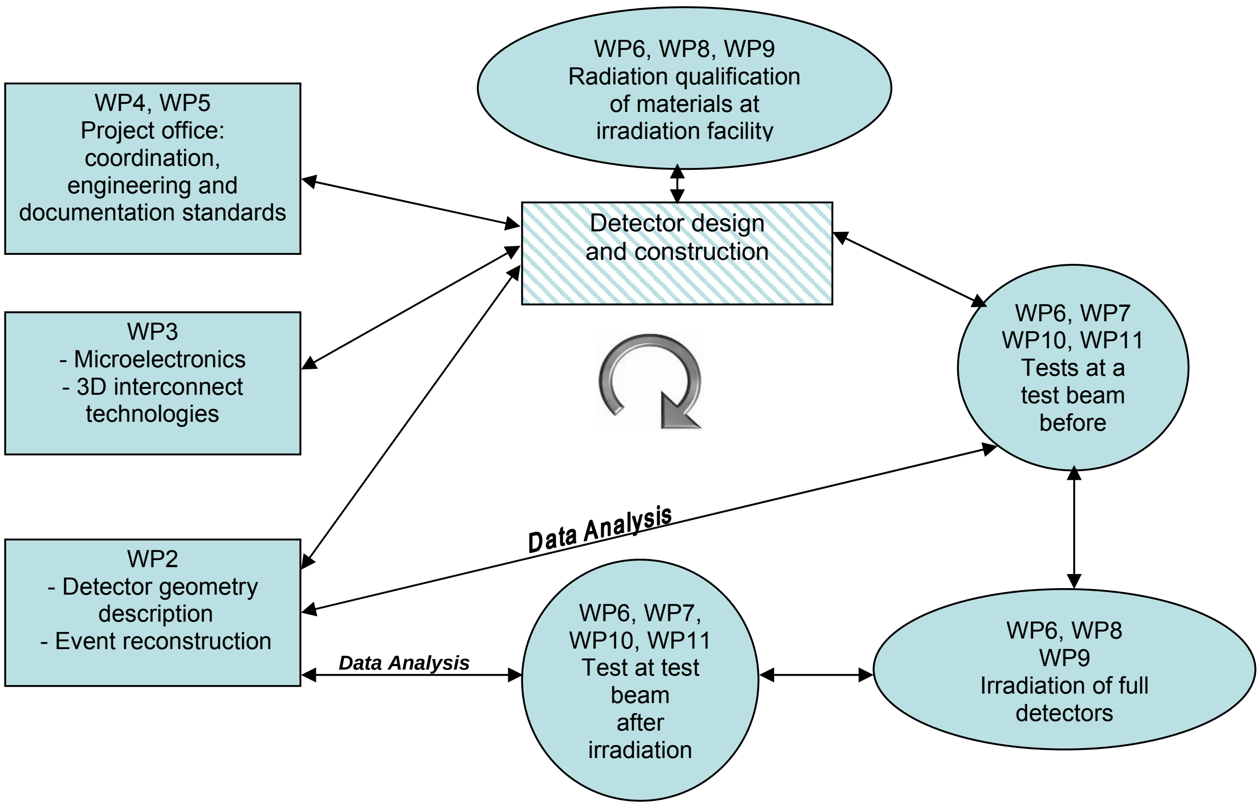

Figure 1.1: Process of detector construction and its relation to DevDet work packages.

Installation and operation of prototype detector elements in particle beamlines (using for example the facilities described in WP6-7) provide the ultimate test-ground for performance verification and improvement of new detector technologies. In many cases such tests are carried out using detectors irradiated (WP8-9) to the doses expected in their future user environment. Test beam measurements are very demanding as they require substantial infrastructures also beyond the primary beamline - as mechanical supports, cooling and thermal control, reference beam telescopes, readout and control systems, monitoring and offline analysis capacities as described in WP10-11. On the other hand, since the detector elements are tested in such realistic environments, test beam measurements are generally considered as the most critical and useful tool in detector technology development and all detectors technologies used in modern detector systems have usually been through several iterations of test beam measurements. The bulk of the beamlines used are at CERN (WP6), but also beamlines at DESY (WP7) and Frascati will be used.

1.3 S/T methodology and associated work plan

The overall strategy of the work plan is shown in the Pert diagram in Figure 1.2. The work is coordinated by members of the management work package (WP1). A coordinator and two deputy coordinators representing the four communities ensure that the interests of the main priority areas are maintained in all the work packages. The work is arranged around three concepts: networking, transnational access to facilities and construction and improvement of infrastructures. Efficient development of the detector R&D programme for all future experiments relies on networking and pooling of resources to develop common tools, including common software tools (WP2) and common microelectronics tools (WP3), as well as detector development and engineering coordination offices for the Linear Collider (WP4) and Neutrino Facilities (WP5). Trans-national access to CERN irradiation and test beam infrastructures (WP6), testbeam facilities at DESY (WP7) and transnational access to European irradiation facilities (WP8) is essential to guarantee that European researchers have the best available infrastructure to carry out their research. In addition, investment in the construction and upgrade of irradiation facilities at CERN (WP9), as well as test beam facilities at CERN (WP10) for integrated detector tests (WP10) for stand-alone detector tests will improve these essential resources for all European researchers.

Mitigation of risk is principally based on experience with proven methodologies for the infrastructural improvements planned, and the involvement of participants with the relevant expertise and the setting of realistic goals. The work-packages are inter-related to cover a full development cycle of detector R&D and prototypes, but built in such a way that they do not depend fully on each other. The communities behind the deliverables are also built up in such a way that in case of problems there is redundant expertise that can help. A failure in one WP or task is therefore unlikely to have major impact on the entire project.

The technological developments for the detector R&D are high-tech and have significant risks, but the improvements of the facilities themselves are based on fairly conservative technologies. Furthermore, if there are technical performance issues related to some parameters (beam quality, readout performance, etc) it is generally possible to reduce the specifications slightly and still provide excellent deliverables (infrastructures) for the user community. Delays of specific components will need to be handled in a similar way, by downscaling initial performance and compensating later.

The WP leaders have an important role in following up the work, and in most cases we have decided to split the WPs into tasks and even subtasks. We will appoint responsible at these levels to make it possible to monitor every part of the project and bring problems to the attention of the overall project management.

Finally the communities involved have a long tradition and experience in developing complicated technical instruments as a collaborative effort, and have the managerial and organisational expertise to carry out this project. DevDet is challenging because of the integrating actions that are proposed, and therefore it is exactly this experience from large collaborations that provides a significant part of the risk mitigation.

The detailed tasks associated to each of the work packages are shown in Table 1.2 and the timing of the work packages is demonstrated by the Gantt chart in Figure 1.3.

Diagram of DevDet work packages

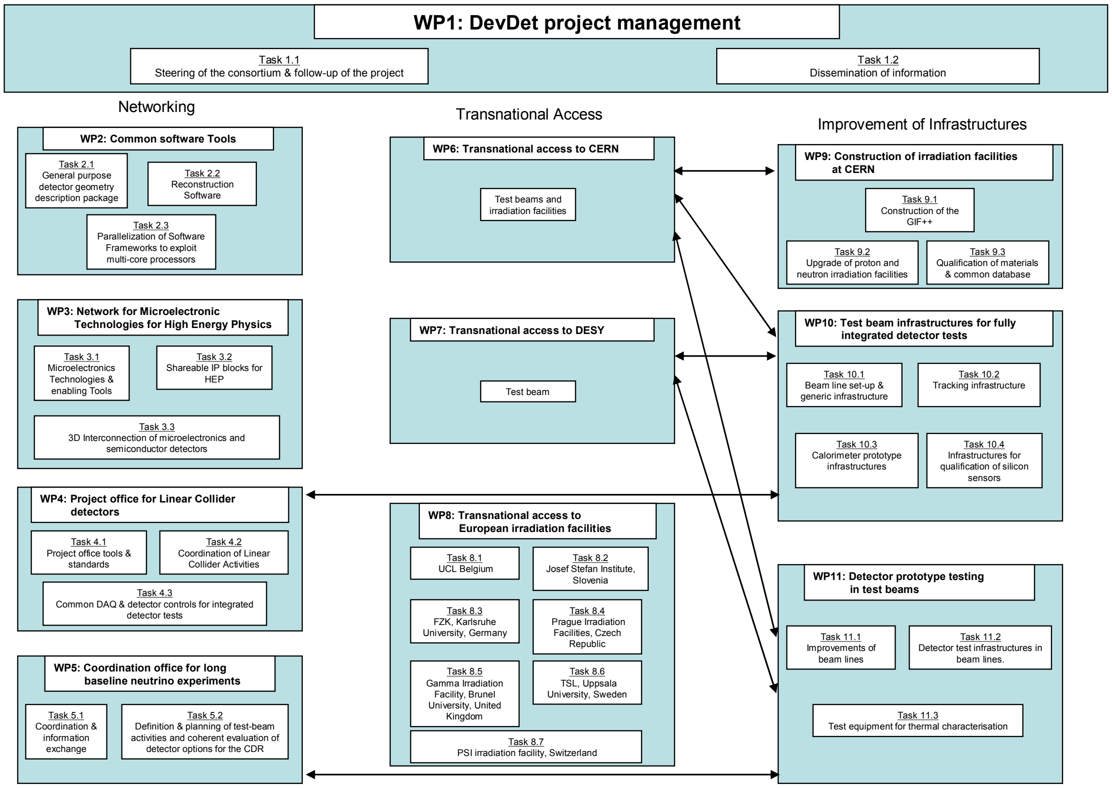

Figure 1.2: Structure of DevDet Work Packages

WP#	Type	Task	Description
1	**MGT**		**DevDet project management**
		1.1	Steering of the consortium and follow-up of the project
		1.2	Dissemination of information
2	**COORD**		**Common software tools**
		2.1	General purpose detector geometry description package
		2.2	Reconstruction software
		2.3	Parallelization of Software Frameworks to exploit multi-core processors
3	**COORD**		**Network for Microelectronic Technologies for High Energy Physics**
		3.1	Microelectronics Technologies and enabling Tools
		3.2	Shareable IP blocks for HEP
		3.3	3D Interconnection of microelectronics and semiconductor detectors
4	**COORD**		**Project office for Linear Collider detectors**
		4.1	Project office tools and standards
		4.2	Coordination of Linear Collider Activities
		4.2.1	Coordination of the Vertical Integration Facility EUVIF
		4.2.2	Application of project office tools to the CLIC forward region integration
		4.3	Common DAQ and detector controls for integrated detector tests
5	**COORD**		**Coordination office for long baseline neutrino experiments**
		5.1	Coordination and information exchange
		5.2	Definition and planning of test-beam activities and coherent evaluation of detector options for the CDR
6	**SUPP**		**Transnational access to CERN test beams and irradiation facilities**
7	**SUPP**		**Transnational access to DESY test beam**
8	**SUPP**		**Transnational access to European irradiation facilities**
		8.1	Access to UCL, Belgium
		8.2	Access to Jozef Stefan Institute, Slovenia
		8.3	Access to FZK, Karlsruhe University, Germany
		8.4	Access to Prague Irradiation Facilities, Czech Republic
		8.5	Access to Gamma Irradiation Facility, Brunel Univ., United Kingdom
		8.6	Access to TSL, Uppsala University, Sweden
		8.7	Access to PSI irradiation facility, Switzerland
9	**RTD**		**Construction of irradiation facilities at CERN**
		9.1	Construction of the GIF++
		9.2	Upgrade of proton and neutron irradiation facilities
		9.3	Qualification of materials and common database
10	**RTD**		**Test beam infrastructures for fully integrated detector tests**
		10.1	Beam line set-up and generic infrastructure
		10.2	Tracking infrastructure
		10.2.1	Vertex detector infrastructure
		10.2.2	Intermediate tracker infrastructure
		10.2.3	Improvement of infrastructure for gaseous tracking detectors
		10.3	Calorimeter prototype infrastructures
		10.3.1	Infrastructure for electromagnetic calorimeters
		10.3.2	Infrastructure for hadron calorimeters
		10.3.3	Infrastructure for forward calorimetry
		10.4	Infrastructures for qualification of silicon sensors
11	**RTD**		**Detector prototype testing in test beams**
		11.1	Improvements of beamlines
		11.2	Detector test infrastructures in beamlines
		11.3	Test equipment for thermal characterisation

Table 1.2: DevDet Work Packages with each of the detailed tasks

FP7 IA project: DevDet

				1st YEAR											2nd YEAR											3rd YEAR											4th YEAR											5th YEAR	
WP#	**Type**	**Task**	**Description**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1	**MGT**		**DevDet project management**																																																			
		1.1	Steering of the consortium and follow-up of the project		M				D						M		D										M		D										M		D										M		D
		1.2	Dissemination of information			D							D																																							
2	**COORD**		**Common software tools**																																																			
		2.1	General purpose detector geometry description package										M								M						D												D												D		
		2.2	Reconstruction software										M												M		DD						D						D												DD		
		2.3	Parallelization of Software Frameworks to exploit multi-core processors										M																										D												D		
3	**COORD**		**Network for Microelectronic Technologies for High Energy Physics**																																																			
		3.1	Microelectronics Technologies and enabling Tools												DD												D												D												D		
		3.2	Shareable IP blocks for HEP												D												D												D												D		
		3.3	3D Interconnection of microelectronics and semiconductor detectors									D			DD						DD			D			D												D												D		
4	**COORD**		**Project office for Linear Collider detectors**																																																			
		4.1	Project office tools and standards								D				D		D						M		D																						M						D		
		4.2	Coordination of Linear Collider Activities										D								D						D																		M						D		
		4.3	Common DAQ and detector controls for integrated detector tests																						M			D						D		MM				DD						M								
5	**COORD**		**Coordination office for long baseline neutrino experiments**																																																			
		5.1	Coordination and information exchange			M									D												M																										
		5.2	Definition and planning of test-beam activities and coherent evaluation of detector options for the CDR	M		D			D				M										D		M																				D		D						D		
6	**SUPP**		**Transnational access to CERN test beams and irradiation facilities**																																																			
7	**SUPP**		**Transnational access to DESY test beam**																																																			
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		8.1	Access to UCL, Belgium																																																			
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		8.3	Access to FZK, Karlsruhe University, Germany																																																			
		8.4	Access to Prague Irradiation Facilities, Czech Republic																																																			
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		8.7	Access to PSI irradiation facility, Switzerland																																																			
9	**RTD**		**Construction of irradiation facilities at CERN**																																																			
		9.1	Construction of the GIF++						M						D						D				M														D						M						D		
		9.2	Upgrade of proton and neutron irradiation facilities						M												M						D																		D			M			D		
		9.3	Qualification of materials and common database								M				D						M										D								M			M										D		
10	**RTD**		**Test beam infrastructures for fully integrated detector tests**																																																			
		10.1	Beam line set-up and generic infrastructure																								M												D														
		10.2	Tracking infrastructure																								M	M					MD MD D					D	DD						D							
		10.3	Calorimeter prototype infrastructures																								MM												DD								D	D					
		10.4	Infrastructures for qualification of silicon sensors																		M														MD						D				D							
11	**RTD**		**Detector prototype testing in beams**																																																			
		11.1	Improvements of beam lines												M			MM												D				DD																			
		11.2	Detector test infrastructures in beam lines												M			MM												D				DD						D													
		11.3	Test equipment for thermal characterization												M														D																D							

Figure 1.3: Timing of the work packages

Table 1.3 a: Work package list

Work package No	Work package title	Type of activity	Lead participant No	Lead participant short name	Person-months	Start month	End month	Indicative Total costs (MEuro)	Indicative requested EC contribution
1	DevDet project management	MGT	1	CERN	108	1	48	1.56	0.80
2	Common software tools	COORD	11	DESY	385	1	48	3.61	1.20
3	Network for Microelectronic Technologies for High Energy Physics	COORD	1	CERN	437	1	48	5.63	1.20
4	Project office for Linear Collider detectors	COORD	38	UNIGE	338	1	48	3.42	0.52
5	Coordination office for long baseline neutrino experiments	COORD	34	CSIC	68	1	48	0.74	0.25
6	Transnational access to CERN test beams and irradiation facilities	SUPP	1	CERN	2	1	48	0.23	0.15
7	Transnational access to DESY test beam	SUPP	11	DESY	2	13	48	0.15	0.10
8	Transnational access to European irradiation facilities	SUPP	3	UCL	10	1	48	0.86	0.75
9	Construction of irradiation facilities at CERN	RTD	1	CERN	176	1	48	3.00	1.00
10	Test beam infrastructures for fully integrated detector tests	RTD	11	DESY	1198	13	48	12.95	3.14
11	Detector prototype testing in test beams	RTD	1	CERN	539	1	48	5.65	1.89
	TOTAL				3263			37.80	11.00

Table 1.3 b1: Deliverables List

Deliverables for the 1st Year:

Del. No.	Deliverable Name	WP no.	Nature	Diss. level	Delivery Date
1.2.1	DevDet web-site operational for the scientific community inside and outside the collaboration	1	O	PU	M3
5.2.1	List of test-beam requirements completed	5	R	PU	M3
1.1.1	Project Management Plan, based on modern informatics tools, in place	1	O, R	PU	M6
5.2.2	List of measurements to be done completed	5	R	PU	M6
4.1.1	Assessment report on relevant engineering and documentation tools used so far for LC studies	4	R	PU	M8
3.3.1	ASIC Designed	3	R	PU	M9
1.2.2	DevDet web-site operational for the general public	1	O	PU	M10
4.2.1	Set of specifications for the CLIC forward region integration design	4	R	PU	M10
3.1.1	Qualification of 130 nm CMOS technology, and supply of corresponding CAE tools	3	R	PU	M12
3.1.2	1st Report on training, support and submissions	3	R	PU	M12
3.2.1	Report on first set of macro blocks	3	R	PU	M12
3.3.2	MPW run submission	3	R	PU	M12
3.3.3	Sensor Production	3	R	PU	M12
4.1.2	Make available EDMS system	4	D	PU	M12
5.1.1	Web site ready	5	D	PU	M12
9.1.1	Design study for a new GIF++ facility published	9	R	PU	M12
9.3.1	Description of materials used in LHC, indication of required properties for SLHC and missing items identified	9	R	PU	M12

Deliverables for the 2nd Year:

Del. No.	Deliverable Name	WP no.	Nature	Diss. level	Delivery Date
1.1.2	1st periodic Report (progress of work + use of resources + financial statement)	1	R	PU	M14
4.1.3	Demonstrate Exchange/ Interoperability	4	R	PU	M14
3.3.4	Dummy Interconnection	3	R	PU	M18
3.3.5	Thinning and vias fabrication	3	R	PU	M18
4.2.2	Mechanical and electrical interface specification for EUVIF	4	D	PU	M18
9.1.2	Technical specifications for the GIF++ with peripheral services and user infrastructure approved	9	R	PU	M18
5.2.3	Test-beam detectors: Technical Design Report completed	5	R	PU	M20
3.3.6	Sensor/ASIC interconnection	3	D	PU	M21
4.1.4	Description of appropriate suite of project tools, together with some prototype installations	4	R	PU	M22
2.1.1	Initial geometry package ready suitable for simulation and reconstruction.	2	O	PU	M24
2.2.1	Event display available for testbeams	2	O	PU	M24
2.2.2	Alignment package without magnetic field suitable for use in testbeam data analysis	2	O	PU	M24

3.1.3	Qualification of 130 nm BiCMOS technology, and supply of corresponding CAE tools	3	R	PU	M24
3.2.2	Report on second set of macro blocks	3	R	PU	M24
3.3.7	Sensor/ASIC interconnection (vias)	3	D	PU	M24
4.2.5	Status presentation of advanced CLIC forward region integration design with proof of successful application of project office tools	4	R	PU	M24
4.3.1	DAQ Architecture description	4	R	PU	M24
9.2.1	Design for upgraded proton and neutron facilities approved	9	R	PU	M24

Deliverables for 3rd Year:

Del. No.	Deliverable Name	WP no.	Nature	Diss. level	Delivery Date
1.1.3	2nd periodic Report (progress of work + use of resources + financial statement)	1	R	PU	M26
11.1.1	Layout and implementation of improved beamlines for SLHC, Neutrino detector testing at the CERN-SPS, including low energy capabilities	11	O	PU	M26
11.2.1	Development of DAQ and readout systems for the detector testing in these beamlines	11	R	PU	M26
11.3.1	Thermal testbenches and environmental chambers for detector testing	11	O	PU	M26
9.3.2	Set of test procedures published	9	R	PU	M28
2.2.3	Initial release of software for tracking, calorimetry and particle flow analysis with persistency software suitable for use in testbeam data analysis	2	O	PU	M30
4.3.2	Interface Prototype	4	P	PU	M30
10.2.1	Vertex global mechanical frame	10	P	PU	M30
10.2.2	Silicon tracker multi-layer support structure with lightweight material	10	P	PU	M30
10.2.3	TPC local DAQ and trigger hard- and software	10	P	PU	M30
11.1.2	Improved beamline for SuperB detector testing at LNF including monitoring, calibration and tagged photon beam	11	O	PU	M30
11.1.3	Basic infrastructure for neutrino detector testing (toroid, cryogenics, water cherenkov tank)	11	O	PU	M30
11.2.3	Development of reference telescope systems	11	R	PU	M30
11.2.4	Development of triggering and timing systems in beamlines	11	R	PU	M30
10.4.1	Prototype of multi channel TCT setup	10	P	PU	M32
10.2.4	Vertex model sensor system in global frame	10	P	PU	M35
2.1.2	Geometry package with efficient memory management and allowing for mis-alignments.		O	PU	M36
2.2.4	Tracking and calorimetry optimised for high pile-up	2	O	PU	M36
2.3.1	LHC software libraries adapted to multi-core CPU's	2	O	PU	M36
3.1.4	2nd Report on training, support and submissions	3	R	PU	M36
3.2.3	Report on third set of macro blocks	3	R	PU	M36
3.3.8	ASIC/ASIC interconnection	3	D	PU	M36
4.3.3	Event building facility	4	P	PU	M36
4.3.4	Detector control infrastructure	4	P	PU	M36

9.1.3	Construction of the GIF++ facility completed	9	O	PU	M36
10.1.1	Report on test beam area preparation	10	R	PU	M36
10.2.5	TPC and magnet installed at CERN	10	P	PU	M36
10.2.6	Full TPC infrastructure available	10	P	PU	M36
10.3.1	ECAL and HCAL characterization of components	10	R	PU	M36
10.3.2	FCAL readout electronics incl. data transfer lines	10	D	PU	M36
11.2.2	Development of DCS and monitoring systems	11	R	PU	M36

Deliverables for the 4th Year:

Del. No.	Deliverable Name	WP no.	Nature	Diss. level	Delivery Date
1.1.4	3rd periodic Report (progress of work + use of resources + financial statement)	1	R	PU	M38
10.4.2	Test setup for electrical characterization	10	D	PU	M38
5.2.4	Performance report of each prototype completed	5	R	PU	M40
5.2.5	Cost estimate and current design of the detectors completed	5	R	PU	M42
9.2.2	Upgraded facilities constructed and operational, together with their peripheral detector-test systems	9	O	PU	M42
10.2.7	Integration of readout electronics into central DAQ	10	P	PU	M42
10.4.3	Result Database	10	O	PU	M42
11.3.2	Cooling system(s) development	11	O	PU	M42
10.3.4	FCAL system integration	10	D	PU	M44
10.3.3	System integration of ECAL and HCAL	10	R	PU	M45
2.1.3	Final geometry package with interfaces to relevant software applications.	2	O	PU	M48
2.2.5	Final release of alignment package suitable for experiments with magnetic fields	2	O	PU	M48
2.2.6	Final release of persistency, tracking, calorimetry and particle flow analysis tools suitable for experiments	2	O	PU	M48
2.3.2	Software libraries for remaining applications adapted to multi-core CPU's	2	O	PU	M48
3.1.5	Qualification of more advanced CMOS technology, and supply of corresponding CAE tools	3	R	PU	M48
3.2.4	Report on fourth set of macro blocks	3	R	PU	M48
3.3.9	Full 2-tier demonstrator	3	D	PU	M48
4.1.5	Report on the operation/support of the engineering and documentation tools	4	R	PU	M48
4.2.3	Report on EUVIF (together with WP10)	4	R	PU	M48
5.2.6	Contribution to the CDR ready	5	R	PU	M48
9.1.4	First Performance and operation report of the new GIF facility published	9	R	PU	M48
9.2.3	Performance and operation reports of upgraded proton and neutron facilities published	9	R	PU	M48
9.3.3	Material Database filled with results on Web	9	O	PU	M48
1.1.5	4th periodic Report (progress of work + use of resources + financial statement) + Final report	1	R	PU	M50

Table 1.3b2 : Summary of transnational access provision

Participant number	*Organisation short name*	*Short name of infrastructure*	*Installation*		*Operator country code*	*Unit of access*	*Unit cost (€)*	*Min. quantity of access to be provided*	*Estimated number of users*	*Estimated number of projects*
			number	*Short name*						
1	CERN	CERN testbeams and irrad.facilities	6	CERN-Test-Beams, CERN-Irrad-East-Hall, CERN-Irrad-GIF	CH	8 hours	4840	1200	480	48
11	DESY	DESY testbeam	7	DESY testbeam	DE	Week	16392	30	100	25
3	UCL	CRC	8.1	UCL	BE	Hour	292	350	30	15
33	JSI	JSI	8.2	JSI Triga Reactor	SL	Hour	218	450	46	23
13	UNIKARL	UNIKARL	8.3	Compact cyclotron	DE	Hour	450	120	30	15
6	IPASCR	IPASCR	8.4	NPL; U120M; Microtron	CZ	Hour	184; 308; 100	300	115	23
41	UBRUN	UBRUN	8.5	High-rate Gamma Facility, Low-rate Gamma Facility	UK	Hour	20,5	2000	30	15
37	SWEDET	UUpps	8.6	TSL	SE	Hour	577	150	24	12
38	UNIGE	PSI	8.7	PIF, Pion/Muon (EH)	CH	Hour 8 Hours	246 738	250 TBD (see p.74)	15	10

Table 1.3 c List of milestones

Milestones for the 1st Year:

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
5.3	Preliminary list of test-beam measurements	5	M1	Publication on web
1.1	Kick-off meeting	1	M2	Meeting
5.1	First version of web site available	5	M3	Test functionality
9.1	GIFF++ and proton and neutron facilities user requirements collected	9	M6	Publication on web
9.6	Compile the list of materials used successfully in LHC trackers and indication of required properties for SLHC agreed	9	M8	Publication on web
2.1	Geometry package Software Design Document based on current models and requirements of the detectors	2	M10	Report forms basis for decisions on which solutions to follow
2.3	Reconstruction Software Design Document based on review of current software and future needs	2	M10	Report forms basis for decisions on which solutions to follow
2.5	Report surveying multicore architectures and tools to measure performance	2	M10	Report forms basis for decisions on which solutions to follow
5.4	Test-beam detectors: conceptual design report ready	5	M10	Report
1.2	1st plenary Annual DevDet Meeting	1	M12	Meeting
11.2	Specifications for LNF-Frascati beam changes	11	M12	Specification report
11.4	Detailed implementation plan for DAQ, DCS and readout in the CERN SPS and LNB testbeam	11	M12	Implementation plan
11.7	Specifications for cooling and thermal testbenches at CERN and INFN-Pisa	11	M12	Specification report

Milestones for the 2nd Year:

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
11.1	Layout proposal for CERN SPS beamlines	11	M15	Design report
11.3	Detailed plan for neutrino testing infrastructure	11	M15	Design report

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
11.5	Design specifications for telescope and mechanical supports	11	M15	Specification report
11.6	Detailed specification for timing and triggering system in beamlines	11	M15	Specification report
2.2	Running prototype of geometry model with limited functionality to demonstrate applicability	2	M18	Quantitative evaluation of processing speed and memory use
9.4	Outline design of proton and neutron irradiation facilities	9	M18	Publication on web
9.7	Identify suitable testing procedures and radiation sources for characterization of new materials	9	M18	Publication on web
10.9	Design of the multi channel TCT setup	10	M18	Design report
4.1	Project Office in place	4	M20	Report published
4.2	DAQ Interface and Protocol definitions	4	M21	Report published
2.4	Tracking, calorimetry and particle flow analysis prototype software	2	M22	Quantitative evaluation of speed and memory needs to check solutions
5.5	Preliminary cost estimate	5	M22	Publication on web
9.2	Implementation plan for the construction of the GIF++ agreed by stakeholders	9	M22	Publication on web
1.3	2nd plenary Annual DevDet Meeting	1	M24	Meeting
5.2	First version of documentation ready	5	M24	
10.1	Final concept of the test beam area and gas infrastructure	10	M24	Design report
10.2	Vertex design global mechanical frame	10	M24	Design report
10.6	ECAL Test facilities available	10	M24	
10.7	Tungsten absorber structure available	10	M24	

<u>Milestones for the 3rd Year:</u>

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
10.4	Silicon tracker module design with lightweight material	10	M25	Design report
10.3	Vertex model sensors ready	10	M30	
10.5	Design front-end electronics	10	M30	Design report

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
4.3	Event building demonstrator	4	M32	Working demonstration
4.4	Detector controls demonstrator	4	M32	Working demonstration
10.8	Mask design for test structures available	10	M32	Design report
1.4	3rd plenary Annual DevDet Meeting	1	M36	Meeting
9.8	Post-irradiation tests of materials completed	9	M36	Publication on web

Milestones for the 4th Year:

Milestone no.	Milestone Name	Work package involved	Expected date	Means of verification
9.9	Materials database specification produced	9	M39	Publication on web
4.5	Start of EUVIF commissioning	4	M42	
9.3	Commissioning of GIF++ completed	9	M42	Declare infrastructure 'Ready for users'
9.5	Open proton and neutron facilities to users	9	M45	Declare infrastructure 'Ready for users'
1.5	4th plenary Annual DevDet Meeting and Final Project Review	1	M48	Meeting

Tables 1.3 d1: Work package descriptions for Management, Networking activity or Joint research activity

WP1 – DevDet project management

Work package number	1	**Start date:**			Month 1
Work package title	DevDet project management				
Activity Type	MGT				
Participant number	1	14	29	44		
Participant	CERN	Unibonn	FOM	UNIGLA		
Person-months per participant:	60	12	24	12		

Objectives:
- effective management and steering of the whole project,
- monitoring and reporting of scientific progress and use of the scientific infrastructures,
- contractual and financial follow-up of the project,
- dissemination of information inside and outside the consortium

Description of work

Task 1.1 Steering of the consortium and follow-up of the project

This task comprises a number of management and communication activities under the responsibility of the Project Coordinator. The management duties are carried out within the overall managerial structure of the project, as described in section 2.1. These include the overall co-ordination and continuous monitoring of the DevDet progress, the organisation of the Steering Committee meetings, of the Institute Board meetings, of the plenary Annual Meetings, as well as the regular communication with the EU Commission. The monitoring of the transnational access activities and the coordination of activities encompassing simultaneously several work packages are also included in this task. The task includes the administrative, financial and contractual follow-up of DevDet, as laid down in the future Grant Agreement and annexes. Among other tasks, these comprise the preparation of periodic activity reports, deliverable and milestone reports and the final activity reports. The financial follow-up encompasses the distribution and payments of EU funding, the budget control, the cost reporting and the collection of the Certificates on Financial Statements. As described in section 2.1, the management team, in collaboration with the steering committee, will set up a detailed project management plan based on modern project management tools.

The Management Team (FOM, UNIGLA, UniBonn), together with CERN as the coordinating laboratory will take responsibility for task 1.1. They will be assisted by the work package coordinator of WP8 (UCL) for the coordination and monitoring of all trans-national access activities. CERN takes responsibility for the informatics development of effective project management tools adapted to the DevDet case.

Task 1.2 Dissemination of information

In this task the tools for an efficient dissemination of information within and outside the consortium as outlined in Section 3.2 of this proposal will be provided and maintained. The main tool for rapid dissemination of information related to the project will be a web-based information system, the DevDet web-site. It will consist of an overview section for non-experts (in several European languages), expert information on the goals and status of the individual work-packages, user access information and information for industrial partners as well as internal information with managerial and technical information. Centrally managed tools will be a content management system for the website maintenance, a repository for internal and public reports and publications and the agenda and information system Indico for the organisation and documentation of

meetings, a recruitment center to announce open positions and a related link section. In this task, the management support team will deploy the DevDet web-site (content management system, publication repository, Indico agenda system), maintain its functionality and support the Work package leaders and the consortium members in filling in the scientific and organisational content. (CERN, FOM, UNIGLA, UniBonn).

Deliverables of tasks	Description	Nature	Delivery Month
1.1.1	Project Management Plan, based on modern informatics tools, in place	O, R	M6
1.1.2	1st periodic Report (progress of work + use of resources + financial statement)	R	M14
1.1.3	2nd periodic Report (progress of work + use of resources + financial statement)	R	M26
1.1.4	3rd periodic Report (progress of work + use of resources + financial statement)	R	M38
1.1.5	4th periodic Report (progress of work + use of resources + financial statement) + Final report	R	M50
1.2.1	DevDet web-site operational for the scientific community inside and outside the collaboration	O	M3
1.2.2	DevDet web-site operational for the general public	O	M10

Milestones	Task	Description	Expected date	Means of verification
1.1	1	Kick-off meeting	M02	Report
1.2	1	1st plenary Annual DevDet Meeting	M12	Report
1.3	1	2nd plenary Annual DevDet Meeting	M24	Report
1.4	1	3rd plenary Annual DevDet Meeting	M36	Report
1.5	1	4th plenary Annual DevDet Meeting and Final Project Review	M48	Report

WP2 - Common Software Tools

Particle detectors continuously evolve: future detectors will be bigger with higher granularity, will have higher particle rates, and include new detector types. Also, technological advances - especially multicore CPUs - make new demands on the software. These developments require new software features and better software performance.

Many of the software requirements are common to all the future experiments. The goal is then to develop generic code, independent of which experiment it is to be used for, with high re-usability, high reliability, and using efficient algorithms. Making generic code allows a larger user-base which feeds back into higher quality code, while at the same time reducing the overall effort needed in development and maintenance.

Design of future detectors requires detailed simulation to find the expected performance of different options. GEANT4 is the universal modern tool for detailed simulation. It is mature software and no direct development of simulation tools is requested here. However, developments are needed in two areas of simulation. One is to facilitate putting in realistic misalignments of detectors, which the geometry package should handle. The other is to deal with high event rates - pile-up of many interactions simultaneously - giving high hit densities. In simulation this needs efficient use of memory and in reconstruction it needs efficient algorithms for track finding.

The raw event data stored by experiments has to be reconstructed to find the particles that were created in the event. This can be sub-divided into tracking for charged particles, and calorimetry for both charged and neutral particles. Much of the reconstruction software can be written in a detector-independent way, making it useful to a broad user base.

Both simulation and reconstruction need to know the shape, position, and materials of the detector: the detector geometry. Having a single geometry model that can feed all parts of the software is a major goal: it guarantees consistency and saves effort in maintenance and modifications.

Large computing resources are needed for the complex detectors. Computing hardware develops with time, taking advantage of technological advances. Software needs to evolve to take full advantage of these improvements. The current trend for computers is to go to multicore CPU's, with ever higher numbers of cores. Software needs to evolve to take full advantage of this, with multi-threading and memory management. This will benefit both simulation and reconstruction.

These then are the central tasks of the software networking work package: generic software for the geometry model and reconstruction; and optimising all software to take full advantage of multicore

Work package number	WP2		**Start date or starting event:**			M1	
Work Package title	Common Software Tools						
Activity type	COORD						
Participant number	1	8	11	27	34	36	40	41
Participant short name	CERN	CNRS	DESY	INFN	CSIC	USC	UNIBRIS	UBRUN
Person-months per participant	92	54	54	66	23	12	12	12
Participant number	42	43	44	47	48			
Participant short name	UCAM	UEDIN	UNIGLA	UOXF	QMUL			
Person-months per participant	24	10	10	12	4			

Objectives:

Task1: General purpose detector geometry description package

1. Develop a detector-independent geometry package, using best practice from the current packages available, and with sufficient flexibility to cope with the needs of the future detectors, including misalignments of detector elements
2. Optimize it for representation in memory to allow fast access to detector parameters, including alignment and calibration constants
3. Develop database tools to store and retrieve alignment and calibration constants
4. Create interfaces to produce geometries for simulation (Geant4, Fluka), digitization, reconstruction, alignment, and event display programs.

Task 2: Reconstruction software

5. Develop a toolkit based on best available practice for charged-particle tracking and calorimetry.
6. Develop software to handle high particle-multiplicities: Optimise algorithms, memory management, data-base access, and file handling.
7. Develop general-purpose alignment software.
8. Improve existing persistency software for long term storage of information; adapt these methods to the testbeam DAQ systems in WP4, WP10, and WP11.
9. Develop an event display using the geometry package, with flexibility to cover in particular the various testbeam detector setups.

Task 3 Parallelisation of software frameworks to exploit multi-core processors

10. Explore thread synchronisation and memory management techniques. Select the most promising and develop them.
11. Optimise the major particle physics frameworks to run on multicore processors, using the techniques developed above.

Description of work:

Task 1. General purpose detector geometry description package

Usually experiments want the geometry described in one place. This is efficient and eases maintenance during the life of an experiment: changes are only required in one place, guaranteeing consistency everywhere else. This central geometry then needs to be interfaced to all the other software packages, which often have very different requirements on level of detail needed etc.: the optimum level of detail needs to be accessible in each package. Covering several future experiments requires a comprehensive and flexible generic model. Methods for dealing with real detector layouts with imperfections - mainly mis-alignments and calibrations - which are time dependent also need to be developed, including databases with fast access to large data sets and efficient memory use to cache the information.

Work plan: Review geometry systems used by current experiments and select the best elements for a widely applicable package. Pay particular attention to efficient memory storage to allow for the future large detectors. Allow for mis-alignments as occur in real detectors. Develop efficient data base tools for the storage of mis-alignment and calibration constants. Enable geometries to be mis-aligned for simulation, including tools to detect or prevent clashes between detector volumes. Develop interfaces between the geometry package and client software. This will include the ability to help simplify the geometry to provide the optimum level of detail needed by a client (CERN, CNRS, DESY, UEDIN, UNIGLA, QMUL).

Task 2 Reconstruction software

The raw data - hits - from the detectors have to be reconstructed into information on the tracks of the particles that were created. The large variations between detectors and the complexity of the data mean it would be too ambitious to try to develop a unified general-purpose reconstruction software package. However, many tasks within such a package are common to all detectors, such as parts of charged particle tracking and calorimetry and particle flow, combining the two. A detector-independent toolkit should be developed using the geometry package of task 1, to ease the process of writing high-quality reliable software for these tasks.

As beam intensities increase, more interactions occur alongside the interactions of interest, known as pile-up events. These increase the amount of data to be handled. More efficient ways to handle the high particle multiplicity need to be developed, especially in pattern recognition for tracking. Memory management is also important here for efficiency. The toolkits should handle high-multiplicity events efficiently.

Reconstruction needs accurate information on detector positions. This information is usually best obtained from the data itself, in a process known as alignment. High quality generic alignment software could considerably reduce the effort typically needed for detector alignment.

Longer-term storage of information ("persistency") - from the raw data to the results of high-level analysis - needs to be developed. This is urgent for handling test-beam data, and in the longer term will be vital for future experiments. Different storage times and access frequencies require different solutions for storage and re-use. The current experiments have solutions, which can be improved on and generalised.

Visualisation of both the detector set-up and events is important to understand what happened in an event, and also for debugging and developing the software. Flexible tools are needed in testbeams where the geometry changes frequently. Development of an event display for testbeams will both help in debugging and developing the geometry and reconstruction packages, and in analysis of test-beam data.

Work plan: Develop toolkits for pattern recognition and fitting of charged tracks, suitable for broad use in testbeams and future experiments. Bring experts together from several experiments to find the best solutions. Optimise reconstruction and simulation for the very high particle rates expected at the SLHC. Produce a generic alignment package initially for testbeam detectors without magnetic fields, and extending it later to cover current and future experiments with magnetic fields. Improve and extend existing persistency software for storage of raw data and apply it to the integrated testbeams. Produce an event display based on the geometry package. Use it to help develop the geometry and reconstruction software, as well as for analysis of testbeam data. (CNRS, DESY, INFN, CSIS (IFIC), USC, UBRUN, UCAM, UNIGLA, UOXF)

Task 3 Parallelisation of software frameworks to exploit multi-core processors

With current CPU's containing four cores and next-generation ones expecting up to 64, many particle physics applications - in simulation, reconstruction, and online-triggering - need considerable adaptation to optimise use of the extra processing power. Event parallelism can be exploited by launching as many processes (threads) as there are cores, provided thread synchronisation techniques are available. Simulation, reconstruction and triggering are all memory-intensive but it is inefficient and costly to increase the memory in line with the number of cores. Much of the memory - geometry and calibration constants, and magnetic field for example - is common to all threads, which can be exploited by developing techniques for sharing memory between many cores.

Once the best techniques for thread synchronisation and memory management have been identified, implementations for the software frameworks currently used in particle physics will be developed. These include Geant4, Root, ILC reconstruction, and the ATLAS, CMS and LHCb frameworks Athena, CMSSW, and Gaudi. Adapting the framework to exploit multicore architectures will automatically benefit the applications built on them, with no - or only minimal - changes needed to specific algorithmic code.

Work plan: Evaluate current and future multicore architectures, selecting and developing tools to measure performance and identify bottle-necks. Try prototype solutions to remove the bottle-necks. Apply solutions initially to the LHC data analysis frameworks, and later to other major particle physics software. By developing the overall packages and frameworks to make optimum use of the multicore CPU's, the vast amount of algorithmic code already developed by the broad community will automatically benefit. (CERN, UNIVBRIS)

Deliverables of Tasks	Description	Nature	Delivery Month
2.1.1	Initial geometry package ready suitable for simulation and reconstruction.	O	M24
2.1.2	Geometry package with efficient memory management and allowing for mis-alignments.	O	M36
2.1.3	Final geometry package with interfaces to relevant software applications.	O	M48
2.2.1	Event display available for testbeams	O	M24
2.2.2	Alignment package without magnetic field suitable for use in testbeam data analysis	O	M24
2.2.3	Initial release of software for tracking, calorimetry and particle flow analysis with persistency software suitable for use in testbeam data analysis	O	M30
2.2.4	Tracking and calorimetry optimised for high pile-up	O	M36
2.2.5	Final release of alignment package suitable for experiments with magnetic fields	O	M48
2.2.6	Final release of persistency, tracking, calorimetry and particle flow analysis tools suitable for experiments	O	M48
2.3.1	LHC software libraries adapted to multi-core CPU's	O	M36
2.3.2	Software libraries for remaining applications adapted to multi-core CPU's	O	M48

Milestones	Task	Description	Expected date	Means of verification
2.1	2.1	Geometry package Software Design Document based on current models and requirements of the detectors	M10	Report forms basis for decisions on which solutions to follow
2.2	2.1	Running prototype of geometry model with limited functionality to demonstrate applicability	M18	Quantitative evaluation of processing speed and memory use
2.3	2.2	Reconstruction Software Design Document based on review of current software and future needs	M10	Report forms basis for decisions on which solutions to follow
2.4	2.2	Tracking, calorimetry and particle flow analysis prototype software	M22	Quantitative evaluation of speed and memory needs to check solutions
2.5	2.3	Report surveying multicore architectures and tools to measure performance	M10	Report forms basis for decisions on which solutions to follow

WP3 Network for Microelectronic Technologies for High Energy Physics

The main objective of this workpackage is to establish a network of groups working collaboratively on advanced semiconductor technologies and high density interconnections in High Energy Physics.

Work package number	WP3		**Start date or starting event:**				M1	
Work Package title	Network for Microelectronic Technologies for High Energy Physics							
Activity type	COORD							
Participant number	1	8	9	12	14	27	29	31
Participant short name	CERN	CNRS	CEA	MPG-MPP	Uni Bonn	INFN	FOM	AGH-UST
Person-months per participant	78	68	8	22	40	60	24	24
Participant number	34	37	38	39	44	45		
Participant short name	CSIC	SWEDET	UNIGE	STFC	UNIGLA	UNILIV		
Person-months per participant	60	8	12	19	7	7		

Objectives:

Task1: Microelectronic Technologies and enabling Tools

- Evaluation, qualification and characterization of advanced CMOS and BiCMOS technologies for users in the particle physics community
- Monitoring of parameters of technologies under irradiation and development of optimised design methodologies
- Distribution of a standard set of Computer Aided Engineering tools and training of designers in using the appropriate design methodologies
- Organization of common computing infrastructure to house, maintain and verify large designs implemented as collaborative efforts
- Coordination of multi-project wafer submission for prototype developments
- Organization of users meeting with engineers from HEP community with the objective of exchanging information specific to designs for particle physics experiments

Task 2: Shareable IP Blocks for HEP

- Creation and coordination of a framework for the design of low and medium complexity microelectronics blocks to be made available to the community
- Organization of the design and qualification of a set of blocks using the technologies of Task 1
- Distribution and documentation of the library of functional blocks
- Organization of regular Microelectronics Users Group meetings to exchange information, plan and coordinate actions related to the creation of a shared library of macro blocks.

Task 3 3D Interconnection of microelectronics and semiconductor detectors

- Demonstration of the feasibility of high density 3D interconnection for applications in Particle Physics (mainly for sensor-electronics interconnection).
- Subdivision of the final objectives into a set of well defined sub-tasks:
  - Design of and production of dedicated ASIC and sensors
  - Preparation of wafer thinning and via etching.
  - Development of high density interconnection technology with direct chip-chip contact by different techniques

- Organization of common Multi-Project-Wafer runs to evaluate alternative solutions developed by collaborating Institutes

Description of work:

Task 1. Microelectronic Technologies and enabling Tools

The size of current and projected particle physics experiments has reached such a dimension as to justify and actually require the design of dedicated ASICs to equip the read-out of systems with tens of millions of electronic channels. The main objective of this task is to provide the infrastructure to make specific modern deep-submicron microelectronics technologies for the design of such ASICs available to the largest possible group of users in the particle physics community.

Besides assessing the technologies and adapting the design methodologies for HEP specific needs, this task includes the organization of the access to design tools, the training and the support for design engineers within a growing community. It also comprises the coordination of common submissions for prototype productions in the form of HEP specific multi-project wafer (MPW) runs.

Within this task, requirements will be collected from the various future experiment collaborations with the aim of selecting a few commercially available technologies that are expected to fulfil the needs. These will include advanced CMOS technologies, for applications where size and power are the most critical requirements, as well as BiCMOS technologies, where high performance is the driving parameter, and finally high-voltage CMOS technologies for specific powering applications. These technologies will be evaluated, qualified and characterized for their suitability for particle physics applications. Particular emphasis will be put on their performance under irradiation. In this context, optimised design methodologies will be developed, implemented and tested.

The resulting design methodologies will be publicly made available to the microelectronics designers in the particle physics community at large. These designers will be given access to a standardised set of Computer Aided Engineering (CAE) tools for the selected technologies. These CAE tools will comprise standard commercial modules, complemented with specific add-on modules (from enhanced simulation models to modified design rule checks). Dedicated training courses will be organised for users to guarantee an optimal use of the tools and they will be given technical support for their design activities. In addition the coordination of multi-project wafer submissions for prototype developments will be part of this task.

As to provide a common computing infrastructure for collaborating groups using these advanced technologies and tools, a reference design work-station containing reference libraries, design kits, up-to-date simulation models, reference verification decks and software, and powerful enough to allow the assembly of multi-million transistors designs will be made available to the community.

Participants to this task will be CERN (including coordination), INFN (INFN-PV, INFN-GE, INFN-LNL-PD), CNRS, CSIC (CNM-IMB), STFC, Uni Bonn, FOM, AGH-UST and UNIGE (PSI).

Task 2 Shareable IP blocks for HEP

The design of ASICs implies the integration of various individual functional design blocks (IPs) into a complex circuit. The availability of libraries with well-proven functional blocks can greatly accelerate the ASIC design and its likelihood of success. Due to the specificity of the circuits for particle physics, in particular the required radiation hardness properties, commercially available design blocks are normally not appropriate.

Designers in the particle physics community will greatly profit from the creation of a library of IPs for all designers. The objective of this task is to provide a framework in which functional blocks of medium and high complexity, designed within the particle physics community, are made available within this community, thus minimizing the project costs and lowering their risks.

This task, which includes the definition, design and qualification of an initial set of blocks, is naturally related to Task 3.1, which provides the underlying silicon technologies.

Of course proper and consistent documentation of the available IPs will be a condition for publishing them and to make them available to the community.

Blocks that are already identified as being essential for facilitating different designs are numerous in both in the analog domain (band-gap references, biasing digital to analog converters, voltage regulators) and in the digital domain (IO radiation tolerant pads, parametrizable memory blocks, SEU resistant storage elements for digital libraries etc.).
The task will coordinate the definition, design, validation, distribution and documentation of the blocks to be designed across a number of collaborating Institutes which will maintain the long term responsibility of supporting users who choose to use one or more of these blocks in their projects.
Participants to this task will be CERN (including coordination), INFN (INFN-BA, INFN-BO, INFN-GE), CSIC (CNM-IMB), Uni Bonn, MPG-MPP, FOM, AGH-UST, STFC and UNIGE (PSI).

Task 3 3D Interconnection of microelectronics and semiconductor detectors

The main objective of this task is to demonstrate that new challenges for high precision tracking and vertex detectors can be met employing recent developments in interconnection technology known as “3D” or “vertical” interconnection. The bump bonding is replaced by a direct high-density interconnection using solder technologies (Eutectic bonding), SOI, or polymer connections. Inter chip vias are etched through thinned silicon chips allowing to connect one electronic (or sensor) layer to the next. In order to meet the requirements of particle physics, which differ in many aspects from industrial applications, dedicated R&D projects are needed. The precision and complexity of the technology go along with prohibitively high development costs, both in personnel and materials resources, which make it very difficult for an individual laboratory to achieve the ultimate objectives. Within this task a network activity is set up to fully assess the technology in a collective effort around a *common demonstrator*, as opposed to the present distributed efforts around specific applications. Within the network the work will be organized in a sub-task leading in a stepwise approach to the final target:

1. Design and production of test and prototype ASICs for 3D R&D which will be needed for sub-tasks 6.These ASIC must be produced in a MPW with access to full wafers.
2. Production of sensors to be used for 3D R&D. Most of these sensors will be chip size mini-pixel sensors matching the ASICs of sub-task 1.
3. Pre-studies: Interconnection of special dummy test structures, wafer thinning and via etching of special test chips. These structures and chips are produced in sub-tasks 1-3 and will be used to monitor quality and yield of these processing steps.
4. Interconnection of a pixel sensor to one layer ASIC. This will be basically a classical hybrid pixel detector with the bump bonding connection replaced by a more advanced 3D interconnection. No wafer thinning and vias are needed at this stage.
5. Sensor/single wafer and ASIC/ASIC interconnection with vias. This will test high density vias interconnecting two tiers.
6. Full demonstrator: Interconnection of Sensor/ASIC (tier 1)/ASIC (tier 2). This step will bundle all results and achievements of sub-tasks 1-5.

Participants to this task will be MPG-MPP (including coordination), CERN, CSIC (CNM-IMB), INFN (INFN-PV), CNRS, Uni Bonn, AGH-UST, STFC, UNILIV, UNIGLA, SWEDET (UUpps).

Deliverables of tasks	Description	Nature[1]	Delivery month[2]
3.1.1	Qualification of 130 nm CMOS technology, and supply of corresponding CAE tools	R	M12
3.1.2	1st Report on training, support and submissions	R	M12
3.1.3	Qualification of 130 nm BiCMOS technology, and supply of corresponding CAE tools	R	M24
3.1.4	2nd Report on training, support and submissions	R	M36
3.1.5	Qualification of more advanced CMOS technology, and supply of corresponding CAE tools	R	M48
3.2.1	Report on first set of macro blocks	R	M12

3.2.2	Report on second set of macro blocks	R	M24
3.2.3	Report on third set of macro blocks	R	M36
3.2.4	Report on fourth set of macro blocks	R	M48
3.3.1	ASIC Designed	R	M9
3.3.2	MPW run submission	R	M12
3.3.3	Sensor Production	R	M12
3.3.4	Dummy Interconnection	R	M18
3.3.5	Thinning and vias fabrication	R	M18
3.3.6	Sensor/ASIC interconnection	D	M21
3.3.7	Sensor/ASIC interconnection (vias)	D	M24
3.3.8	ASIC/ASIC interconnection	D	M36
3.3.9	Full 2-tier demonstrator	D	M48

WP4: Project office for Linear Collider detectors

The infrastructures developed in particular in WP10 of this proposal will result in a complex and sophisticated experimental infrastructure. To coordinate and manage the building and eventual operation of this infrastructure we propose to put into place a networking infrastructure, called the "Project Office for Linear Collider detectors". This project office will manage and operate the infrastructure built up through WP10, and it will develop and make available more generally tools for the management of distributed detector development projects. Close links and adequate structures will be put in place to ensure efficient communication and complete documentation. This workpackage will thus be a show case for a project coordination office of future large new detectors. A particularly important issue is the design of a common data acquisition framework based on modern technologies and integrating the diverse detector types employed in EUVIF. The WP4 network will support the design and provide the coordination of the various EUVIF tasks

The project office will base its tools and methods on existing efforts within the LHC detector projects as well as the Linear Collider projects. It will closely work with existing project offices for the LHC and ILC projects. An important aspect of this work will be the support and contribution to concrete projects, to validate and exercise the tools under realistic conditions. To this end, the project office will participate in the technical coordination of the proposed EUVIF facility, and support other advanced development projects like e.g. the machine detector interface design for the ILC and CLIC.

Work Package title	Project Office for Linear Collider detectors				Start date or starting event: M1			
Activity type	COORD							
Participant number	1	4	8	11	27	38	42	46
Participant short name	CERN	ULB	CNRS	DESY	INFN	UNIGE	UCAM	UNIMAN
Person-months per participant	42	24	6	87	12	131	12	12
Participant number	49							
Participant short name	RHUL							
Person-months per participant	12							

Objectives:
Task 1: Project Office Tools
- Access and support for general information and documentation systems using a Electronic Document Management System (EDMS);
- Standardization and access to engineering tools, as well as putting in place mechanisms to exchange information between different tools;
- Standardization and access to project planning tools, support in the application of these tools to a complex project;
- Definition of standards in the interface specifications, change control and reviewing procedures of complex projects.

Task 2: Coordination of Linear Collider Activities
Task 2.1: Coordination of the Vertical Integration Facility EUVIF
- Propose and develop specifications of the interfaces, ensure the compliance to these by

prototypes to be integrated into EUVIF.
- Coordinate a common DAQ architecture to be used by the experimenters at the EUVIF, based upon developments in task 3.
- Coordinate a common slow control architecture, based upon developments in task 3.
- Coordinate the operation and usage of EUVIF

Task 2.2: Application of project office tools to the CLIC forward region integration
- Get the overview and make the assessment of engineering and documentation tools used so far for existing studies providing essential input for the CLIC forward region integration
- Propose a coherent set of engineering tools and interfaces for the CLIC forward region study
- Participation in the CLIC forward region engineering study process, with particular aim to monitor issues related to engineering tools and documentation coming up during the actual engineering design process

Task 3: Common DAQ and detector controls for integrated detector tests
- Define a common DAQ architecture including protocols, interfaces, etc. .
- Provide an event building facility that allows the different detectors to connect via the predefined interfaces.
- Provide a detector control and monitoring infrastructure including conditions monitoring and configuration management.
- Provide a prototype detector interface to the common DAQ.
- Provide an online event processing with event filter capabilities based on offline software.

Description of work:
Task 1: Project Office Tools

The Project Office will develop an infrastructure of tools, standards and expertise, which will be made available to the groups proposing complex new experiments.

The distributed design of a complex facility requires a powerful central data base system to store information, to manage the information flow, and to provide means to validate and release information. This functionality is provided by so-called Engineering Data Management Systems (EDMS). Within the Global Design effort (GDE) for the International Linear Collider, an EDMS software has been setup and is maintained for the accelerator design and management. The Project Office in its branch located at DESY will develop, install, and make available a system for the experimental community. This will involve the development of the system to meet the needs of the experimental community, the operation of the system, and support for its usage.

The EDMS system will be fed from a number of different data sources, among them design systems (CAD), project management tools, and different drawing packages. A major goal of the project office will be to provide transparent and easy access to the EDMS for the experimental community, while faced with a very heterogeneous environment at the different partner laboratories. The goals of the project office therefore are twofold: develop mechanisms to exchange information between different packages, in a transparent and easy manner, and, at the same time, work towards reducing the numbers of options used in the community and try to establish a small number of standard systems.

In addition to providing the underlying data management tools, the project office will propose and eventually provide different tools needed to efficiently advance the projects. Among them will be general project management tools, planning tools, and tools to follow and control costs. The selection of the tools will be done in close collaboration with the users. Given the international scope of these projects, discussions will not be restricted to the members of DevDet, but involve the international community as well. Particular emphasis will be placed on the early application of these tools to concrete projects, among the first being the EUVIF facility.

To do this the Project Office will require one full time staff member at DESY starting in 2009. The Office will work in close cooperation with the DESY Information and Project Support group IPP to develop and maintain the necessary tools. It will be supported by members from DESY on the technical questions and by providing the needed computing resources. DESY, CERN and CNRS (LLR) will collaborate on this task.

Task 2: Coordination of Linear Collider Activities
Task 2.1: Coordination of the Vertical Integration Facility EUVIF

As a first practical application of the tools developed under Task 4.1, the Project Office will coordinate the Vertical Integration Facility EUVIF described under WP10 of this proposal. EUVIF is a large-scale infrastructure made available to the LC community to test and further develop detectors in an integrated way for the next generation Linear Colliders ILC or CLIC. The installation and operation of this infrastructure is a major task, which requires significant resources and support. The Project Office branch located at CERN and University of Geneva will coordinate the setup, the commissioning and the running of this facility. It will work with the participants to define common standards wherever possible. A major effort will be devoted to documenting interfaces and keeping this documentation up-to-date.

The Project Office ensures a consistent information structure related to the technical infrastructures and tools provided by EUVIF, based on the EDMS developed under Task 4.1. In the preparatory phase, the Project Office establishes detailed technical specifications for all components and services, in the form of a master plan. While individual partner institutes or groups provide individual infrastructure or detector components, the Project Office checks their compatibility with the global technical framework and the master plan. Change control procedures ensure that the documentation provided is accurate and up-to-date. During the installation phase, the Project office is central in the definition of installation scenarios and scheduling.

To do this task one full time person will be required at CERN, starting in 2010. It will receive support from the UNIGE as far as Data Acquisition aspects are concerned, and from CERN on mechanical engineering matters. DESY will support the operation of the EUVIF facility.

Task 2.2: Application of project office tools to the CLIC forward region integration
As a second practical study of applicability and optimisation of the tools developed under Task 4.1, the Project Office will participate in the detector integration efforts for the forward region of a future CLIC detector. This entails the sector of a future CLIC experiment located symmetrically around the interaction region and very near to the incoming and outgoing electron and positron beams. From the experimental physics point of view, particle detection in this region is essential to provide hermeticity to a future CLIC detector. This region is also very important as the luminosity measurements and beam condition monitoring are performed there. This will provide input to the tuning of the beams to maximize the interaction rate over a nanometre-sized beam spot. From the accelerator side, the region houses part of the beam delivery system, such as focusing quadrupoles, vacuum tube, as well as beam stabilisation and alignment elements. Moreover, in view of the particle background rates induced by beam-beam and focalising effects, the region will house a radiation shield.

This study will be a very relevant test-case example of the use and exchange of project office tools, because the work covers new collaboration efforts, integrating building blocks that have so far been produced by separate communities.

Over the past years, extensive studies have already been carried out in relation to the ILC forward region design. These studies involve a number of beam and physics simulation tools (including tools further developed under WP2), engineering design and documentation tools for experiments and accelerator (see WP4-1), as well as hardware developments (see WP10-3.3). Of high relevance for the CLIC forward region, they nevertheless will need major adaptations for CLIC. The integration of the CLIC forward detector region design will interface with the CLIC accelerator design, which so far has been using different engineering standards, principally based on the engineering tools used for LHC at CERN.

The participation in the engineering study of the CLIC forward detector region with particular emphasis on the assessment, adaptation and monitoring of the project office tools is therefore of high relevance within the process of setting-up project office tools for the Linear Collider community. The actual work performed under this work package covers only part of the full engineering effort for the integration of the CLIC forward region, because it concentrates principally on the application of project office tools. This task will be carried out by CERN, in collaboration with the ILC forward study teams, in particular DESY.

Task 3: Common DAQ and detector controls for integrated detector tests

For the Vertical Integration Facility a common Data Acquisition (DAQ) system has to be provided that allows easy integration of various detector components and ensure efficient data taking of the facility for varying detector setup. To allow for an easy exchange of detectors a common interface and a protocol has to be defined and prototypes for the hardware setup as well as the software components have to be provided from the common DAQ side. The different detector components should then interface to the common DAQ via these tools to ensure compatibility.

The common DAQ itself will then provide event building and if necessary event selection capability on an online computing facility (event building farm) and a network based uplink to persistent storage. The software on the event building farm should be as close as possible to the offline computing environment envisaged.

In addition detector control interfaces for detector configuration and conditions monitoring should be provided as well as the interface to calibration and alignment data for a possible online event processing in case event filter capability is needed.

Defining the common DAQ architecture including the protocols and interfaces to the detectors will be done by all participants involved in this task. (DESY, UNIGE, ULB, UCAM, UNIMAN and RHUL).

The central event building facility will interface the different detector components to the permanent storage. This will be provided by the work of UNIMAN and RHUL.

The University of Cambridge will work on the detector control and monitoring infrastructure using custom made controls and commercial fan-outs.

A prototype of the detector interface to the central DAQ based on ATCA and Ethernet will be provided by the work of ULB and DESY. Existing developments like PCIExpress will be adapted accordingly from UNIMAN and UNIGE.

Deliverables of tasks	Description	Nature	Delivery month
4.1.1	Assessment report on relevant engineering and documentation tools used so far for LC studies	R	M8
4.1.2	Make available EDMS system	D	M12
4.1.3	Demonstrate Exchange/ Interoperability	R	M14
4.1.4	Description of appropriate suite of project tools, together with some prototype installations	R	M22
4.1.5	Report on the operation/support of the engineering and documentation tools	R	M48

4.2.1	Set of specifications for the CLIC forward region integration design	R	M10
4.2.2	Mechanical and electrical interface specification for EUVIF	D	M18
4.2.3	Report on EUVIF (together with WP10)	R	M48
4.2.5	Status presentation of advanced CLIC forward region integration design with proof of successful application of project office tools	R	M24
4.3.1	DAQ Architecture description	R	M24
4.3.2	Interface Prototype	P	M30
4.3.3	Event building facility	P	M36
4.3.4	Detector control infrastructure	P	M36

Milestones	**Task**	**Description**	**Expected date**	**Means of verification**
4.1	4.1	Project Office in place	M20	Report published
4.2	4.3	DAQ Interface and Protocol definitions	M21	Report published
4.3	4.3	Event building demonstrator	M32	Working demonstration
4.4	4.3	Detector controls demonstrator	M32	Working demonstration
4.5	All	Start of EUVIF commissioning	M42	

WP5 – Coordination office for neutrino detectors

Unlike other fields, the neutrino community does not know yet which will be the next neutrino oscillation facility. This decision strongly depends on the value of the mixing angle θ_{13}, which will probably be known by 2011, from the Double-Chooz and T2K experiments. The proposed facilities are Neutrino Factories, Beta-beams and Super-beams. The detector options: a large water Cherenkov detector, a magnetised iron calorimeter, a totally active scintillating detector, an emulsion cloud chamber and a giant liquid argon TPC.

According to the European Strategy for particle physics a Conceptual Design Report (CDR) of the facility(s) and detector(s) shall be submitted by 2012. A comprehensive CDR requires a realistic performance, feasibility and cost evaluation. It's the task of this WP to contribute significantly to the CDR of the detector(s) for this future neutrino oscillation facility.

Input to the CDR should come from existing data[5], Monte Carlo simulations, feasibility studies and dedicated test-beams. The CDR involves however other international networks: i) the International Design Study for a Neutrino Factory (IDS-NF), which includes the design studies for accelerator and detectors, based mainly on simulations; ii) EURISOL/Beta-beam, dedicated to the design of a Beta-beam accelerator facility ii) EURONU, a FP7 Design Study focused on Monte Carlo simulations for all three facilities and the corresponding detectors; and iv) LAGUNA, a FP7 Design Study devoted to the underground excavation, construction and operation of large liquid detectors of three technologies (Water, Liquid Argon and Scintillator) and their safety and environmental impact at the potential sites hosting of the facility. It can be concluded that detector instrumentation R&D is not contemplated in any of the ongoing international projects. DevDet is therefore the ideal framework to complement the above projects with detector prototyping and test-beams for the understanding of the key issues.

Given the complex structure described above, the success of the neutrino detector R&D program strongly depends on good communication and coordination procedures between the different international communities and also among different work packages in DevDet. It is the task of WP5 to ensure that the information is correctly shared and that the correct physics output is obtained from DevDet studies. Two main subtasks have been identified: i) information exchange, which includes a web site, documentation and meetings; and ii) definition and planning of test-beam activities and coherent evaluation of detector options for the CDR.

Work package number	WP5		**Start date or starting event:**					M1		
Work Package title	Coordination office for neutrino detectors									
Activity type	COORD									
Participant number	8	10	34	38	44					
Participant short name	CNRS	RWTH Aachen	CSIC	UNIGE	UNIGLA					
Person-months per participant	19	5	14	20	10					

[5]From currently or soon running experiments: Super-Kamiokande, MINOS, T2K, OPERA, ICARUS T600, but also from others like MINERVA and INO that will be tested in the coming years. In addition, smaller scale prototypes will provide vital information and answers to specific issues of the instrumentation.

Objectives:
Task1: Information exchange

- Create and maintain a web site
- Help in writing documentation
- Coordinate information exchange with other international neutrino projects
- Organization of meetings.

Task 2: Definition and planning of test-beam activities and coherent evaluation of detector options for the CDR

- Collect information from IDS-NF and EURONU on simulation results
- Propose list of measurements to be done at the test-beams
- Collect requirement list for test-beam setup
- Coordinate the design of test-beam detector prototypes
- Coordinate test-beam data analysis
- Extract the relevant information from the analysis of the DevDet test-beams to tune the IDS-NF and EURONU Monte Carlo simulations
- Cost estimates for the different detector options based on WP3 results
- Contribute to the Conceptual Design Report for the detector(s) of a future neutrino oscillation facility

Description of work:

<u>Task 1. Information exchange.</u>

A web site will be created with the help of a professional webmaster. This person will also be in charge of helping to write the documentation and organizing the meetings.

An interactive (wiki,) web site, where people can edit and add documents is recommended. It will contain the relevant information from other neutrino projects and from other DevDet WPs (2, 3, 6, 7, and 11), information about meetings, current status of CDR, etc. The WEB site will be continuously updated.

All neutrino activities in DevDet will be properly documented. This WP will be in charge of collecting and updating the documentation (software manuals, technical drawings, detector designs, etc) and in presenting it on the webpage in a coherent way.

This task also includes the organization of tele/video meetings and in-person meetings, both in the context of DevDet and in the context of other international neutrino networks[6].

The groups involved are CSIC (IFIC), UNIGLA, UNIGE (DPNC), UNIGE (UNIBE), CNRS (APC, IPNL) and RWTH Aachen.

<u>Task 2 Definition and planning of test-beam activities and coherent evaluation of options for the TDR</u>

While WP11 will cover the infrastructure for the test-beams, WP5 will coordinate (in close cooperation with other networks) the definition of the measurements to be done and the detector prototypes to be tested. As described above, five detector options will be studied. There will be a coordinator for each of the options.

The first step is to understand from the current designs and performance evaluations what are the key issues to be understood at dedicated test-beams. A priority list of measurements to be done at the test-beams will be proposed. This list will take into account the available test-beam areas and

[6] In some cases WP5 will not organize the meetings but the contribution of the DevDet/neutrino to the meetings

infrastructures defined by WP11, and may lead to small adjustments to the WP11 specifications.

WP5 coordinates the design of detector prototypes, ensuring that the proposed prototypes fulfil the requirements and that the list of measurements can be completed. The design process will be followed up by the usual CDR and TDR (Technical Design Report) documents.

A possible upgrade of the test-beam infrastructure will require intensive feedback between WP5 and WP11. In this case a list of requirements for the test-beam infrastructure (input to WP11) should be proposed.

This WP will also coordinate the analysis of test-beam data and extract the relevant information required by the existing simulations (in the context of IDS-NF and EURONU).

The evaluation of detector options shall be driven by physics performance, where the main indicator is the sensitivity to the oscillation parameters. Cost and feasibility are the other driving factors. The results on electronics developments from WP3 can have serious implications on the cost and feasibility of the detectors, and therefore shall be properly monitored and used by WP5.

It is the final task of WP5 to make the final evaluation of detector options for the CDR, taking into account all the elements, and again, in cooperation with the other neutrino networks.

All groups are involved in this task.

Deliverables of tasks	**Description**	**Nature**	**Delivery month**
5.1.1	Web site ready	D	M12
5.2.1	List of test-beam requirements completed	R	M3
5.2.2	List of measurements to be done completed	R	M6
5.2.3	Test-beam detectors: Technical Design Report completed	R	M20
5.2.4	Performance report of each prototype completed	R	M40
5.2.5	Cost estimate and current design of the detectors completed	R	M42
5.2.6	Contribution to the CDR ready	R	M48

Milestones	**Task**	**Description**	**Expected date**	**Means of verification**
5.1	5.1	First version of web site available	M3	Test functionality
5.2	5.1	First version of documentation ready	M24	
5.3	5.2	Preliminary list of test-beam measurements	M1	Publication on web
5.4	5.2	Test-beam detectors: conceptual design report ready	M10	Report
5.5	5.2	Preliminary cost estimate	M22	Publication on web

WP.6 – Access to CERN test beams and irradiation facilities

Throughout the development of particle detectors from initial conceptual models up to final detector modules, testing and qualification under realistic conditions is of prime importance. In particular, detector responses to high-energy particles of different types and energies need to be assessed. In case particle detectors are developed for experiments where high irradiation levels prevail, extensive testing of detector components and detector system elements under high irradiation doses is required. In this context CERN, as the largest particle accelerator laboratory in the world, offers unique infrastructures for particle detector developers. This work package describes transnational access to two types of CERN infrastructures:

- Test beams of high energy particles
- Irradiation facilities based on particle beams or a combination of strong radioactive sources and particle beams

In both cases subsistence and travel support for the users of the facilities is requested from the European Commission. Operation costs are fully covered by CERN.

Work package number	6	**Start date or starting event:**		M1			
Work package title	Access to CERN test beams and irradiation facilities						
Activity Type	SUPP						
Participant number	1						
Participant short name	CERN						
Person-months per participant:	2						

Description of the infrastructure
Name of the infrastructure: CERN PS and SPS test beams; PS East Hall irradiation facilities; GIF and GIF++ irradiation facilities
Location (town, country): Geneva, Switzerland
Web site address: http://public.web.cern.ch/Public/Welcome.html and in particular: http://ab-div-atb-ea.web.cern.ch and http://irradiation-facilities.web.cern.ch/irradiation-facilities/
Legal name of organisation operating the infrastructure: CERN, European Organization for Nuclear Research
Location of organisation (town, country): Geneva, Switzerland
Annual operating costs (excl. investment costs) of the infrastructure (€): 15245360 Euro

Description of the infrastructure:

CERN PS and SPS test beams (CERN-Test-Beams)

The CERN PS (proton synchrotron) and SPS (super proton synchrotron) test beams provide particle beams in the energy range from 1 GeV to 250 GeV. Following extraction from the PS and SPS proton accelerators the test beams emerge from selectable primary targets. Upstream of the physicist's test set-up sophisticated beam line equipment allows selecting the particle type (e.g. electron, muon, hadron), its polarity and energy as well as the beam intensity (typically up to 10^4 particles per 1-2 sec beam spill). In total at least 7 general purpose test beam lines and their large well-equipped experimental areas are available for transnational access.

This activity will start from the beginning of the DevDet project. Unique high-energy test beams with their supporting infrastructure are already available now. As described in WP10 and WP11 substantial infrastructure additions will be constructed within the framework of DevDet. These additions will allow for an ever more optimised and specialized use of the CERN test beams, adapting them to the challenges imposed by the future particle physics experiments. They will progressively become available (see WP10 and WP11 deliverables), without major interruption of the test beam schedules. Therefore they will gradually become integral parts of the WP6 transnational access provision.

The CERN test beams are unique facilities in Europe, with beam energies and diversity going largely beyond what is available elsewhere. They have extensively been used for the majority of the particle physics experiments in Europe and even world-wide. Complemented with the DevDet improvements (WP10, WP11) the beam lines will provide much improved quality to the Users in the form of: better information on particle identification, allowing combined detector performance assessments, providing plug-in data acquisition and control systems, providing realistic running conditions with state-of-the-art detector cooling

CERN PS East Hall irradiation facilities (CERN-Irrad-East-Hall)

The irradiation facilities in the PS East Hall have been operational since 1992 and have been upgraded several times since then. The facilities use two secondary beams, extracted from the PS proton accelerator. Several kinds of irradiations are provided:

- Direct exposure to 24 GeV/c protons
- Mixed field irradiations (mainly 1 MeV neutrons)

At the proton irradiation zone, samples with an area of up to 2*2 cm^2 can be exposed to fluences of up to 10^{14} particles/cm^2 per hour. At the mixed field zone samples of up to 30*30*35 cm^3 and 5 kg weight can be exposed to fluences of up to 10^{12} neutrons/cm^2 per hour (1 MeV energy equivalent). Automatic shuttle systems are available for remotely positioning the samples into the beam without access of personnel to the primary beam area. Occasionally proton irradiations can be carried out over larger surfaces, using scanning tables, but without availability of the shuttle system.

The facilities have been used extensively to test materials, sensors and electronics components. The majority of the users originate from the particle physics community. Since 2000 there have been 130 registered users working for 32 different physics experiments. In the year 2007 alone, 1500 objects have been irradiated and 500 dosimeters measured during 135 days of beam time. The PS East Hall irradiation facilities will be available as of the start of the DevDet project. As described in WP9, Task 2, an upgrade of the facility is part of the DevDet project.

CERN GIF and GIF++ irradiation facility (CERN-Irrad-GIF)

The operation of particle detectors at the LHC and future colliders is characterized by sustained high particles rates over large areas. The Gamma Irradiation Facility (GIF) and its GIF++ upgrade (see WP9) allows physicists to study the performance and ageing of detectors under high particle fluxes. CERN test beams can provide the required particle fluxes, but only over small areas of about 10x10 cm^2. Therefore, at GIF a strong ^{137}Cs source provides a high flux (~$10^5/cm^2s$) of 662 keV photons over an area of several square metres. The photon rate is remotely controlled by a system of movable lead filters. The ^{137}Cs gamma irradiator, with a half-life of 30 years, was measured to have a strength of 740GBq in March 1997. Until the end of 2004, GIF was located on a beam line of the SPS accelerator, allowing to carry out detector performance test with high-energy particles before, during and after gamma irradiation. Due to a reorganisation of SPS beam lines, this option is no longer available. Nevertheless, the GIF facility has been fully booked until now and will remain available at least until the end of 2009. As described in WP9, task 1, an upgrade of the facility is part of the DevDet project. The upgrade (GIF++) will consist in providing a stronger source and in relocating the facility on a high-energy beam line. The GIF facility will be available for transnational access as of the start of the DevDet project. Transnational access will then move to the new upgraded GIF++ facility in the fourth year.

Services and support currently offered by the infrastructure:

CERN PS and SPS test beams

Test beam users will profit from the professional advice and technical support of experts, who are specialised in the optimisation of test beams following the user's requirements. On request, selected elements of the test beam infrastructure are adapted to the needs of the user. Standard infrastructures like electricity, water cooling, counting rooms, computer networks and electronics racks are generally available. Specialised additions can be put in place with the professional help of CERN services.

CERN PS East Hall irradiation facilities

A number of technical services are provided with the proton/neutron irradiation facilities. Based on over 15 years of experience with irradiations, individual professional advice on irradiation issues is given to the users. Dosimetry measurements accompany the irradiations, using techniques adapted to each case. Dosimeters are analysed and calibrated in-house. Low volumes of passive irradiations are carried out by the operators themselves. A bench for the electrical characterization of irradiated materials is available to the users. All material are handled, stored, packaged and shipped following strict Safety Regulations. This includes tracing of all irradiated material. Where needed, shipping is performed in containers that keep the samples cold for several days

CERN GIF and GIF++ irradiation facility

At the GIF facility as well as at GIF++ technical support and expertise is provided to the Users. They can install and operate their equipment in a large beam area prior, during and after irradiation. Specialised detector gas supply facilities, safety and control systems, counting rooms, computer networks and electronics rack are available to the users.

In general

Users of the facilities will fully profit from CERN's general user support. User accounts to the central CERN computing facilities will be provided including internet access and access to many specialised professional software tools. Users will attend adequate safety training related to their work at the test beam. They can fully profit from the scientific life at the laboratory and are invited to the many seminars (typically daily) and scientific events. They have access to the scientific library and a wealth of web-based scientific information. They can be hosted in one of the three on-site guest houses providing accommodation at cost price.

Modality of access under this proposal:

Access to the CERN test beams and irradiation facilities will be provided free of charge. The irradiations will take place on the CERN site, and the users are given access to the experimental areas, where they can install and test their equipment. Professional crews operate the beam lines, while the users themselves can carry out standard setting-changes. Depending on the complexity of the equipment under test, the minimum duration of test beam access is 8 hours, though in general periods span from several days to several weeks. Irradiations at the PS East Hall typically last from a few hours to a few days. GIF irradiations span normally from several days to several weeks. Scheduling of the facilities take place on a yearly basis for users requiring long exposure times. For shorter exposures, the schedules allow for more short-term flexibility. Transnational access users will be treated on an equal footing with normal users both for the access and for the scheduling. The ultimate result the users will obtain from the test beam and irradiation campaigns will be a thorough understanding of the performance of their particle detectors under realistic conditions.

Support offered under this proposal:

In addition to the services and support described above, transnational access users will be eligible for receiving travel and subsistence payments, financed by Community funding.

Outreach of new users:

CERN test beams and irradiation facilities are unique world-wide, and already well-known within the particle physics community. They are not only used by physicists preparing experiments on the CERN site, but also for testing particle detectors for many experiments outside CERN, including experiments outside Europe. CERN presently has 8000 registered users who are using its infrastructures. A major fraction of these users are profiting directly and indirectly from its test beams and irradiation facilities. Nevertheless, through DevDet and its infrastructure improvements and even larger user community can be served efficiently, by extending in particular the usefulness of the infrastructures for the Neutrino and Linear Collider communities. Outside particle physics, CERN's facilities have important assets for astroparticle physics research, space applications and research in plasma physics and fusion. We therefore plan to advertise actively in media like CERN courier, ILC newsletter, ASPERA newsletter, EIROFORUM communication media, ITER communication media, as well as via the DevDet outreach web pages.

Review procedure under this proposal:

The selection of users will follow a review procedure similar to that already in place at CERN:

- Requests for more than two weeks (one week) of beam time at the PS (SPS) have to be examined and recommended by the "PS and SPS experiments committee"; those requests which concern R&D projects for the upgrade of LHC experiments are considered by the "LHC experiments committee". Both committees meet typically five times per year, are composed of well-known experts in particle physics, and report to the CERN "Research Board".
- Shorter requests for beam time are usually easy to fulfil. They will be examined by the SAB (Scientific Advisory Board) of DevDet, which will make recommendations to the "PS and SPS physics coordinator" for test-beam requests, and to the responsible of the irradiation beam-lines for irradiation requests.

Implementation plan

Short name of installation	Unit of access	Unit cost (Euro)	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure per visit at user	Estimated number of projects
CERN-Test-Beams	8-hour shift	4840	600	160	10	20

CERN-Irrad-East-Hall	8-hour shift	4840	400	80	5	20
CERN-Irrad-GIF	8-hour shift	4840	200	50	10	8

Unit of Access:

The unit of access is an 8-hour shift for all three facilities. The time includes the setting-up and dismantling time of the user's equipment in the beam area, as the beam cannot be made available to another user during that time. Obligatory safety courses are taken outside the units of access. The average up-time of the CERN PS and SPS beam facilities amounts typically to 90%. In case of important beam failures, every effort is normally undertaken to provide additional beam time to the disadvantaged user.

WP7 - Transnational Access to DESY Test Beam

This work package describes transnational access to the DESY test beam infrastructure. Travel support and subsistence for the users of the facility is requested from the European Commission. Operation costs are fully covered by DESY.

Work package number	WP7		**Start date or starting event:**			M13		
Work Package title	Transnational Access to DESY Test Beam							
Activity type	SUPP							
Participant number	11							
Participant short name	DESY							
Person-months per participant	2							

Description of infrastructure
Name of infrastructure: DESY Test Beam
Location: Hamburg, Germany
Web site address: http://www.desy.de Detailed information at http://testbeam.desy.de
Legal name of organisation operating the infrastructure: Deutsches Elektronen-Synchrotron
Location of organisation (town, country): Hamburg, Germany
Annual operating costs (excl. investment costs) of the infrastructure (€): 409,810
Description of the infrastructure: DESY presently operates at Hamburg several particle accelerators of worldwide relevance. The largest facility, HERA, provided collisions of 920 GeV protons with 27.5 GeV electrons between 1992 and 2007. DORIS is an electron storage ring which previously was operated as e^+e^--collider and is since 1993 exclusively used under the name DORIS III as synchrotron light facility. For both machines the DESY II synchrotron is used as pre-accelerator and delivers in parallel electron or positron beams for to up to three test beam areas using a fixed target. Access to these beam lines is the subject of the Transnational Access Activity discussed here. DESY II can provide electron or positron beams with an energy variable between 1 GeV and 6 GeV, a small energy spread of about 5%, and intensities of up to 5000 particles per cm^2 and second, depending on beam line and secondary target. Next to CERN which has beam facilities for even higher energies and different particles (hadrons, electrons, muon, and neutrinos) DESY is currently the only laboratory in Europe which can deliver high energetic particles in the multi-GeV range. The support for users requested in this proposal will foster and enlarge the continued use of this infrastructure upgraded in the EUDET project. Within this proposal access will be made available immediately following the end of the EUDET project (December 2009). The encouraging experience from EUDET demonstrates that there is the potential of further enlarging the user community to the benefit of detector research in Europe. Services currently offered by the infrastructure: The test beam areas provide sufficient space for the installation of larger scale detector prototypes. They are equipped with huts to house data acquisition and control electronics, and data connections to the DESY computer centre exist. The beam areas are shielded providing working space for operators.

Safety equipment is in place such that gaseous detectors can be used even with flammable gases. Translation stages are available for remote controlled positioning of test equipment in the beam lines. Within EUDET the infrastructure was equipped with a high field superconducting magnet, and a high precision silicon pixel telescope. The exploitation of these two items will be part of this TA project until they become part of the EUVIF installations at CERN (around month 36) whereas access to the DESY test beam as such lasts until the end of the project. A second telescope of medium precision is also available within the infrastructure, typically used for “proof-of-principle” studies.
This existing infrastructure makes the DESY II beam facility one of the few places in Europe where R&D for particle detectors can be performed. It has been extensively used in the past for the development of new detectors and prototype tests. In recent years the DESY test beam played an important role for the ILC detector R&D as well as for first studies within the LHC upgrade programme. Several groups performed experiments with calorimeter prototypes and small pixel detectors at the facility which contributed very significantly to the current state of this R&D effort. Many groups performed experiments with prototypes as well as calibration measurements with detector components which were later installed in the experiments. For example in the year 2007 in total 15 groups from 11 different countries accessed the DESY test beam facilities.

Description of work:

Modality of access under this proposal:
The DESY test beam coordinators, appointed by the DESY directorate, negotiate with the selected applicants the date and the length of access, in close cooperation with the User Selection Committee (see below). The typical length of access to the test beam is between one and four weeks with an average of about two weeks. The average size of user groups is about five researchers. Typical infrastructures used by groups in the DESY test beam are the telescopes, translation stages or trigger electronics. Once the groups are set-up in the beam area and familiar with the DESY safety rules the studies are conducted independently.
During DESY operational periods the beam is available at the experimental areas for about 50% of the time. The remaining time is needed to refill the accelerator replacing the spent beam and to synchronize with the other accelerators on the DESY site. The overall dead time of 50% includes also all losses due to technical problems of the machine. The operation of the beam and therefore access to the test beam area is under the control of the experimenter.
Access to the DESY test beam facility will be provided free of charge.

Support offered under this proposal:
The DESY test beam coordinators are the contact people for the experimenter at DESY, and ensure the proper support of the experimenter during the time at DESY. This includes access to technical services, safety instructions, assistance during the setup up and dismantling phase. DESY provides access to shop services according to the standard conditions for DESY users, access to stores, office and IT infrastructure. The test beam coordinators also instruct and support the user in the use of the additional equipment such as the telescope or the superconducting magnet which were provided within EUDET.
User accounts for the central computing facilities are granted on request including internet access. A scientific library is on site. There are several guesthouses on the DESY site providing accommodations at cost price. External users are an integral part of the life and are invited to seminars and other scientific events at the laboratory. They profit from the highly international and stimulating atmosphere at the laboratory.
This TA activity will continue the successful TA to the DESY test beam of the EUDET project and thus will start beginning of 2010. TA users will be eligible for receiving travel and subsistence payment, financed by the community funding.

Outreach of new users:
The DESY test beam is in the international detector R&D community already well known as an easy to access reliable facility. Scientific results obtained were published at many conferences and in numerous journals, giving rise to higher recognition of this facility. Within EUDET an increase of

applicants for test beam access was observed. Due to the broader scope of this proposal a further increase of applicants is expected. Additionally the infrastructure will be advertised on the WEB and in suitable scientific media, at least once a year.

Review procedure under this proposal:
The SAB will play a central role as the User Selection Panel to grant transnational access to the test beam facility. It will evaluate the proposals and rank them into three categories (A: Approved, B: Approved, but on waiting list, C: Rejected) based on the scientific merit of the proposed experiment.

Implementation Plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the Infrastructure per visit and user	Estimated number of projects
DESY test beam	TB week	16392	30	100	10 per visit and user	25

Units of access
The unit of access to this infrastructure is one week of beam time (TB week). This includes the preparatory work of the external group at the facility, assembling and disassembling of experimental set up as well as radiation and general safety briefings as required by local laws.
A TB week comprises 7 days of 24 hours access to the experimental installation. In general technical and scientific support is provided during normal working hours, i.e. 5 days a week for 8 hours during day-time. An on-call service is in place to assist in urgent problems at any moment. The DESY II accelerator is operated for approximately 10 month per year and the remaining two months are scheduled shut-down time when the facility is not available.
The TB week includes the time needed to assemble, test and disassemble the experimental set-up in the beam line. Depending on the complexity of the apparatus the installation and dismantling of the experiment may take several days during which the beam line is not available for other users.

WP8: Transnational access: European Irradiation Facilities

Work package number	8	**Start date or starting event:**				M1	
Work Package title	Transnational access: European irradiation facilities						
Activity type	SUPP						
Participant number	3	6	13	33	37	38	41
Participant short name	UCL	IPASCR	UNIKARL	JSI	SWEDET	UNIGE	UBRUN
Person-months per participant	4	1	1	1	1	1	1

The objective of this work package is to provide access to the various existing irradiation facilities in Europe. These infrastructures have been used extensively in the past for High Energy Physics (HEP) detectors developments, notably for LHC, that imposed specific and tight constraints for radiation hardness of materials, detectors and electronics used in HEP. The SLHC program is a new challenge in this field because of the expected increase of 10 times in luminosity and five times in particle fluences respect to LHC. For any apparatus at the future linear colliders like ILC or CLIC, the radiation hardness issues will be less demanding than for hadron colliders; however radiation tests shall be performed, especially for detectors and systems that will operate in forward regions. Depending on the type of accelerator and its configuration around the beam collision point, the detectors will be exposed to radiation that has several contributions: from photons, electrons, charged hadrons and neutrons. Simulations have shown that the radiation field is dominated, at low radii, by charged particles, mainly pions, and, at larger radii, by neutrons. Both radiation fields have the same fluence at around 30-40 cm from the beam axis. The table below illustrates both the composition and the expected fluences for 10 years of SLHC operations. Fluences are given in terms of a standard radiation field, 1-MeV neutron equivalent.

Radius (cm)	n (%)	p, π (%)	Fluence (n_{eq}/cm^2)	Typical Detectors
<20	20	80	10^{16}	Pixels (Si)
20-60	50	50	10^{15}	Short strips (Si)
60-100	90	10	$5x10^{14}$	Long strips (Si)
>100	90	10	10^{14}	Calorimeters (Crystals)

The above table has been used as a reference, as the sLHC environment is the most challenging one.
The different irradiation facilities have been selected according to these criteria

1. Accessibility: readiness of the installation and existing links and experience with the High Energy Physics community.
2. Fluences: irradiation facilities shall provide the above-sketched fluences in a reasonably short time (typically few hours).
3. Irradiated area: irradiation should cover areas suited to the detector dimensions.
4. Complementarities: the group of facilities shall provide all required radiation fields.
5. Redundancy: each radiation field shall be covered by at least two facilities
6. Uniqueness: facilities that provide a unique radiation field (both in terms of radiation type and/or fluence)
7. Support to the users: during set-up and after irradiation.

Following these criteria seven irradiation infrastructures have been chosen. These facilities will receive support both for operation and user support.

Infrastructure short name	Installation number	Installation name	Source	Particle	Energy (in MeV)	$\square_{Max}$ part $s^{-1}cm^{-2}$
UCL: CRC_Irrad	8.1	NIF	Cyclotron	Neutron	1-50 E_{mean}=20	7×10^{10}
		LIF	Cyclotron	Proton	5-60	5×10^{8}
		GIF	^{60}Co	Gamma	1.11 and 1,33	50 Gy/hr
JSI_Irrad	8.2	Triga	Reactor	Neutron	<15	4×10^{12}
UNIKARL_Irrad	8.3	Compact Cyclotron	Cyclotron	Proton	15-35	6×10^{13}
IPASCR_Irrad	8.4	NPL	Reactor	Neutron	<15	1×10^{14}
		U-120	Cyclotron	Neutron	4-35	6×10^{10}
			Cyclotron	Proton	10-37	1×10^{12}
		Microtron	Microtron	e/Gamma	6-25	$1x\ 10^{12}$
UBRUN_Irrad	8.5	High Rate	^{60}Co	Gamma	1.11 and 1,33	150 Gy/hr
		Low Rate	^{60}Co	Gamma	1.11 and 1,33	3 Gy/hr
SWEDET: UUpps_Irrad	8.6	QMNP	Cyclotron	Neutron	11-174 Mono-energetic	5×10^{5}
		WSNF	Cyclotron	Neutron	<180 White spectrum	1×10^{6}
		MPF	Cyclotron	Proton	20-175	1×10^{10}
UNIGE: PSI_Irrad	8.7	PIF	Cyclotron	Proton	10-250	2×10^{8}
		Pion/Muon	Cyclotron	Pion/muon	<300	1×10^{10}

Besides the installations listed above, there are other facilities that can be used by DevDet users in case of specific needs or geographic proximity. At time of writing this proposal these facilities are:

- NCSR-Demokritos (Greece): Low energy monochromatic neutron beams.
- Atomki (Hungary): Neutrons continuous spectra up to 18 MeV.
- Legnaro (Italy): 14 MeV mono-energetic neutrons.
- ELBE (Germany): 10-40 MeV electrons.

An updated table of these facilities will be maintained in the DevDet web pages. These installations will not receive support for operation nor for user access and travel.

As described in section 2.1, the Scientific Advisory Board is the main strategic User Selection Panel. Together with the work package leader of WP8, it will study (at an annual or bi-annual basis, where applicable) the global requests for transnational access from the various communities, it will set guidelines for access allocations and will provide guidance on the choice of the facility to address. Where needed, the SAB will seek advice from external experts for this task (e.g. reactor physics expert). The SAB transmits its recommendations to the contact persons from each of the facilities, such that the final beam time allocations can be made following the normal selection procedures in place. In this way, the facilities will be used in the most affective way.
Outreach is managed centrally for DevDet and will be financially supported from WP1 and WP6. Additional local information source are mentioned in each infrastructure description.

Task 8.1: Access to UCL, Belgium

Work package number	8.1	**Start date or starting event:**		M1		
Work package title	Access to CRC irradiation facility					
Activity Type	SUPP					
Participant number	3					
Participant short name	UCL					
Person-months per participant:	4					

Description of the infrastructure
Name of the infrastructure: *Centre de Recherche du Cyclotron*
Location (town, country): *Louvain-la-Neuve, Belgium*
Web site address: *www.cyc.ucl.ac.be* Legal name of organisation operating the infrastructure: *Université Catholoque de Louvain (UCL)*
Location of organisation (town, country): *Louvain-la-Neuve, Belgium* Annual operating costs (excl. investment costs) of the infrastructure (€): 1,458,693

Description of the infrastructure:

Cyclotron Research Center (CRC) is a research unit attached to the Nuclear Physics (FYNU) department at UCL. The facility has three cyclotrons called CYCLONE110, CYCLONE44 and CYCLONE30, able to accelerate charged ions to kinetic energies up to 110, 44 and 30 times Q^2/M (in MeV). For irradiation purposes the most suitable one is the CYCLONE110. Main activities of the center are: research in Nuclear (Astro)Physics experiments, industrial applications (membrane production), irradiation of electronic components and detectors and radiobiology experiments. In total around 2500 effective hours of beam are delivered to users during 35 weeks of operations.

In this proposal three areas are offered for access.

Neutron Irradiation Facility (NIF). Neutrons obtained impinging a 50 MeV deuteron beam on a Be target giving a continuous neutron spectrum up to 50 MeV with a mean energy of 20 MeV. The intensity of the beam can reach a flux of 7.3×10^{10} $ns^{-1}cm^{-2}$, providing a beam diameter ~4cm. This beam has been setup especially for detector irradiations at LHC and it has been extensively used by CMS collaboration. Mono-energetic neutrons with energies from 20 to 65 MeV can be obtained with a flux up to 10^6 $ns^{-1}cm^{-2}$, and an irradiation field of about 2.5 cm in diameter.

Light Ion Irradiation Facility (LIF). Mono-energetic protons with energies between 20 and 65 MeV. Beam size of ~10 cm diameter and maximum flux of 5×10^8 $ps^{-1}cm^{-2}$.

Gamma Irradiation Facility (GIF). Cobalt 60 source providing gammas of 1.11 and 1.33 MeV. Dose rates up to 50 Gy/hr. This area is under construction and it is expected to be operational in spring 2008.

Services currently offered by the infrastructure:

CRC has a long experience in receiving external groups for material and electronics irradiation. Assistance from the CRC technical staff is assured along the experiment lifetime. During the scheduling and preparation phases, CRC engineers contact users providing relevant information about experimental areas, as well as reviewing the proposed set-up. During installation CRC technicians helps in placing and cabling the dispositive under test. Cables and power supplies can be provided. In case of need, the design office and mechanical workshops can be accessible for users.

During irradiation cyclotron operators assure beam stability and control. Irradiation areas are equipped with moving tables capable to place or remove devices under test (DUT) from beam, allowing the irradiation of several samples. Radiation monitors and dosimeters are connected to dedicated control systems giving on-line information about instantaneous and integrated fluxes. These systems also allow to stop irradiation once the total maximum flux has been achieved. Offline analysis allows also to study beam spot size and uniformity. All these information are provided to users after irradiations.

NIF beam line provides also a cryogenic box capable to cool DUT down to -20C during the whole process of irradiation and deactivation.

Radiation protection is assured both to persons and DUT. Handling, storage and transportation of irradiated samples are provided by CRC qualified personnel.

Description of work

Modality of access under this proposal:

In order to apply for access at the Cyclotron Research Center, the CRC Program Advisory Committee (PAC) shall approve the experiment proposal. This committee meets twice per year (January and July). Each request should include the proposal and the accompanying beam time request form filled out in English. Proposals must be sent at least one month before the meeting of the PAC to the CRC secretary.

Application form should include:

1. A detailed proposal covering the following topics: general context and motivation for the experiment, proposed experiment, equipment, timing, and possible by-products of interest.
2. A summary of the proposal (3 pages in the given format, including a list of publications of the spokesperson).

A template file can be downloaded from CRC web pages. Once the experiment has been approved, a complete set of instructions for access will have to be fulfilled as documented by CRC web pages.

Support offered under this proposal:

UCL cyclotron team has more than 40 years tradition in hosting external users experiments. The proximity of beam areas to Nuclear Physics department encourages interchange of ideas and experiences between users and UCL academic and scientific personnel.

Besides support to users listed above, for DevDet users CRC can offer access to clean rooms and test equipments, such as probe station, and a charge collection efficiency set-up. Special requests should be discussed with cyclotron engineers to study their feasibility

Outreach of new users:

Web pages describing the facility and CRC personnel participation to meeting, workshops and conferences.

Review procedure under this proposal:

Experiments should be accepted by CRC Program Advisory Committee as described above. Reports on results are also expected to be sent to CRC PAC.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated over all users	Estimated number of projects
UCL	Beam hour	292	350	30	150	15

Unit of Access:

Beam hour: Includes effective irradiation time. Preparation, deactivation and dismantling time are not accounted in this unit.

Task 8.2: Access to Jozef Stefan Institute, Slovenia

Work package number	8.2	**Start date or starting event:**		M1		
Work package title	Access to Jozef Stefan Institute (Slovenia)					
Activity Type	SUPP					
Participant number	33					
Participant short name	JSI					
Person-months per participant:	1					

Description of the infrastructure

Name of the infrastructure: *J. Stefan Institute TRIGA Reactor*

Location (town, country): *Ljubljana, Slovenia*

Web site address: *http://www.rcp.ijs.si/ric/*

Legal name of organisation operating the infrastructure: *Jožef Stefan Institute (JSI)*

Location of organisation (town, country): *Jamova cesta 39, Ljubljana, Slovenia*

Annual operating costs (excl. investment costs) of the infrastructure (€): 436.000

Description of the infrastructure:

The infrastructure consists of a TRIGA-Mark-II reactor with hot-cell laboratories and various neutron irradiation facilities. Reactor power is 250 kW, maximum total flux is $6x10^{12}$ $cm^{-2}s^{-1}$ (central channel). Reactor is equipped with several in-core and ex-core irradiation channels. Typical flux in the in-core channels is 1-6 $x10^{12}cm^{-2}s^{-1}$, and in the ex-core channels < $10^{11}cm^{-2}s^{-1}$. Typical thermal-to-total flux ratio is 1/8. Maximum uninterrupted irradiation time is 16h. Irradiation facilities (channels) are described in detail in :http://www.rcp.ijs.si/ric/description-a.html

The reactor is equipped for irradiation of various samples. Irradiation and manipulation is safe and simple. Hot-cell laboratory with manipulators for remote handling is available for highly radioactive samples, connected to the reactor by two automatic pneumatic transfer lines. Reactor staff is licensed for and experienced in performing the irradiations for scientific and other purposes.

The reactor is routinely used in the following research:

1) Neutronics and reactor physics
2) Activation analysis
3) Neutron dosimetry and spectrometry
4) Neutron radiography
5) Activation of materials, nuclear waste and decommissioning
6) Irradiation of materials for fusion reactors
    a. irradiation of detectors, test structures and electronics for HEP

Services currently offered by the infrastructure:

Irradiation of neutron activation samples (1500 per year); irradiation of other samples (50 per year), neutron radiography, training of NPP operators and other reactor specialists (20 per year)

Description of work

Modality of access under this proposal:

Qualified JSI reactor staff will perform the irradiation of samples (inserting and extracting of samples, operation of the reactor). The users are expected to prepare the research part of the experiment (preparation of the sample, preparation of special equipment). The users (maximum 5) may assist in the irradiation, however under guidance of a qualified worker. They will receive the irradiated sample after the irradiation for further experimental work. They may use the hot-cell laboratory for handling the radioactive samples.

Irradiations will be performed according to reactor operation plan. Normally, reactor operates every day from 8am to 15pm. One 16h (overnight) irradiation is feasible per week. The users will have access to the reactor during normal operating hours. The operation plan can be fully adjusted to the needs of users.

Support offered under this proposal:

Scientific support: The external users may use the gamma spectroscopy laboratory at the reactor facility equipped with high sensitivity gamma detection system and corresponding software. Additional facilities (manual ultrasonic bonder, probe station, C/V-I/V characterization, CCE measurement) are available within the Experimental Particle Physics Department.

Local scientific staff is well experienced in neutron activation methods, neutron, gamma and alpha spectroscopy and characterization of neutron and gamma irradiation fields (Monte-Carlo calculations).

Complete radiation protection and health physics services are provided. Manipulation of the radioactive samples can be entirely performed by the reactor staff. The radioactive waste will be conditioned, stored and disposed by the JSI staff.

If necessary, assistance will be provided in preparing the radioactive samples for transportation.

Outreach of new users:

Basic information can be found on the web page: http://www.rcp.ijs.si/ric/. The reactor is included also in the IAEA information system and it is well known among the users in the nuclear technology field. However, the potential users outside the nuclear community are usually not aware about the research possibilities it offers. In this respect, new users are attracted mainly through personal contacts (conferences, visits, personal communication).

The reactor has been widely used by international users for neutron activation analysis purposes (several hundred samples per year, 2-3 visiting scientists per year), mainly in nuclear chemistry and environmental research. Recently, it has been widely used by scientists from CERN RD-48 and RD-50 collaborations who develop solid state particle detectors for application in extreme radiation fields in collaboration with JSI scientists form the Experimental Particle Physics Department of (several hundred irradiated samples per year, ~5 visiting scientists per year).

Review procedure under this proposal:

It is proposed that at least one of the members of the DevDet User Selection Panel will be familiar with reactor technology to be able to evaluate feasibility of the proposed research as well as the quality of the results from the aspect of reactor utilization.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated over all users	Estimated number of projects
JSI TRIGA REACTOR	reactor operation hour	218 EUR	450	46	200	23

Unit of Access:

One hour of reactor TRIGA operation for the user (preparation, pre-operational tests, steady state mode irradiation). It includes all services necessary for reactor operation (operators, radiological protection, health physics). It includes insertion and extraction of samples.

Task 8.3: Access to FZK, Karlsruhe Universiteit, Germany

Work package number	8.3	**Start date or starting event:**			M1		
Work package title	Access to FZK						
Activity Type	SUPP						
Participant number	13						
Participant short name	UNIKARL						
Person-months per participant:	1						

Description of the infrastructure
Name of the infrastructure: *Compact Cyclotron*
Location (town, country): *Forschungszentrum Karlsruhe, Eggenstein-Leopoldshafen, Germany*
Web site address: *http://www.zyklotron-ag.de*
Legal name of organisation operating the infrastructure: *Zyklotron AG*
Location of organisation (town, country): *Forschungszentrum Karlsruhe, Eggenstein-Leopoldshafen, Germany*
Annual operating costs (excl. investment costs) of the infrastructure (€): 1 944 000
Description of the infrastructure: The Compact Cyclotron can be adjusted to provide protons from 16 MeV to 30 MeV at currents from 10 nA to 200 µA. A 'standard' irradiation is performed at 26 MeV at 1-2 µA. The cyclotron is located in the Forschungszentrum Karlsruhe with many research institutes, e.g. the Institute for Material Science, which offers plenty of methods to investigate material properties and the Institut für Experimentelle Kernphysik, which has vast experience in silicon sensor qualification and execution of irradiation plans. Services currently offered by the infrastructure: In the last 5 years a strong collaboration with the Zyklotron AG was established and many improvements to the infrastructure have been made. There is a controlled movable stage carrying an insulated box, in which devices for irradiation can be fixed. The box can be temperature controlled by flushing with cold nitrogen and devices can be connected to instruments outside the bunker. Dosimetry is done via the activation of nickel foils. The irradiation qualification for the CMS silicon strip sensors has been performed here, as well as irradiations for many R&D projects (RD50, SMART, BCM, diamond).

Description of work
Modality of access under this proposal: The Institut für Experimentelle Kernphysik act as an intermediary for irradiations at the cyclotron, coordinate the beam time and provides the experimental setup at the beam area. A request for irradiation should be sent to the scientific coordinator of the Institut für Experimentelle Kernphysik at least four weeks in advance. A possible date can then be arranged within 1-2 weeks. Continuous time slots are of the order of 2-4 hours at cost of 450 Euro per hour. Support offered under this proposal: Experienced local staff in close cooperation with the user performs irradiation. Irradiated devices will

be stored in restricted area until radiation level has dropped (cooled if necessary). Dosimetry will be provided. Irradiated devices can be tested on site using the existing equipment for the qualification of silicon strip sensors and detector modules respectively.

Outreach of new users:

Experienced local staff, web-page

Review procedure under this proposal:

The scientific coordinator and the head of the Institut für Experimentelle Kernphysik together with the advisory board as foreseen in the DevDet Project Management *Structure*

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated over all users	Estimated number of projects
Compact Cyclotron	Beam hour	450	120	30	15	15

Unit of Access:

Beam hour: It includes effective beam irradiation time. Setup and dismantling are not included in this time.

Task 8.4: Access to Prague Irradiation Facilities, Czech Republic

Work package number	8.4	**Start date or starting event:**		M1			
Work package title	Access to Prague Irradiation Facilities						
Activity Type	SUPP						
Participant number							
Participant short name	IPASCAR						
Person-months per participant:	1						

Description of the infrastructure

Name of the infrastructure:

Neutron Physics Laboratory, Light-water moderated nuclear reactor LVR-15

Cyclotron Laboratory, Isochronous cyclotron U-120M

Microtron Laboratory

Location (town, country): *Řež near Prague, Czech Republic*

Web site address:

http://www.nri.cz/eng/rsd_services.html - *Neutron Physics Laboratory*

http://mx.ujf.cas.cz/~ou-www/Cyclotron.html - *Cyclotron Laboratory*

http://mx.ujf.cas.cz/~ou-www/Microtronpps_soubory/frame.htm - *Microtron Laboratory*

Legal name of organisation operating the infrastructure:

Nuclear Physics Institute of the Academy of Sciences of the Czech Republic, public research institution

Location of organisation (town, country): *Řež near Prague, Czech Republic*

Annual operating costs (excl. investment costs) of the infrastructure (€):

Reactor LVR-15: 183,678

Cyclotron U-120M: 923,943

Microtron: 150,335

Description of the infrastructure:

Neutron Physics Laboratory (NPL)

It is a part of the Nuclear Physics Institute (NPI) of the Czech Academy of Sciences. It was founded with the aim to perform neutron physics experiments according to NPI research programme as well as to provide experimental facilities and research experience to external users.

The research activities of the NPL neutron physicists are located at the medium flux research reactor LVR-15 (10 MW mean power, thermal neutron flux in the core about $1{\times}10^{14}$ $ncm^{-2}s^{-1}$) that belongs to the neighbouring Nuclear Research Institute, plc. (NRI, plc.). NRI, plc. operates the reactor LVR-15 on a commercial basis. The reactor serves predominantly as a radiation source for material testing, irradiation experiments and production of radiopharmaceuticals. The reactor operates on average about 170 days a year.

Corresponding information can be found also on:

http://www.nri.cz/eng/rsd_services.html

http://neutron.ujf.cas.cz/CFANR/access.html

In general, NPL offers particular instruments and techniques complementary with the ones existing at large centers, which can have an impact on the European research with neutrons. NPL operates 8 instruments installed at 5 radial horizontal beam tubes (for experiments in nuclear physics, solid state physics and materials research) and 2 vertical irradiation channels (for neutron activation analysis) hired from NRI, plc. Seven of these instruments have been currently offered also for external users: particularly

12. High-Resolution Stress/Strain Diffractometer (TKSN-400),
13. Double-Crystal SANS Diffractometer (DN-2),
14. Multipurpose Double Axis Diffractometer (SPN-100),
15. Medium Resolution Powder Diffractometer (MEREDIT, under construction, expected 06/2008),
16. Neutron Activation Analysis (NAA),
17. Thermal Neutron Depth Profiling (T-NDP),
18. Thermal Neutron Capture Facility (NG) - suitable also for Prompt Gamma Activation,

At present, most of the neutron research carried out at NPL can be characterized as materials and interdisciplinary science. Only a negligible portion of the work is aimed directly to the industry. The majority of experiments are a part of research on materials with possible technological applications (shape memory alloys, two-phase stainless steels, high strength steels, superalloys, superplastic ceramics, thermal barrier coatings etc.), of surface studies (e.g. diffusion, sputtering corrosion) of technologically interesting materials used in electronics and optronics technology and of biological/biomedical studies (plant, animal and human tissue analyses), trace elements detection in an environmental samples as well as in biological, geological and metallurgical materials.

Isochronous cyclotron U-120M (U120M)

It is a versatile machine operated in both positive and negative regimes which can accelerate light particles with the mass to charge ratio: A/Z = 1 - 2.8. Accelerated beams and energy ranges are: p^+/10-37 MeV, H^-/10-37 MeV, D^+/10-20 MeV, D^-/10-20 MeV, $^3He^{2+}$/17-54 MeV, $^4He^{2+}$/20-40 MeV.

Beam line system consists of 4 lines in the experimental hall (extraction by the deflection system) and 1 line in the cyclotron hall (extraction by the stripping method).

Microtron

It is a cyclic electron accelerator; the facility allows for irradiation of various materials and samples in well defined radiation fields. Microtron makes possible the irradiation of various samples in homogeneous electron and bremsstrahlung fields in the upper energy range from 6 to 24 MeV and in mixed neutron and bremsstrahlung fields. The laboratory is equipped with facilities for precise dose, dose rate and integral electron current measurements.

Services currently offered by the infrastructure:

Neutron Physics Laboratory

The instruments belonging to the infrastructure have been widely available to the international users in connection with the Access action of NMI3 project (2004-2008, FP6). Within this NMI3 project, 25 experiments (roughly 200 beam days) carried out by 17 different groups all over the Europe and associated countries (particularly Belgium, France, Germany, Greece, Italy, United Kingdom, Hungary, Latvia, Poland, Slovakia, Israel) were successfully carried out. The non-conventional facilities offered for NPL Access have appeared to be beneficial for Europe's scientific community.

Isochronous cyclotron U-120M

It has been operational for over three decades. It has been used for variety research activities both by in-house teams, and by a large number of collaborating research groups. The following summary of selected results in recent years illustrates both the quality of the research and versatility of the machine use.

For research in ADS (Accelerator Driven Systems) and fusion, several types of Fast Neutron Facilities (FNF) have been developed by Neutron group and installed on the cyclotron beams. The

FNF together with U-120M is the only one fast neutron source with IFMIF (International Fusion Material Irradiation Facility) neutron spectrum. (Cooperation with: CEA Cadarach, ENEA Frascati, FZ Karlsruhe, UKAEA Culham).

A new method has been developed in astrophysics, for the indirect determination of the astrophysical S-factors (i.e. Method of Asymptotic Normalization Coefficients) by the Nuclear Reaction Department. The main test of ANC method was realized on U-120M using reaction 16O(3He,d)17F. (Cooperation: Texas University, INFN Catania).

For application in nuclear medicine, a variety of cyclotron based radionuclides (i.e. 67Ga, 201Tl, 111In, 211At, 123I) and radiopharmaceuticals (i.e. 2-18F-deoxy glucose, 81Rb/81mKr generator) have been developed including different types of targets for their production. In the last three years the focus was on production of new alpha emitting radioisotope 230U and positron emitters 86Y and 124I. (Cooperation: ITU Karlsruhe).

For radiation biophysics, the effects of ionising radiation on specific complexes between proteins and DNA have been studied in cooperation with Department of Radiation Dosimetry.

Microtron

Some of the most interesting achievements:

1. online measurement of gamma radiation-induced absorption PbWO4 crystals intended to be used in the LHC experiment, CERN and in the framework of the development of scintillation crystals in the industry
2. research of kinetics of induced absorption phenomena in YalO3:Ce scintillator
3. radiation damage of light guide fibres in gamma radiation field – on-line monitoring of absorption centres formation (research and development connected with the COMPASS project)
4. multi element analysis by gamma activation of geological samples (gold, rare elements content)
5. development of production apparatus for 123I and Rb-Kr generator
6. biological research (enzymes)

- radiation hardness of electronic components

Description of work

Modality of access under this proposal:

It is assumed that the annual plan of the work, as well as approximate schedule, will be agreed with the user. The concrete irradiation runs can be adjusted upon with about one month early notice.

For the scheduled period, the facility is fully reserved for the user experiment. The user is supposed to be present at NPL during the whole duration of the experiment. Depending on the type of the experiment, generally, the measurement time can be in the range from several hours to several days. If a tedious experiment is to be carried out or if a complex sample environment is to be used, two users can take part at the experiment. In special cases, samples can be sent to NPL and the responsible scientist can carry out the experiment without participation of the user.

Support offered under this proposal:

Neutron Physics Laboratory

At NPL, a considerable emphasis is placed on the provision of entire support, including permanent assistance of the responsible researcher, quality software for data analysis and preliminary data evaluation. This is an approach ensuring the cost-effective use of the instruments.

Each experiment is performed under a supervision of an instrument responsible person who organizes the user programme at that facility, trains and supports users during the experiment period, eventually helps with the pre-analysis of the received data. The facilities also have a responsible technician who deals with the maintenance of the instrument and sample environment.

Construction of simple mechanical elements necessary for the successful performance of the experiment is possible in the workshop. PCs, computer network, as well as software for basic data treatment are available as well. The NPL user programme administrator helps users with regard to their travel and accommodation requirements and provides other necessary assistance.

Isochronous cyclotron U-120M

The laboratory can provide base for arrangement of irradiated samples and devices. An ionization chamber with an electrometer for measurement the absorbed doses in radiation beams will be available. Access to a gamma spectrometry facility can be provided as well.

Microtron

The laboratory can offer precise dose and dose rate measurements in electron, gamma and mixed gamma-neutron fields. The upper limit of the bremsstrahlung gamma rays energy can be selected, the neutron fields spectra are similar to the fission spectrum without moderation, mean neutron energy about 2 MeV.

Outreach of new users:

NPL has a strong interest in promoting the use of neutron physics techniques and to encourage new users to enter the neutron physics field. Training periods are offered on an individual basis, in particular to students. NPL Access possibilities are disseminated using the following methods:

4. The facilities opened for external users are listed in database at “The Neutron Pathfinder”, http://pathfinder.neutron-eu.net/idb , a facility-selection tool for European neutron instruments (see e.g. http://idb.neutron-eu.net/facilities.php)
5. The local web page http://neutron.ujf.cas.cz/CFANR/access.html is frequently updated in order to inform the scientific community on the facilities available, on the research areas investigated using these facilities as well as on the organizational issues connected with the experiments.
6. The potential users are informed on proposal submission deadlines via European neutron portal web pages, http://pathfinder.neutron-eu.net/idb/access .

Review procedure under this proposal:

Neutron Physics Laboratory

Before acceptance of the irradiation proposal, the responsible researcher will consider the technical feasibility. It can result in a request to modify the proposal according to the available equipment. The Access administrator assesses each accepted proposal on its eligibility for financial support. Irradiation of samples in the reactor core or in the vicinity of the reactor core, organization of special selection panel is not considered. The author of the possibly rejected proposal is notified, the reason for rejection is clearly stated and further actions to be taken are suggested (e.g. discussion with the instrument responsible on the feasibility, referee’s suggestions to improve proposal). After carrying out the experiment the user has to prepare an experimental report according to the standard rules.

Isochronous cyclotron U-120M

Research groups or individual scientists can apply for access to the cyclotron by submitting a research project or just a request for the irradiation time to the Department of accelerators. Each project proposal can only be considered for acceptance if it fits in the area of the management of radioactive waste or other activities in the field of nuclear technology and safety. Allocation of the beam time will depend on scientific or technological quality and will be approved by cyclotron experts or members of Cyclotron board.

Microtron

The responsible staff of the Microtron Laboratory will study each request from the point of view of its feasibility in the laboratory conditions and of the ability to achieve the requested dose and dose rates. The influence of the relatively high electromagnetic noise on electrical measurement apparatus will be considered as well.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated overall all users	Estimated number of projects
NPL	Beam hour	184 €	150	18	45	9
U120M	Beam hour	308 €	100	18	45	9
Microtron	Beam hour	100 €	50	10	25	5

We expect that the need of radiation tests will be uniform over all 4 years of the project. Better estimate is difficult to make now and such expectation is justified by experience from e.g. CERN RD50 studies.

Unit of Access:

Beam hour

Minimal irradiation run is 4 hours. The amount specified for unit cost covers:

1. The reactor/accelerator operation and beam costs
2. Costs for laboratory space, infrastructure and utilities
3. Scientific and technical support for visiting scientists
4. Modification and maintenance of equipment required for user’s experiments
5. Consumables costs associated with user’s experiments
6. Radiation safety support for visiting scientists
7. Management costs

Task 8.5: Access to Gamma Irradiation Facility, Brunel U. United Kingdom

Work package number	8.5	**Start date or starting event:**			M1		
Work package title	Access to Brunel Gamma Irradiation Facility.						
Activity Type	SUPP						
Participant number	41						
Participant short name	UBRUN						
Person-months per participant:	1						

Description of the infrastructure

Name of the infrastructure: *Gamma Irradiation Facility Brunel*

Location (town, country): *Uxbridge, UK*

Web site address: *http://www.brunel.ac.uk*

Legal name of organisation operating the infrastructure: *Brunel University*

Location of organisation (town, country): *Uxbridge, UK*

Annual operating costs (excl. investment costs) of the infrastructure 204,346

Description of the infrastructure:

Two specialised installations each containing a strong gamma ray source (^{60}Co). Each installation is physically and operationally independent of each other, but both are located within a single geographical campus of Brunel University. One installation has an extremely strong source capable of giving doses in excess of 1kGy per hour. The location of this source is fixed within the facility and space around the source is limited to a volume of about 0.2 m^3. In the second installation the source is weaker by about a factor of 50 but the irradiation cell is designed to accommodate large pieces of apparatus (> 1m^3). The source in the second facility has been designed such that it can placed freely within a part of the bunker (including inside apparatus) and can also be collimated to an extent by a dense tungsten shield. A 1 tonne hoist is available in this bunker. Both cells have some cabling infrastructure (AC mains, low voltage and signal) and the high-rate source has piping for transferring gases such as nitrogen to devices under irradiation. In both cells the ambient temperature is controlled to about 1C (24 hours). A Farmer air-ionisation chamber can independently measure the instantaneous dose-rate and total dose.

Supporting facilities that can be made available to users include electronic and optical laboratories and a class 10000 clean room.

Services currently offered by the infrastructure:

In recent years these two facilities have been extensively used by the international particle physics collaboration CMS. Primarily by members of the community building the electromagnetic calorimeter for irradiation testing of $PbWO_4$ crystals, electronic components, photo-detectors, signal and HV cables and connectors and structural components (e.g. Carbon-fibre alveolar). It has been used also by the CMS Tracker community during the tests of prototypes of a VLSI chip used for readout out of the silicon strips.

Other significant users include industrial manufacturers of CCD chips, industrial manufacturers of photomultiplier tubes, industrial manufacturers of scintillating crystals and work for NASA and Officine Galileo (Italy) on radiation damage to image sensors and optical lens assemblies for space missions to moons of solar system planets.

Description of work

Modality of access under this proposal:

Users can request short (24 hours) or long (weeks to months) access to the facilities. In many cases irradiations can be uninterrupted for periods exceeding 150 hours, interruptions to the radiation, should they occur, are likely to be limited to < 1 hour. Equipment provided by users can be left in-situ and powered up/read-out at all times during the duration of a complete irradiation experiment. Short irradiations can usually be accommodated without any problem into the normal operation of the facility. Longer irradiations can be arranged with some prior notice, but often there is considerable flexibility of scheduling available to users. Irradiation can continue during the formal closure of the University (Easter/Christmas) but access to the facilities themselves during these periods is not usually possible.

Support offered under this proposal:

Users can be offered a range of support. Technical support is mandatory since only a small number of local experts have the authorisation to access the irradiation facilities directly. Where this might conflict with a long-term irradiation which might require significant access training, access and individual dosimetry can be provided to users. Expert assistance and advice on setting up irradiations and dosimetry, including the use of GEANT4 Monte Carlo simulation is available. Access to electronic and optical characterisation of materials, sub-systems and components for pre and post irradiation comparison can be provided as well as assistance and training in the use of apparatus. The ability to interact with experienced scientists who have used the facilities over many years will enhance the user experience. Such support has already been provided to external users in the recent past.

Outreach of new users:

Web pages.

Review procedure under this proposal:

Users request should be send to head of the installation for approval.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated over all users	Estimated number of projects
High-rate gamma facility	Beam-hour	20	1200	20	50	10
Low-rate gamma facility	Beam-hour	5	800	10	30	5

Unit of Access:

In each minimum quantity of access (24 hours) we include some technical assistance in using the sources. For longer (or repetitive) periods of access we would undertake to train external users to use the source and to provide them with individual personal dosimeters.

Task 8.6: Access to TSL, Uppsala University, Sweden

Work package number	8.6	**Start date or starting event:**			M1		
Work package title	Access to TSL						
Activity Type	SUPP						
Participant number	37						
Participant short name	SWEDET						
Person-months per participant:	1						

Description of the infrastructure

Name of the infrastructure: *Neutron and proton irradiation facilities at TSL*

Location (town, country): *Uppsala, Sweden*

Web site address: *www.tsl.uu.se*

Legal name of organisation operating the infrastructure:

The Svedberg Laboratory, Uppsala University (SWEDET – Uupps)

Location of organisation (town, country): *Uppsala, Sweden*

Annual operating costs (excl. investment costs) of the infrastructure (€):1,441,764 €

Description of the infrastructure:

Access is offered to the following irradiation facilities at TSL: the quasi-mono-energetic neutron facility, the white-spectrum neutron facility, the mono-energetic proton facility. All the listed facilities are driven by Gustaf Werner cyclotron at TSL and constitute a part of the beam line structure of the cyclotron. The other major activity at the cyclotron is proton therapy of cancer. Neutron and proton irradiations for industrial/scientific users share the available beam time with the proton therapy.

The quasi-monoenergetic neutron facility (QMNP)

It produces neutron beams with energy choosable by the user in the region 11 - 180 MeV, via interaction of accelerated protons with isotopically-pure ^{7}Li targets. The user can choose a size of the beam spot in the range from 1 cm to 1 m. The maximum available neutron flux is $5x10^4$ – $5x10^5$ cm^{-2} s^{-1}, depending on the energy and the beam spot size. The most recent description of the facility can be found at: A.V. Prokofiev, J. Blomgren, O. Byström, C. Ekström, S. Pomp, U. Tippawan, V. Ziemann, and M. Österlund, "The TSL Neutron Beam Facility", Tenth Symposium on Neutron Dosimetry (NEUDOS10), June 12-16, 2006, Uppsala, Sweden; Rad. Prot. Dosim. (in press); doi: 10.1093/rpd/ncm006. The facility is unique in Europe due to the available energy range, beam spot size, and flexibility of beam parameters.

The white-spectrum neutron facility (WSNF)

It produces a neutron beam with continuous spectrum that extends from thermal energies to 180 MeV, via interaction of accelerated 180-MeV proton beam with a full-stop tungsten target. The shape of the resulting neutron energy spectrum is similar to the one encountered, e g, in the atmosphere of the Earth being irradiated by cosmic rays, or near high-energy accelerators. The user can choose a size of the beam spot in the range from 1 cm to 2 m. The maximum available flux of high-energy neutrons (> 10 MeV) is □10^6 cm^{-2} s^{-1}. The facility was launched in 2007.There are very few facilities of this type in Europe.

The mono-energetic proton facility (MPF) produces beams with energy selected by the user in the region 20 - 180 MeV, the beam spot diameter up to 20 cm, and the homogeneity of the beam within the spot within ±10%. The maximum available proton flux is $5*10^8$ - $5*10^9$ cm^{-2} s^{-1}, depending on the energy and the beam spot size. There are few facilities of this type in Europe.

A common feature of all irradiation facilities at TSL is that the user can choose the beam parameters (energy, flux, size and shape of the beam spot) and flexibly control most of them during the campaign.

Services currently offered by the infrastructure:

1. planning/scheduling of irradiation,
2. area information, orientation and lodging,
3. radiation protection training and supervision,
4. logistics for users' equipment, including dosimetry control and storage of irradiated objects,
5. access to counting rooms, auxiliary office space, meeting rooms, Internet and intranet, electronics pool, etc.
6. user-oriented structures at the beam lines for mechanical support/alignment, electrical power, cables for analog and data connections, vacuum/gas equipment, radiation protection, etc.
7. automated user's workplace for on-line control of the beam,
8. on-line beam monitoring/dosimetry,
9. beam characterisation data,
10. a qualified cyclotron operator and an irradiation facility engineer on duty, both available at all times during user's irradiation.

Annually, the irradiation facilities are run during □30 weeks and visited by □20 user groups, some of which coming a few times during a year. More than 700 external users have visited TSL and worked at the beam lines so far. The most prominent areas of research/industrial activities at the irradiation facilities are: (1) accelerated testing, qualification, and optimization of electronic devices for harsh irradiation environments and critical applications, (2) development and calibration of dosimetry/monitoring devices, (3) measurements of nuclear data for fundamental science and applications. In the areas (1) and (2), user groups from CERN/LHC and collaborating institutions have had a number of campaigns at the irradiation facilities at TSL during last years, in the framework of Integrated Infrastructure Initiative/Transnational Access programme. According to our CERN/LHC liasons, radiation-resistance related issues may become crucial with the coming start-up of the LHC. In order to be able to quickly localize and solve possible problems, access to the irradiation facilities needs to be secured even in this phase.

Description of work

Modality of access under this proposal:

All interested users/user groups will be given possibility to submit applications to the Program Advisory Committee/User Selection Panel 4 times a year, with deadlines on January 15, April 15, July 15, and October 15. When an application is approved, the user is contacted by the Coordinator, and the scheduling of the user's campaign is agreed. The typical duration of user's visit/campaign is about 1 week.

Support offered under this proposal:

SWEDET (Uupps) provides high-quality scientific environments with long-term traditions. The support/services listed above are already provided to external users. In addition, specific needs of users/user groups are normally accounted for.

Outreach of new users:

Web-page and Call for proposals have already been every-day instruments in our contacts with external users during a number of years. The number of international users is expected to increase as a result of this proposal. This expectation is based on the fact that our previous Transnational access funds has always been insufficient to accommodate all eligible user's requests.

Review procedure under this proposal:

As described above in Modality of access.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated overall all users	Estimated number of projects
TSL	Beam hour	576.7 €	150	24	60	12

Unit of Access:

Beam hour: Effective irradiation time. Setup and dismantling is not included in this time

Task 8.7: Access to PSI, Switzerland

Work package number	8.7	**Start date or starting event:**					
Work package title	Access to PSI						
Activity Type	SUPP						
Participant number	38						
Participant short name	UNIGE						
Person-months per participant:	1						

Description of the infrastructure

Name of the infrastructure: *Proton Irradiation Facility and PSI Secondary Beam Lines*

Location (town, country): *Villigen PSI, Switzerland*

Web site address: *www.psi.ch*

Legal name of organisation operating the infrastructure: *Paul Scherrer Institut (UNIGE-PSI)*

Location of organisation (town, country): *Villigen PSI, Switzerland*

Annual operating costs (excl. investment costs) of the infrastructure (€): PIF 156,083, EH: 2,324,620

Description of the infrastructure:

The Paul Scherrer Institute (PSI) is a multi-disciplinary research centre for natural sciences and technology. It is the largest national research institute with priorities placed in areas of basic and applied research that is conducted by about 1,200 members of staff. PSI develops and operates complex research installations, which require especially high standards of know-how and experience. It operates unique accelerators and adjacent facilities for more than 30 years and encompasses large expertise in scientific use and applications of protons, muons, synchrotron radiation and neutrons beams. The PSI facilities are: the synchrotron radiation source SLS, the spallation neutron source SINQ as well as pion and muon beams and the proton irradiation facility (PIF),. In particular, under the contract between European Space Agency (ESA) and PSI the Proton Irradiation Facility (PIF) was constructed for test and qualification of components and instruments operating in various radiation environments. The facility can realistically simulate space radiation environment as well as provide mono-energetic beams for dedicated tests and calibration of detectors, components and devices. PSI also provides beam time at its secondary beam lines for particle physics experiments including detector tests and development. Its unique specialty is very high intensity pion and muon beams of momentum up to a few hundred MeV/c. These secondary beam lines are maintained, jointly, by the Laboratory for Particle Physics and the Department of Large Research Facilities.

Services currently offered by the infrastructure*:*

PSI offers its dedicated beam lines to scientific users and other customers (including industrial partners) under certain conditions. The particle physics experiments are proposed in front of the research committee that strictly organizes the beam line access via a proposal procedure evaluation. Reach infrastructure including beam line support, radiation protection, vacuum, mechanics and electronics workshops are available for the users. Currently about 17 experiments with international participation are carried out in the PSI pion/muon areas. Detector test runs have bean already performed in several secondary areas. Test periods for all accepted proposals are scheduled during the accelerator users meeting organized twice a year. They have a variable duration of few weeks and provide the beam continuously with exception for setup and service days. Experiments at PIF facility are performed mainly during weekends after completing the biomedical exposures at PROSCAN accelerator. Such short exposure tests have simplified application procedure. Moreover the time between the beam-time request and conducting of the experiment is much shorter. More than 44 test blocks were provided for users from 22 national and foreign institutes and companies visited the facility in 2007.

Description of work

PSI infrastructure can be of great importance for the detector developments activities allowing comprehensive tests and calibrations of the new instrument with unique and high quality particle beams. It allows an access to and a usage of numerous test facilities with different radiations and particles for detector development, characterizing and calibration. The PSI is in particular important for the development of particle physics and space experiments being itself involved in several large proposals (CERN, LHC, MAGIC, HERA etc.) and space missions (RHESSI from NASA or INTEGRAL, XMM-NEWTON, ROSETTA marked as ESA kern-stone observatories) and others.

Modality of access under this proposal:

The PIF facility is offered to the DevDet community as outlined within this proposal on the basis of a hourly rate given in the calculation sheet covering the personnel costs. The DEvDet community may consider that this research service of PSI is conditional on the availability of the PIF facility and the respective proton accelerator. It is the responsibility of the PIF beam line scientist to allocate the facility to the DevDet community. Therefore the DevDet community shall apply for its requested experiments at least 3 months in advance of possible deadlines for completion. The DevDet community's contact therefore at PSI is Mr. Wojtek Hajdas.

During the performance of experiments PSI also offers their computing utilities as well as internet access, remote control and printing facilities. The institute provides to its users a guest-house (if desired), restaurants and cafeterias as well as its meeting and conference rooms for discussions and gatherings.

The PIF beam line can provide up to 160-200 hours of beam time per year over a period of four years. The maximum beam time offered herein is 640 hours. Since PSI is accounting personnel costs only for this service to the DevDet community a report on the test results is expected from the user group in due time after each detector characterization project by acknowledging the PSI / PIF contribution to the result.

The access to the Pion and Muon beam line cannot be guaranteed within this proposal however PSI provides a way to apply for it to each member of the DevDet community. A party interested is invited to apply by providing a scientific proposal which will be evaluated by the respective international research committee in order to guarantee the scientific relevance and feasibility of the work. Under the accepted proposal, the user will get the access to the particular beam line without any additional costs.
For further information please consult our respective website:
http://ltp.web.psi.ch/user_information/call_proposal.htm.

Outreach of new users:

The PSI facilities are attended by the international community though there still is left some potential to increase the number of scientific users at some beam lines (e.g. PIF). All facilities offer both well prepared and information reach web-pages as well as general calls for proposals that are issued periodically. In case of the PIF facility the community funding of the experiments will make an access to its high quality beams much easier and faster. It will allow the new (and old) users to concentrate mainly on research and development aspects of their activities leaving the burden of financial and administrative duties aside. We anticipate an increase of the number of users by about 20-30%.

Implementation plan

Short name of installation	Unit of access	Unit cost	Min. quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure integrated over all users	Estimated number of projects
PIF	Hour	245.70 (EUR)	250	15	80	10
Pion/Muon beamline	8 Hours	738 (EUR)	TBD (see text above)			

WP9 - Construction of irradiation facilities at CERN

The high radiation levels expected in LHC and future SLHC detectors require extensive R&D to study detector performance and optimization under such conditions, as well as finding suitable materials, testing control sensors and innovative approaches for detector assembly. The ability to investigate neutron, proton, X-ray, and gamma radiation effects in an experimental setting allows anticipation of component failure and development of new systems that can withstand these radiation exposures. At CERN, the existing Gamma Irradiation Facility (GIF), which permits irradiation of large area detectors, and the high fluence proton and neutron irradiation facilities in the PS T7 and T8 beam lines have been used at 100% of their capacity. Both facilities are unique in the world, as they allow testing the radiation tolerance of detectors and detector components in high-intensity, high-energy beams in a high quality setting offering centralized services around the irradiation experiments. To cope with the demanding detector R&D for SLHC these facilities need to be significantly upgraded especially in terms of radiation dose. Due to the overlap between LHC running and SLHC R&D work carried out by detector, accelerator and radioprotection communities, it is also important to improve user interfaces and accessibility to the new facilities such that setting up procedures and test time are minimized and more users can use them, even at very short notice if needed.

Another major issue facing the design teams of the LHC detectors was that the required assembly materials performance data was not available or not sufficient, therefore their performance could not be accurately predicted. The SLHC detector community requires a compilation effort to understand what has worked well in LHC and to establish the parameters and test procedures that are needed to validate and fully characterize new materials and fluids for the particle detectors foreseen for SLHC.

All these facilities can be regarded as indispensable qualification and development tools for understanding and mitigating possible failure effects in LHC, and starting an efficient LHC upgrade programme.

Work package number	WP9		**Start date or starting event:**			M1	
Work Package title	Construction of irradiation facilities at CERN						
Activity type	RTD						
Participant number	1	5	13	25	28	39	44	45
Participant short name	CERN	INRNE	UNIKARL	WEIZMANN	VU	STFC	UNIGLA	UNILIV
Person-months per participant	62	6	10	24	8	18	18	18
Participant number	50							
Participant short name	USFD							
Person-months per participant	12							

Objectives:

Task1: Construction of the GIF++.

- Elaboration and evaluation of different scenarios to construct a new CERN gamma irradiation facility (GIF++), optimized for an effective SLHC R&D program. GIF++ will be used to probe efficiently LHC test detectors, establish recovery plans and validate SLHC detector prototypes.
- Produce the design specifications for the optimal gamma irradiation facility: freeze the technical requirements for the new source and coexisting particle beam - if any, the area layout, and general and peripheral infrastructure.

- Set-up the common infrastructure for the optimal and efficient use of the GIF++ facility by the different user communities (detector, accelerator, radioprotection).
- Build and operate the facility.

Task 2: Upgrade of proton and neutron irradiation facilities

- Elaboration and evaluation of different scenarios to upgrade and adapt the neutron and proton irradiation facilities at CERN in view of the upcoming SLHC irradiation programs.
- Design of new proton and neutron irradiation facilities according to the outcome of the evaluation study.
- Construction and commissioning of the upgraded proton and neutron irradiation facilities.
- Design and set up of common infrastructure for the facility, such as an offline radiation monitoring system based on the microwave absorption technique, and including specific equipment for the characterization of silicon sensors for SLHC:
  - Scanning table with >10cm^2 reach with local dose monitor and self-calibrating scanning software.
  - Temperature controlled cold box suitable for the scanning table.
  - System for monitoring and biasing a large number of Silicon detectors during irradiation.

Task 3 Qualification of materials and common database

- Publish a report with the history of materials used in LHC and defining the most important characteristics identified for SLHC detectors (trackers, muon detectors) and their services.
- Find optimal procedures for testing and report on results of selected materials for SLHC.
- Set-up and publish a WEB database compiling the information above.

Description of work:

<u>Task 1. Construction of GIF++.</u>

The CERN GIF set-up has permitted, in an accelerated manner, the extensive characterization of LHC detectors in presence of background radiation and the optimization of their system services, such as the complex re-circulating gas systems for the LHC muon gas detectors. The combination of high rate background radiation and coexisting muon beam has made it unique in the world. Following the dismounting of the SPS West Area beams, simultaneous beam tests are no longer possible, and the facility is scheduled to be shutdown in 2009. However, detector communities express the strong need of having access to a similar facility, modernized to cope with the needs imposed by the planned R&D for SLHC. The starting point for the construction of GIF++ is the collection of user requirements to perform the design studies and to freeze the technical specifications for the construction of the optimal facility. The requirements will be collected by CERN via questionnaires sent to user-communities in particle physics and in-depth discussions with the LHC upgrade programme teams. A dedicated task force including experts from several departments in the Organization will create and analyze the data and produce a report including:

- Technical specifications for the gamma source(s), linked to a high-energy particle beam if most users would request it.
- Optimized choice to condition the area for efficient use (heavy work needs, mechanics, attenuating filters and their remote control), design of the control room, optimized layout of common peripheral services (gas systems, cooling, slow controls, dose monitoring, common trigger and readout) and all the studies related to safety and radiation protection aspects (interlocks, log procedures).
- Operation plan for the facility and its inclusion in the CERN irradiation and beam tests programme.

The lead of CERN and involvement of Weizmann in this task will trigger the construction of the new facility GIF++ in time to improve and find solutions for failure modes of detectors in LHC, and to coordinate prototyping work for SLHC detectors in a set-up that permits a fruitful interchange of experiences by all user groups involved. Weizmann and INRNE will play an important role defining and providing common infrastructure for the users, with special emphasis on the Slow Control Systems. This is of special importance as tests carried out to ascertain the long-term behaviour of detectors would run unattended for long periods of time.

Task 2 Upgrade of proton and neutron irradiation facilities

CERN will lead the process to evaluate the requirements of the High Energy Physics community for irradiation facilities based on the very high energy and intense proton beams available at CERN. The resulting requirement list will be taken as an input to develop upgrade scenarios for the presently existing facilities. For the most feasible options, operation scenarios and cost estimates will be worked out and presented to the CERN management. Upon selection and approval of a specific facility proposal a detailed construction plan will be worked out and finally this work package will serve to contribute to the construction and commissioning of the new facilities. In detail the CERN contribution will be the area conditioning (heavy work, mechanics, beam lines, safety and radioprotection aspects, control room) and the optimized layout of common services (electrical and gas systems, cooling, slow control, common trigger and readout) as well as the installation of shuttle systems (remote sample positioning systems) and their control.

The UK groups UNIGL, UNILIV, and USFD will design and deliver a cold box that can be scanned through the proton beam to achieve uniform fluences across an area of about 10x10 cm^2 surface. The system will be monitored in terms of stage position and movement, temperature and humidity inside the box and fluence. Its main purpose will be the irradiation of Silicon detectors and modules. Therefore, the system will be capable of biasing the detectors and monitoring their current to reproduce realistic operating conditions. A beam monitoring system that can monitor the relative fluence remotely will be developed. This will monitor the relative fluence across the box as a function of time to ensure that the devices are uniformly irradiated. The monitor will consist of a pixellated detector based on a rad-hard technology. The final deliverable will be a cold box system with a stage and monitoring commissioned in the CERN proton irradiation facility. Operation of the cold box system will then be taken over by the CERN group with the UK groups providing maintenance and expert support. An independent absolute fluence monitoring system based on carrier lifetime measurements in silicon as measured by microwave absorption will be provided by the Vilnius group. The system will allow for an absolute fluence calibration of the online monitor data after the irradiation experiment.

Task 3 Qualification of materials and common database

The construction of the particle detectors in consideration for the LHC upgrade demands an exhaustive and systematic search for new yet commercially available materials, with attractive properties in terms of density, expansion coefficient, elasticity modulus, radiation hardness, electrical and chemical properties, etc. This task will establish the shortfall in data for the LHC upgrade experiments, establish a set of procedures for obtaining the data, stress those procedures by making some tests, and publish the results and the procedures on the web for the benefit of the whole community. The guiding principle will be that materials successfully used and well characterized for LHC should remain suitable and be used again for SLHC. However it is possible that LHC will show that some materials do not perform as expected (e.g. adhesive did not always adhere), some others will be no longer available, performance of other ones will not match SLHC (e.g. radiation tolerance) or new required parameters have not been measured in a reliable way, or possibly a significantly better material is available (cheaper, lighter, stronger, etc.) whose performance in key areas has been demonstrated by trustworthy methods.

The task, led by the Advanced Materials Group of STFC is divided in three sequential sub-tasks:

Subtask 1 requires establishment of the critical performance parameters for the materials, to document what materials were used or rejected before, and what promising alternative candidate materials there are. This will be carried out by all participants in this task working in close collaboration with the LHC and SLHC communities, performing a survey of literature about the original detectors, and by eliciting knowledge from the relevant members of the teams. From this exercise the list of materials requiring further tests will be established. The involvement of the UK groups is especially relevant as they hold important knowledge from the construction of silicon detectors for LHC. CERN, in collaboration with Weizmann will also play an important role opening up this activity to other detector communities, such as groups working on LHC muon gas detectors and their possible upgrades.

Subtask 2 requires establishing procedures to fill in the missing data items identified at the end of subtask 1 where radiation testing is involved. For this, the participants will give access to mechanical, electrical and thermal testing equipment and to suitable irradiation facilities. CERN and

UNIKARL will therefore play an important role in this subtask, facilitating the use of their irradiation facilities on a suitable time scale. Uni Karlsruhe, in collaboration with the Institut of Material Science at the Forschungszentrum, offers cutting-edge methods to investigate material properties.
Subtask 3 requires database expertise, as well as a full set of results from subtasks 1 and 2 and a specification of the required functionality of the database. CERN will actively contribute to the development and maintenance of the database using in-house know-how.

Deliverables of tasks	**Description**	**Nature**[1]	**Delivery month**[2]
9.1.1	Design study for a new GIF++ facility published	R	M12
9.1.2	Technical specifications for the GIF++ with peripheral services and user infrastructure approved	R	M18
9.1.3	Construction of the GIF++ facility completed	O	M36
9.1.4	First Performance and operation report of the new GIF facility published	R	M48
9.2.1	Design for upgraded proton and neutron facilities approved	R	M24
9.2.2	Upgraded facilities constructed and operational, together with their peripheral detector-test systems	O	M42
9.2.3	Performance and operation reports of upgraded proton and neutron facilities published	R	M48
9.3.1	Description of materials used in LHC, indication of required properties for SLHC and missing items identified	R	M12
9.3.2	Set of test procedures published	R	M28
9.3.3	Material Database filled with results on Web	O	M48

Miles-tone	**Task**	**Description**	**Delivery month**	**Means of verification**
9.1	9.1 9.2	GIFF++ and proton and neutron facilities user requirements collected	M6	Publication on web
9.2	9.1	Implementation plan for the construction of the GIF++ agreed by stakeholders	M22	Publication on web
9.3	9.1	Commissioning of GIF++ completed	M42	Declare infrastructure 'Ready for users'
9.4	9.2	Outline design of proton and neutron irradiation facilities	M18	Publication on web
9.5	9.2	Open proton and neutron facilities to users	M45	Declare infrastructure 'Ready for users'
9.6	9.3	Compile the list of materials used successfully in LHC trackers and indication of required properties for SLHC agreed	M8	Publication on web
9.7	9.3	Identify suitable testing procedures and radiation sources for characterization of new materials	M18	Publication on web
9.8	9.3	Post-irradiation tests of materials completed	M36	Publication on web
9.9	9.3	Materials database specification produced	M39	Publication on web

WP10 - Test Beam Infrastructures for Fully Integrated Detector Tests

At high-energy colliders, because of their peculiar time structure and challenging background conditions, detectors are an integral part of the design process. Technology development and assessment for LC detectors is currently being co-funded by the EC through the EUDET Integrated Infrastructure Initiative in FP6. This successful project, now at its mid-term, defines and implements European infrastructure for research and development towards components of future LC detectors. An important aspect of EUDET, which is greatly appreciated by its partners, is the integration of partners and associates into a common scientific network, which makes common facilities available to others, facilitates the exchange of information and prepares for the future establishment of more formal collaborations.

The next logical step towards an LC detector design is to assess system aspects of the proposed detector concepts. This means that the interplay between detector components must be studied. The principal integrating factor in linear collider event reconstruction is the concept of particle flow. In this concept, an attempt is made to identify and separate the individual particles (photons, electron, muons, charged and neutral hadrons) which form a particle jet. After successful separation, each reconstructed particle can be measured using the detector component which provides the best energy-momentum measurement for this particle species (e.g. charged particles in the tracking system, photons in the electro-magnetic calorimeter etc.). With the advent of imaging calorimeters, this approach, which was already successfully exploited in the LEP era, provides the tools to enter a new dimension to physics analysis with collider detectors.

It must thus be established how single measurements from the detector components complement each other to form particle flow objects. It must be determined how the system as a whole can be integrated mechanically, how services can be distributed and how data can be collected. This requires the definition of interfaces and their implementation. It also requires establishing data conditioning and reconstruction strategies that correspond to the well studied physics requirements.

To this end, the European Vertical Integration Facility (EUVIF) is proposed as unique infrastructure to integrate commensurate prototypes of LC detector components and expose them to particle beams of different types and the appropriate energy range. It will present to users a flexible framework of infrastructure for services, data acquisition and prototype accommodation, in which complete vertical slices through future detectors can be tested. In this way, the performance of the overall detector system can be studied and optimized under realistic conditions.

The network proposed in WP4 will take the leading role in planning and coordinating the development of the EUVIF facilities employing the tools developed there. Close links and adequate structures will be put in place to ensure efficient communication and complete documentation. The development of EUVIF will thus provide a show case for a project coordination office of future large new detectors. A particularly important issue is the design of a common data acquisition framework based on modern technologies and integrating the diverse detector types employed in EUVIF. The WP4 network will support the design and provide the coordination of the various EUVIF tasks.

A special beam line delivers secondary beams to a reserved area, where particles penetrate the prototypes of detector components placed into the beam line. Detector component prototypes are principally those, which are being developed using the EUDET infrastructure: pixel-based vertex detectors; TPC type tracking detectors with micro pattern gas detector or silicon readout, supplemented with silicon strip layers; and compact structures for electromagnetic and hadronic imaging calorimeters. However, EUVIF will allow exchanging every single component for an evaluation of alternative technologies and optimization of the overall LC detector performance.

Infrastructure components concern mechanical, thermal and electrical services. A major task in the preparation of these services is to define interfaces. As far as data acquisition is concerned, the definition of the architecture, definition of common interfaces as well as the interplay between trigger and data flow are major tasks.

The simulation, reconstruction and analysis of EUVIF data will heavily rely on the use of software tools that are developed in WP2, such as the flexible geometry package for describing the changing detector setups including its misalignment, fast access to conditions data, event display and the reconstructions toolkit. The direct application of these generic software packages to running test beam experiments will in turn provide important feed back on the usability of the tools to the developers in WP2 thus leading to a fruitful interplay between WP2 and WP10.

Work package number	WP10		**Start date or starting event:**			M13		
Work Package title	Test beam Infrastructures for Fully Integrated Detector Tests							
Activity type	RTD							
Participant number	1	2	4	6	8	9	11	12
Participant short name	CERN	OEAW	ULB	IPASCR	CNRS	CEA	DESY	MPG-MPP
Person-months per participant	38	64	10	97	244	41	64	23
Participant number	13	14	15	16	17	18	19	20
Participant short name	UNIKARL	UniBonn	TUD	ALU-FR	Goettingen	UNI-Hamburg	UHEI	JOGU
Person-months per participant	64	19	24	19	12	18	16	19
Participant number	21	22	26	27	29	30	31	32
Participant short name	UNSIEG	Wuppertal	TAU	INFN	FOM	UiB	AGH-UST	UVT
Person-months per participant	12	18	24	63	19	18	89	24
Participant number	34	35	37	38	46			
Participant short name	CSIC	CIEMAT	SWEDET	UNIGE	UNIMAN			
Person-months per participant	43	23	24	45	24			

Objectives:
Task 1: Beam line set-up and generic infrastructure
- Supply beam line with adequate magnets necessary for the vertical infrastructure: Dipole magnet for the tracking infrastructure and dipole magnet for calorimeter infrastructure
- Equip beam line area with gas supplies, electrical and network cables

Task 2: Tracking infrastructure
Tasks 2.1: Vertex detector infrastructure

- Building a global mechanical infrastructure to host multi-layer modules for vertex detectors in different technologies
- Developing the data acquisition system including hardware from EUDET to suit the new infrastructure
- Producing a target system to create jet-like structures
- Integrating the EUDET telescope upstream of the target

Tasks 2.2: Intermediate tracker infrastructure

- Evaluating lightweight support structures for both module carrier and overall support structure
- Developing prototype silicon modules with minimized material consumption
- Developing an overall support structure for modules/ladders arranged in layers
- Improving the existing EUDET readout chip and developing a front-end hybrid prototype suitable for testing silicon sensors with conventional (wire-bonding) or novel (bump-bonding) connection techniques
- Integration of the front-end electronics developed in EUDET into the central DAQ system (see WP4)

Tasks 2.3: Improvement of infrastructure for gaseous tracking detectors

- Providing the EUDET TPC infrastructures for combined tests of the particle flow concept
- Develop and provide readout software
- Integration into DAQ and slow-control system

Task 3: Calorimeter prototype infrastructures

Tasks 3.1: Infrastructure for electromagnetic calorimeters

- Develop facility for mechanical and system integration
- Develop facility for optimization and test of silicon readout sensors
- Develop facility for the test and characterization of readout systems

Tasks 3.2: Infrastructure for hadron calorimeters

- Develop facility for mechanical and system integration
- Develop facility for the optimization of SiPM micro-structures and on-wafer sensor tests
- Develop facility for the characterization of packaged sensors and integrated scintillator systems
- Develop facility for the test and characterization of readout and calibration systems

Tasks 3.3: Infrastructure for forward calorimetry

- Design and prototyping of a flexible tungsten absorber structure for beam tests including a laser position monitoring
- Development of a prototype of a multi-channel readout system including fully instrumented sensor planes, FE ASICS and high throughput transmission lines to link the FE electronics to the common DAQ

Task 4: Infrastructures for qualification of silicon sensors

- Design of test structures to be processed on silicon wafers
- Build and optimize a test station to fully electrically characterize test structures
- Establish a data base where measurement results are stored for future reference and to enable comparison across different producers and production methods
- Design, construction and optimization of a multi-channel TCT set-up

Description of work:

Task 1: Beam line set-up and generic infrastructure

The goal of this task is the provision of a dedicated test beam area for the vertical integration facility at CERN SPS. Services necessary for the subsystems described within WP10 and not provided within the subtasks will be furnished. The cost estimate and details are based on typical requests from users at CERN test beams. The task will be organised in close cooperation with the project office (WP4).

Different sub-systems such as the tracking detectors (WP10.2) and the calorimeter (WP10.3) need a magnetic field for operation under realistic experimental conditions. Magnets will be identified, relocated, and equipped with power lines and cooling water lines if necessary. Several systems of WP10 use gas for their operation. Primary gas limes to be extended into the dedicated area and gas pipes will be fed from the primary gas lines to the sub detectors. The calorimeters of WP10.3 will be positioned on a large scanning table to enable the study of different areas of the detector. The table should be able to carry about 10 tons of equipment.

In order to house the full vertical integration facility at one beam line refurbishing might be necessary. This will include layout changes of the experimental hall, counting house modifications, electrical, and network modifications. The operation of high magnetic fields has to be taken into account in the general safety system of the test beam area. Emergency offs have to be implemented in the existing safety system to ensure safe operation. Also gas and cryogenics system require careful operation and have to be implanted in the existing safety protocols. CERN and DESY will contribute to this task.

Task 2: Tracking infrastructure

The particle flow approach relies on the robust identification and precise momentum measurement of charged particle tracks. In the ILD detector concept for an LC detector, charged particle tracking relies on a system which consists of a pixel vertex detector, an intermediate silicon strip detector and a large volume time projection chamber (TPC).

Infrastructure which allows for a test of these individual components is currently being developed within EUDET. In this task, building on the EUDET structures, a facility shall be developed, which for the first time allows for tests of the overall tracking concept and its interplay with calorimetry (task 3) in order to verify the particle flow approach. In order to achieve this, the EUDET prototypes have to be assembled together with a common DAQ and Slow Control system (see WP4). The systems have to be equipped with larger area readout in order to provide sufficient spatial acceptance to measure jet-like particle showers produced in the CERN test beam. Once the infrastructure is available, users can exploit the features of different technology choices for the individual sub-detectors (pixel technologies, different silicon strip sensors and front-end electronics, different gas amplification and readout schemes for a TPC).

- **Sub-task 1: Vertex detector infrastructure**

Within this task a small-scale full vertex detector will be provided. The interface to the overall facility will be designed in such a way that vertex detector modules of different type can be easily integrated and benchmarked.

A mechanical structure outside of the acceptance will allow mounting devices independent of the sensor technology. For this purpose a common mechanical interface needs to be defined. The partners contributing are DESY, INFN-MI and CEA (IRFU).

The data of this kind of detectors is typically sparsified and binary. Therefore the focus of the data acquisition system will be on data throughput, multi-event data storage and maximum event rate, compliant with a future linear collider time structured beam. Care needs to be taken incorporating a central clock and time-stamp system to include the vertex slice in the overall vertical integration facility timing. The hardware needed to interface between the vertex slice data acquisition and the common DAQ (WP 4) will be developed based on the trigger logic unit (TLU) developed within EUDET. Also the necessary software will evolve from existing EUDET data acquisition software. Partners: IPASCR (CUPRAGUE), INFN-MI, UNIGE.

Software targeted at the reconstruction and analysis of data from the high resolution, low material vertex slice will be developed evolving from the package developed in EUDET. It provides functionality for calibration, alignment and offline data reduction as well as for pattern recognition and determination of the resolution of the device under test (DUT). The developed software will be tightly integrated with and make use of the generic tools that are developed in WP2. Partners: IPASCR (CUPRAGUE), DESY, INFN-MI, AGH-UST.

Jet-like particle showers necessary to fully test a vertex detector will be produced from high energy particles hitting a target. This target will be constructed of a number of thin plates in which the impinging particles shower. Simulations will help to define the optimal geometry and material. Actuators enable the target to move in and out of the beam. Partners: IPASCR (CUPRAGUE), DESY, AGH-UST.

In order to identify the impinging particle on the target the beam particles need to be tracked with high resolution. The by then existing high-resolution pixel telescope of the EUDET project will be positioned upstream of the target to provide this information.

A model system based consisting of at least four layers will be build to serve as a benchmark and to allow the development of the fully integrated facility at an early stage of the project. For each layer a light weight mechanical structure will be designed. An effort will be made to limit the material to optimise the single point resolution. The pixel sensors and the data acquisition board will be interconnected by a light flexible cable. Partners: DESY, INFN-MI, CNRS (IPHC), CEA.

- **Sub-task 2: Intermediate tracker infrastructure**

The goal of this task is to provide a full system to test silicon strip sensors. Each component will be designed in a way that different sensor designs can be tested. Moreover, the readout electronics should be able to be either directly connected to special sensors equipped with an integrated routing layer, omitting any pitch adapter or by wire bonding.

Following designs under discussion for LC detectors, silicon strip sensors are placed between the vertex detector and the TPC as well as between TPC and the calorimeters. Module designs to be used in EUVIF thus include small area modules equipped with single sensors up to daisy-chained ladders containing up to six silicon sensors in a row. The support structure has to follow the different needs. It will be based on ultra-thin, lightweight structures constructed from e.g. carbon fibre, but also novel materials like aluminium foam will be investigated. Partners: OEAW, UNIKARL.

The front-end electronics will be based around a readout chip, which is under development within EUDET. When using conventional wire-bonding technique to connect the readout chip to the silicon sensor, a PCB holding the readout chip and auxiliary electronics will be developed. For tests of new connection techniques using bump bonding, the readout chip needs to be equipped with bump-bonding possibility. It will be necessary to integrate the chip into a readout chain suitable for the common DAQ system (see WP4). To this aim both, hardware and software have to be adapted. Partners: CNRS and CSIC.

- **Sub-task 3: Improvement of infrastructure for gaseous tracking detectors**

Within this task the EUDET TPC infrastructure will be upgraded and made available as part of the EUVIF facility. The TPC infrastructure will be integrated with the other detector components for tests of the particle flow concept allowing for optimization of the overall detector design. It will be interfaced to a common trigger, DAQ and slow control system. Software will be provided in order to allow users of the infrastructure to test various developments of readout modules.

The TPC field cage and the PCMAG magnet will be moved to CERN and installed in the test beam area. DESY will coordinate this activity. The technical support for the equipment and infrastructure like liquid He supply and installation of electronics is to be provided by CERN. An improved slow control system adequate for safe operation will be developed and integrated in the more complex EUVIF environment (CERN and DESY). The trigger and DAQ integration of the TPC facility together with the monitoring software will be provided by ULB, SWEDET (ULund) and UniBonn, exploiting synergies with the generic software developed in WP2. The pixel based diagnostic facility developed in EUDET will be upgraded and integrated. This necessary work consists of software development, FPGA programming and user support will be done by CEA, FOM, JOGU, ALU-FR.

Task 3: Calorimeter prototype infrastructures

The electromagnetic and hadronic calorimeters (ECAL and HCAL) play a central role for the validation of the particle flow approach in a test beam experiment. Both must have very fine segmentation and a compact structure, requirements which can be met with tungsten as absorber and thin silicon detectors as active layers for the ECAL, and steel structures for the HCAL, where both optical readout

of scintillators, using novel Geiger mode photo-sensors, so-called SiPMs, as well as gaseous techniques, glass resistive plate chambers (GRPCs) or micro-mesh gaseous structures (micromegas) are attractive candidates. Within the EUDET initiative test structures are being developed which tackle the mechanical and electronic challenges of very compact designs with embedded and power-cycled electronics. They will serve as test-beds for newly developed sensors.
For an experimental test of particle flow reconstruction, a detector volume must be instrumented which is large enough to measure the showers of particle “jets” generated on a beam target. This implies instrumentation of the ECAL with at least 10 m^2 of active silicon and readout of order of 10^5 electronic channels. The HCAL must here have an absorber structure made of non-magnetic material such as stainless steel, and it must be instrumented with fine granularity over the full jet volume, thus requiring about 50’000 photo-sensors, or alternatively about 40 m^2 of gaseous devices, equipped with the associated electronics channels. As this corresponds to an increase by an order of magnitude with respect to previous experience, we propose to establish the facilities for test and integration of components as an infrastructure network.
The forward region (near the beam pipe) represents particular challenges to calorimetric instrumentation, in terms of radiation tolerance, rate capability, compactness, alignment precision and notably also modelling in simulations. Particle rates are very different from other detector components entailing special requirements and the need for careful synchronisation of the data acquisition. The performance of forward calorimeters and their interplay with the other components, as well as their integration into the overall detector concept must therefore be part of the experimental tests. Facilities to develop and integrate a forward calorimeter into the EUVIF configuration are thus included in this task.

- **Sub-task 1: Infrastructure for electromagnetic calorimeters**

The activities will be grouped into three packages. Semi-automatic test stands will be established for the characterization and tests of silicon wafers. The establishment of the test facilities will be based on test structures and procedures developed and optimized in WP 10.4. The compact design requires ultra-thin printed circuit boards (PCB) with embedded, unpackaged ASICs. A special test set-up for the quality assurance of the bare chips will be required, and the assembled PCBs need to be tested electronically. After gluing the silicon pad wafers to them, so-called active sensor units (ASU) are obtained which must be tested with cosmic particles using a provisional DAQ. The compact structure represents several integration challenges which necessitate special tools and verification procedures, for example the gluing process, the interconnections of ASUs and the common services of the multi-layer system within tight spatial constraints. The following partners will contribute to this task: CNRS-(LLR), CNRS-(LAL), CNRS-(LPC), UNIMAN, IPASCR (NPIASCR) and UNIGE (ETHZ).

- **Sub-task 2: Infrastructure for hadron calorimeters**

The work will be organized in five packages as given below indicating the contributing partners:

1. Facility for the optimization of SiPM micro-structures and on-wafer sensor tests (MPG-MPP)
While SiPMs have a wide field of applications form astrophysics to medical diagnostics, their design parameters need to be adapted in each case. Optimization of the micro-structures requires investigating the response to small light intensities on microscopic level. A test stand with a high precision gas laser set-up will be installed, which allows to study sensor response to single photons in the relevant spectral region. Once the structures are optimized, large numbers of silicon wafers need to be processed. Due to inevitable spread in production parameters, the sensors need to be characterized before the wafers are cut and the sensors packaged. A probe station with semi-automatic measurement and scanning devices will be set up, and test procedures will be developed.

2. Facility for the characterization of packaged sensors and integrated sensor scintillator systems (UiB, UHEI)
The full characterization of sensor parameters, as required for further integration and ultimate calibration steps must be done with packaged devices. This requires test set-ups with stabilized light sources and simultaneous read-out of many sensors. Once integrated with scintillator cells, the performance must be quantified by means of radio-active sources. The test stands and procedures will be developed for use in the network.

3. Facility for the test and characterization of readout and calibration systems (CNRS-(LLR), INFN-ROMA1, IPASCR-(NIPASCR), Wuppertal)
Light calibration systems are indispensable for detectors with optical read-out. The integrated systems need to be optimized and their electronic and optical parameters characterized. A test environment for this purpose will be established. Detector-specific interfaces for the DAQ system common to the entire test beam infrastructure will also be produced and tested.

4. Facility for large area gaseous readout layer integration (CNRS-(IPNL), CNRS-(LAL), CNRS-(LAPP))
Separate test and integration infrastructure will be required for the novel gaseous readout devices and their electronics integration, where procedures adapted to the fine segmentation and consequently high channel count will be established.

5. Facilities for mechanical and system integration (CIEMAT, DESY, MPG-MPP)
The integration of active systems, electronics and mechanical structure requires the development of tools and testing procedures, and the mechanical construction for the integration of supplies and services. The mechanical structure will be built in a modular way, and a facility for subsequent integration and testing be installed.

- **Sub-task 3: Infrastructure for forward calorimetry**

A sector of a forward calorimeter prototype will be designed, constructed, tested and integrated into the common infrastructure for data acquisition, mechanics, survey and pixel tracking. The mechanical design and production of a flexible tungsten absorber structure will be done in collaboration of DESY and AGH-UST-(IFJPAN-UJ). The mechanical stability will be ensured by a frame, which will be instrumented with CCD sensors to monitor the position with high accuracy using laser beams. The laser positioning monitoring will be prepared by AGH-UST-(IFJPAN).
The fast FE ASICs designed within EUDET will be completed for multi-channel applications by AGH-UST. Digitization and power consumption will be optimised. The manufacturing of ASICS, serving for about 1000 readout channels, and the integration in the sensor planes for beam-tests will be shared between AGH-UST, DESY and TAU. The development of high throughput transmission lines for feeding the signals into the common DAQ will be done by TUD and DESY. UVT will contribute to the software for the test facilities and to the data transfer to the common DAQ.

Task 4: Infrastructures for qualification of silicon sensors

- **Sub-task 1: Qualification of silicon sensors using standardized tests structures and procedures**

During the mass production of silicon sensors for vertex detectors or tracking systems of future HEP experiments, an elaborate quality assurance program must be developed to ensure a high quality of the delivered sensors. Since the main sensors are produced on circular wafers, some cut-off space is available, where additional test structures (TS) are located. These structures allow the measurement of parameters that are not accessible on the main sensor or would require destructive measurements. The knowledge of these parameters helps monitoring the stability of the manufacturing process and compliance with the specifications. The TS are also perfectly suited for irradiation tests, avoiding the damage of the main sensors. They are optimized in a way that every single parameter is measured on a dedicated structure. To get a complete picture of the overall quality and to determine all interesting parameters, a set of test structures is necessary. The main goal of the project is the possibility to offer interested groups the design of test structures to be included on their wafers. The design of tools to qualify the TS, e.g. characterization setups will also be provided to these groups.

Test structures will be designed using state of the art EDA (Electronic Design Automation) tools normally employed for semiconductor chip design. The design will be evaluated in a test setup and optimized in terms of robustness of the measurements. OEAW together with ASCR will perform this work. The semi-automated test setup including mechanical support and suitable electrical contacts as well as the control software will be developed by OEAW and UNIKARL. The work will be complemented by the design of a relational database to store measurements in way suitable to be applied for future mass production.

Sub-task 2: Infrastructure for the evaluation of the radiation harness of silicon sensors
To ensure the proper performance of silicon sensors for the lifetime of an experiment in the harsh radiation environment of a high luminosity collider, the change of performance parameters like dark current, resistivity, carrier lifetimes and the defect characteristics as function of irradiation dose has to be known. They depend on the technology used for the sensor fabrication and can be well assessed using the standardized test structures described above. Based on existing equipment and expertise, a multi-channel Transient Current Technique (TCT) set-up will be developed, which has a particular sensitivity to the determination of the change of the electric field in silicon sensors and the life time of electrons and holes as function of radiation dose.

The TCT design will be based on extensive test measurements and simulations of charge transport. Combined with measurements from set-ups already running in the collaboration, the multi-channel TCT results will allow a reliable long-term prediction of the sensor performance. The work of this sub-task will be performed by UNI-Hamburg.

Deliverables of tasks	Description	Nature[1]	Delivery month[2]
10.1.1	Report on test beam area preparation	R	M36
10.2.1	Vertex global mechanical frame	P	M30
10.2.2	Silicon tracker multi-layer support structure with lightweight material	P	M30
10.2.3	TPC local DAQ and trigger hard- and software	P	M30
10.2.4	Vertex model sensor system in global frame	P	M35
10.2.5	TPC and magnet installed at CERN	P	M36
10.2.6	Full TPC infrastructure available	P	M36
10.2.7	Integration of readout electronics into central DAQ	P	M42
10.3.1	ECAL and HCAL characterization of components	R	M36
10.3.2	FCAL readout electronics incl. data transfer lines	D	M36
10.3.3	System integration of ECAL and HCAL	R	M45
10.3.4	FCAL system integration	D	M44
10.4.1	Prototype of multi channel TCT setup	P	M32
10.4.2	Test setup for electrical characterization	D	M38
10.4.3	Result Database	O	M42

Milestone	Task	Description	Expected date	Means of verification
10.1	10.1	Final concept of the test beam area and gas infrastructure	M24	Design report
10.2	10.2.1	Vertex design global mechanical frame	M24	Design report
10.3	10.2.1	Vertex model sensors ready	M30	
10.4	10.2.2	Silicon tracker module design with lightweight material	M25	Design report
10.5	10.2.2	Design front-end electronics	M30	Design report
10.6	10.3.1	ECAL Test facilities available	M24	
10.7	10.3.3	Tungsten absorber structure available	M24	
10.8	10.4.1	Mask design for test structures available	M32	Design report
10.9	10.4.2	Design of the multi channel TCT setup	M18	Design report

WP11 – Detector prototype testing in testbeams

This work-package describes the test-beam infrastructures that need to develop for R&D and prototyping of the key detector technologies planned to be used in SLHC experiments, Neutrino experiments and for Super B detector construction in Europe. The typical detector elements that will be developed and tested are silicon detector system or new gas detector system for tracking and muon systems, and also calorimeter systems. The measurements in these facilities cover efficiencies, noise, time, position and energy resolutions – basically all the critical performance parameters for new detector systems. The measurements are carried out with beam conditions as close as possible to those the detectors will see in their final implementation.

The beamlines at CERN have been used 1998-2006 to test detector parts for LHC. These beamlines therefore have a significant part of the basic infrastructures needed to provide beams also for SLHC prototypes, but major infrastructural improvements and adaptations are needed to support, install and operate these detectors in the beamline and perform the measurements needed. An additional concern is access to low energy beams for neutrino detector testing, where additional infrastructure development is needed, both to provide such a beam and for particle identification in this low energy beam. Testing equipment for novel gas detectors (Micro Pattern Gas Detector (MPGD) systems), with applications at SLHC, for Neutrino detectors, or for Linear Collider detector systems, is also foreseen. The SuperB detector development will use mainly the Frascati National Laboratory (INFN-LNF) testbeam, where similar new developments are needed, including beam monitoring and beam energy calibrations systems for low energy beams. The basic infrastructures in the DESY beamline are sufficient and no changes are planned as part of this work-package.

It is considered that the operation of the beamlines and the particle beams themselves, are largely covered by the missions of these laboratories (CERN, DESY, INFN-LNF). The infrastructures discussed here are therefore the additional equipment needed to improve these beamlines to the required standards for future experiments, and to install, operate and make efficient and meaningful measurements of R&D and prototype detector elements in these beamlines. This includes preparatory work and measurements carried out on the samples in connected laboratories. In many cases such tests are carried out using detectors irradiated (see WPs 8-9) to the doses expected in their future user environment to increase the realism of the tests.

With these infrastructures in place most of the detector R&D foreseen for the major projects mentioned above over the coming 4 years can be evaluated and tested in common high quality beamline infrastructures. Some of the supporting infrastructure equipment is moveable such that they can be moved from one beamline to another as needed.

The testbeam infra-structures developments are divided into three subgroups:

1. Basic infrastructures as beamline equipment changes, magnets for testing in magnetic fields, cryogenics equipment, particle identification systems (task 1),
2. Specific support equipment for detector operation as data acquisition systems and readout, reference telescopes and mechanical support of devices under tests, control and monitoring systems, trigger chambers and timing equipment that allow the timing between asynchronous beam-particles and reference clocks (task 2),
3. And finally more general support facilities that allow also pre and post measurements in surrounding lab areas to take place, the primary example are equipment for cooling and thermal performance evaluation (task 3).

Work package number	WP11		**Start date or starting event:**			M1	
Work Package title	Detector prototype testing in testbeams						
Activity type	RTD						
Participant number	1	5	6	7	8	9	10	14
Participant short name	CERN	INRNE	IPASCR	UH	CNRS	CEA	RWTH-Aachen	UniBonn

Person-months per participant	66	30	28	16	40	14	24	15
Participant number	16	17	23	24	27	29	31	34
Participant short name	ALU-FR	Goettingen	NTUA	KFKI-RMKI	INFN	FOM	AGH-UST	CSIC
Person-months per participant	12	12	20	18	91	15	26	28
Participant number	38	44						
Participant short name	UNIGE	UNIGLA						
Person-months per participant	60	24						

Objectives:
Task1: Improvements of beamlines.
- Adapt beamlines for SLHC, Neutrino and Super B detector testing – with layout, beam-energies and intensities optimized to cover the requirements from these large users.
- Improve access to and particle identification for low energy beam at the CERN SPS and install basic neutrino detector testing infrastructures in such a beamline.
- Build and install beam monitor and beam calibration system at the LNF testbeam, and setup of a Tagged Photon Beam.

Task 2: Detector test infrastructures in beamlines
- Development of DAQ and readout systems for detector testing.
- Development of reference telescope systems and mechanical support tables for detector testing, allowing to position, scan and rotate the DUTs (Devices Under Test).
- Develop detector control systems and monitoring in beamlines.
- Improve triggering and timing systems in beamlines.

Task 3: Test equipment for thermal characterization
- Build cooling systems and equipment for thermal characterization of detector modules, to be used in lab and during testbeam operation.

Description of work:
Task 1. Improvements of beamlines.
Subtask 1: Beam line setups at CERN. The following new/improved infrastructures are needed in these beamlines:
- Optimization and improvement of the beamline layout and equipment to support parallel use for SLHC detector tests, neutrino detector testing and for gas detector testing.
- Implement low energy beamline for neutrino detector testing in particular, including particle identification for this beamline.
- Install cryogenics for LAr based detectors, magnet and muon detectors, and tank for water Cherenkov tests for long baseline neutrino detector testing. The muon detector implementation foreseen is with Micromegas systems and the readout support in general for such systems is planned under task 2.

The leading groups: CERN, UNIGE (DPNC), CRNS, CEA, NTUA, NRCPS, KFKI-RMKI.

Subtask 2: Improvement of testbeam setup at LNF.
- Install beam monitor and profiler to continuously monitor the beam quality, position and width. The implementation can be done with GEM chambers.
- Improve the beam energy calibration to improve the energy resolution and correct for non-linearity and hysteresis of the momentum selection magnets. This requires a small precise

calorimeter and field probes in these magnets.
- Develop a reliable tagged photon beam with low background at low energies.

The leading groups are from INFN.

Task 2. Detector test infrastructures in beamlines.

To read out and control the detector elements being developed during testbeam operation a significant amount of surrounding support equipment is needed. This equipment is generally build up and maintained in a specific beamline, suitable for the bulk of the tests for a specific component, but the equipment can in most cases be moved to other beamlines if special tests are needed - for example with a different beam (different energy range, intensity or timing structure).
Specific support equipment for operation of the detectors in the beamlines are data acquisition systems (DAQ) and detector readout systems, reference telescopes and mechanical support tables, detector control systems (DCS) and computers for detector monitoring and offline checks. Additionally, cooling systems are needed as discussed in task 3. These tasks include commissioning and initial operation of the infrastructures, and the tasks are strongly correlated to provide overall infrastructural support to the beamlines.

Subtask 1: Develop DAQ and readout for stand-alone tests: We will develop DAQ systems for the SLHC systems compatible with the SLHC readout parameters and the new front end electronics in the SLHC detector systems, including monitoring functions. This includes readout of beam telescopes such that full rate tests are possible in some cases. DAQ and specific readout systems will also be developed for neutrino detector testing, for 3D electronics/sensors (in conjecture with the work done in WP3.3) and general MSGD systems, and for the LNF testbeam lines. The lead groups are: CERN, IPASCR (CU Prague), INFN, AGH-UST (INPPAS), INRNE (UniSofia), UNIGE (DPNC), CSIC (IFIC, IFCA), UNIGLA, ALU-FR, UniBonn, Goettingen, CNRS, CEA, NTUA.

Subtask 2: Beam telescopes for the beamtests. Improve beam telescopes to be used for SLHC testing and make compatible with high rate readout, and build a low material straw tube telescope for the LNF facility. Mechanical support tables for the Detectors Under Tests (DUT), allowing to position, scan and rote the DUTs. The lead groups will be FOM, UniBonn, ALU-FR, INFN and UH.

Subtask 3: Detector Control Systems (DCS). The DCS systems are crucial to set up voltages and detector parameters, for monitoring of key parameters and for safe operation of the detectors being tested. Monitoring hardware and software need to be developed for operation of the detectors. These systems must be compatible with the final protocols and environment of the detectors. The lead groups are CERN, UNIGE (DPNC), IPASCR (CU Prague, CTU), INFN, CRNS, CEA, NTUA.

Subtask 4: Trigger and timing modules for the beamlines. This equipment is needed to allow timing between asynchronous beam-particles and the readout system clocks to better than a nanosecond and to trigger on particles in the beam for readout. TOF measurements will be needed for particle identification in the low energy beamlines. The lead groups are KFKI-RMKI, CERN and INFN.

Task 3. Test equipment for thermal characterisation.

The thermal performance of detectors is one of the most critical parameters in modern detector system. With increased granularity, stringent speed requirements, high packaging density, and irradiation damage, advanced low mass cooling systems are critical for the detector system, and thermal performance is among the most crucial parameters that need to be tested and verified for new detector solutions. This task covers the cooling infrastructures needed to test detector systems in the lab and to carry out detailed measurements there, and also in the testbeams where the system need to be cooled during operation and the effect of different temperatures studied. Such measurements are particularly important for the detectors that have been irradiated to their final doses (see WP8 and 9) before being put into the testbeam. These devices cannot be operated, and in some cases even stored, without sophisticated cooling and control systems.
The goal of the work in this task is therefore to develop cooling plants and test (beam) box(es) which can be operated at low temperatures of -40C or even lower, for detailed testing of SLHC inner detector systems. It is also foreseen to develop a thermo-hydraulic testbench for the thermal and fluid

dynamical characterization of tracker modules and subsystems for SuperB. Lead group are RWTH Aachen, CERN, FOM, CTU and INFN.

Deliverables of tasks	Description	Nature[1]	Delivery month[2]
11.1.1	Layout and implementation of improved beamlines for SLHC, Neutrino detector testing at the CERN-SPS, including low energy capabilities	O	M26
11.1.2	Improved beamline for SuperB detector testing at LNF including monitoring, calibration and tagged photon beam	O	M30
11.1.3	Basic infrastructure for neutrino detector testing (toroid, cryogenics, water cherenkov tank)	O	M30
11.2.1	Development of DAQ and readout systems for the detector testing in these beamlines	R	M26
11.2.2	Development of DCS and monitoring systems	R	M36
11.2.3	Development of reference telescope systems	R	M30
11.2.4	Development of triggering and timing systems in beamlines	R	M30
11.3.1	Thermal testbenches and environmental chambers for detector testing	O	M26
11.3.2	Cooling system(s) development	O	M42

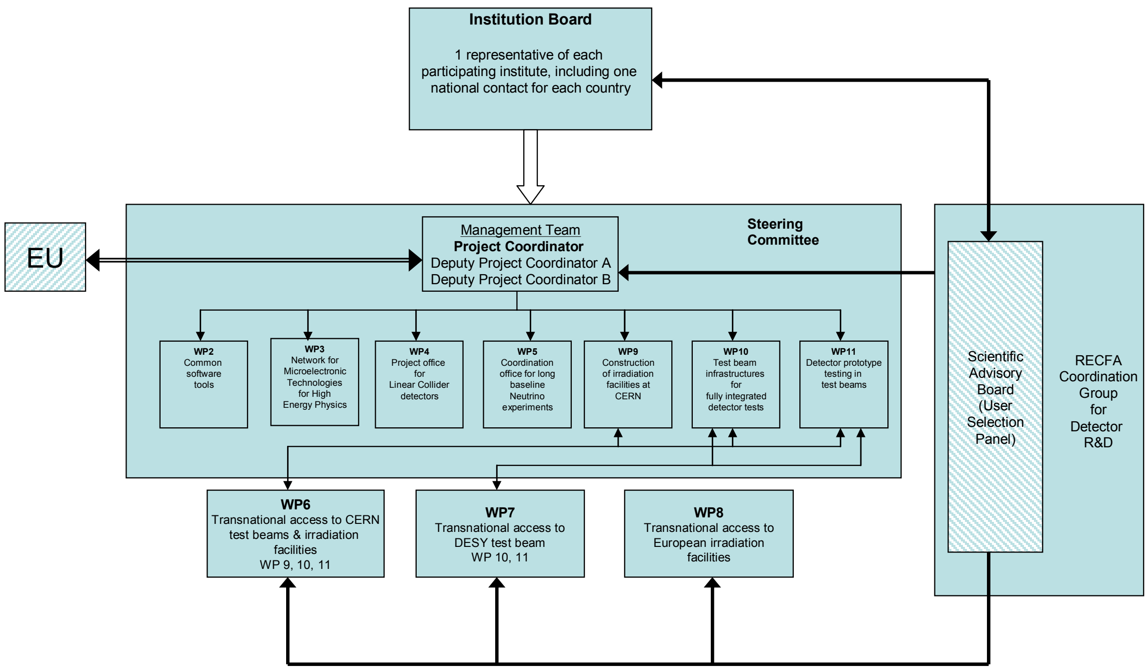
Mileston e	Task	Description	Expected date	Means of verification
11.1	11.1	Layout proposal for CERN SPS beamlines	M15	Design report
11.2	11.1	Specifications for LNF-Frascati beam changes	M12	Specification report
11.3	11.1	Detailed plan for neutrino testing infrastructure	M15	Design report
11.4	11.2	Detailed implementation plan for DAQ, DCS and readout in the CERN SPS and LNB testbeam	M12	Implementation plan
11.5	11.2	Design specifications for telescope and mechanical supports	M15	Specification report
11.6	11.2	Detailed specification for timing and triggering system in beamlines	M15	Specification report
11.7	11.7	Specifications for cooling and thermal testbenches at CERN and INFN-Pisa	M12	Specification report

Table 1.3e Summary of staff effort

Participant number	Short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	Total
1	CERN	60	92	78	42	0	2	0	0	62	38	66	**440**
2	OEAW	0	0	0	0	0	0	0	0	0	64	0	**64**
3	UCL	0	0	0	0	0	0	0	4	0	0	0	**4**
4	ULB	0	0	0	24	0	0	0	0	0	10	0	**34**
5	INRNE	0	0	0	0	0	0	0	0	6	0	30	**36**
6	IPASCR	0	0	0	0	0	0	0	1	0	97	28	**126**
7	UH	0	0	0	0	0	0	0	0	0	0	16	**16**
8	CNRS	0	54	68	6	19	0	0	0	0	244	40	**431**
9	CEA	0	0	8	0	0	0	0	0	0	41	14	**63**
10	RWTH_Aachen	0	0	0	0	5	0	0	0	0	0	24	**29**
11	DESY	0	54	0	87	0	0	2	0	0	64	0	**207**
12	MPG_MPP	0	0	22	0	0	0	0	0	0	23	0	**45**
13	UNIKARL	0	0	0	0	0	0	0	1	10	64	0	**75**
14	Uni_Bonn	12	0	40	0	0	0	0	0	0	19	15	**86**
15	TUD	0	0	0	0	0	0	0	0	0	24	0	**24**
16	ALU_FR	0	0	0	0	0	0	0	0	0	19	12	**31**
17	Goettingen	0	0	0	0	0	0	0	0	0	12	12	**24**
18	UNI_Hamburg	0	0	0	0	0	0	0	0	0	18	0	**18**
19	UHEI	0	0	0	0	0	0	0	0	0	16	0	**16**
20	JOGU	0	0	0	0	0	0	0	0	0	19	0	**19**
21	UNSIEG	0	0	0	0	0	0	0	0	0	12	0	**12**
22	Wuppertal	0	0	0	0	0	0	0	0	0	18	0	**18**
23	NTUA	0	0	0	0	0	0	0	0	0	0	20	**20**
24	KFKI_RMKI	0	0	0	0	0	0	0	0	0	0	18	**18**
25	Weizmann	0	0	0	0	0	0	0	0	24	0	0	**24**
26	TAU	0	0	0	0	0	0	0	0	0	24	0	**24**
27	INFN	0	66	60	12	0	0	0	0	0	63	91	**292**
28	VU	0	0	0	0	0	0	0	0	8	0	0	**8**
29	FOM	24	0	24	0	0	0	0	0	0	19	15	**82**
30	UiB	0	0	0	0	0	0	0	0	0	18	0	**18**
31	AGH_UST	0	0	24	0	0	0	0	0	0	89	26	**139**
32	UVT	0	0	0	0	0	0	0	0	0	24	0	**24**
33	JSI	0	0	0	0	0	0	0	1	0	0	0	**1**
34	CSIC	0	23	60	0	14	0	0	0	0	43	28	**168**
35	CIEMAT	0	0	0	0	0	0	0	0	0	23	0	**23**
36	USC	0	12	0	0	0	0	0	0	0	0	0	**12**
37	SWEDET	0	0	8	0	0	0	0	1	0	24	0	**33**
38	UNIGE	0	0	12	131	20	0	0	1	0	45	60	**269**
39	STFC	0	0	19	0	0	0	0	0	18	0	0	**37**
40	UNIVBRIS	0	12	0	0	0	0	0	0	0	0	0	**12**
41	UBRUN	0	12	0	0	0	0	0	1	0	0	0	**13**
42	UCAM	0	24	0	12	0	0	0	0	0	0	0	**36**
43	UEDIN	0	10	0	0	0	0	0	0	0	0	0	**10**
44	UNIGLA	12	10	7	0	10	0	0	0	18	0	24	**81**
45	UNILIV	0	0	7	0	0	0	0	0	18	0	0	**25**
46	UNIMAN	0	0	0	12	0	0	0	0	0	24	0	**36**
47	UOXF	0	12	0	0	0	0	0	0	0	0	0	**12**
48	QMUL	0	4	0	0	0	0	0	0	0	0	0	**4**
49	RHUL	0	0	0	12	0	0	0	0	0	0	0	**12**
50	USFD	0	0	0	0	0	0	0	0	12	0	0	**12**
	TOTAL	**108**	**385**	**437**	**338**	**68**	**2**	**2**	**10**	**176**	**1198**	**539**	**3263**

2. Implementation

2.1 Management structure and procedures



DevDet Project Management Structure

Figure 2.1: DevDet Project Management Structure

Figure 2.1 shows a schematic layout of the DevDet organisational structure. The project will be centrally managed by a management team, composed of the project coordinator and two deputy project coordinators. The management team covers a good representation of the physics communities involved in the DevDet IA project. The management team will be assisted and guided by three bodies: the Institution Board (IB), the Scientific Advisory Board (SAB) and the Steering Committee (SC).

- **The Institution Board (IB)**

The DevDet collaboration is composed of 50 legal participants. Some of the legal participants are consortia, comprising several institutes, as described in section 2.2. Therefore, in total 87 Institutes are engaged in the project. The Institution board is the top decision-making and arbitration body. It has one representative from each Institute in the project and includes the members of the management team. Each member has one vote and decisions will be taken following rules laid down in the Consortium Agreement. The IB has the authority to decide upon Steering Committee proposals, on strategic issues, such as modifications of the project programme (if necessary) and admission of new participants. The IB will review the progress of the project at the annual DevDet meetings, and, where necessary, will decide on changes in the work plan and budget allocation for the next reporting period. It settles disputes in case of failure by one of the partners to meet its project assignments. Outside the annual meetings, the IB may call for intermediate (phone) meetings. The chairperson of the IB will be elected by its voting members.

- **Steering Committee (SC)**

The SC is composed of: the Project Coordinator, the two Deputy Project Coordinators, the Work Package Leaders of the networking activities (WP2, WP3, WP4, WP5), one work package leader representing the trans-national access activities (normally the WP leader of WP8) and the work package leaders of the RTD activities (WP9, WP10, WP11). The SC oversees and reviews the work progress across the DevDet project, consolidates the reports received from the work package leaders and decides in a collegial manner on overall technical and administrative matters. The SC will have regular meetings at least six times a year. The SC brings strategic issues forward to the IB.

- **The Scientific Advisory Board (SAB)**

The Scientific Advisory Board is an external advisory body, nominated by the RECFA coordination group for detector R&D. The SAB will advice the management on a regular basis on scientific and strategic matters. In addition, the SAB will report to the Institution Board on the occasion of the annual DevDet meeting. In its report to the IB the SAB independently assesses the progress of the various DevDet tasks and their scientific excellence. It will put the progress and scope of the project in the light of the evolution of strategic matters in particle physics. The report from the SAB will serve as input to the IB for taking strategic decisions, where needed. The SAB will also play a central role as the User Selection Panel to grant trans-national access to test beam and irradiation facilities. It will provide advice on priorities for WP6, WP7 and WP8. The SAB will also play a strategic role in setting priorities or transnational access and directing users to the most suitable facility. Together with the work package leader of WP8, it will study (at an annual or bi-annual basis, where applicable) the global requests for transnational access from the various communities. In view of these requests, it will then set guidelines for access allocations and provides guidance on the choice of the facility to address. Where needed, the SAB will seek advice from external experts for this task (e.g. reactor physics expert). The SAB transmits its recommendations to the contact persons from each of the facilities, such that the final beam time allocations can be made in compliance with the internal selection procedures for each facility. The SAB will elect a chair from its members. The Chair of the SAB may participate as an observer and advisor in the meetings of the SC.

- **Project Coordinator (PC)**

The PC will be the main executive leader of the project, responsible for the scientific and administrative management of the DevDet project. The PC is also in charge of all communication with the European Commission. The task of the PC includes the overall supervision and regular follow-up of the progress in all Work Packages, in collaboration with the SC members. The PC will chair and organize the Steering Committee meetings, and will be in charge of the preparation of the Periodic Reports and the Final Report. The PC is ex-officio work package leader of the DevDet management work package (WP1).

- **Deputy Project Coordinators (DPC)**

The two Deputy Project Coordinators will assist the Project Coordinator in the daily execution of the PC mandate. To this end, the PC will officially delegate specific tasks (e.g. overlooking part of the scientific program, financial follow-up and financial reporting, follow-up of reporting on deliverables and milestones, organisation of the Annual Review and Final Review meetings, editing of the annual reports, follow-up of legal issues such as the consortium agreement and intellectual property rights, dissemination of information, follow-up of gender equality) to each of the DPC's. The DPC's will replace the PC in case of absence.

- **Management Team**

The Project Coordinator and Deputy Project Coordinators form a collegial Management Team. Together they have extensive experience and knowledge of the scientific issues at stake and of the physics programs of the DevDet User communities. The PC and DPC's are all senior staff members of different institutes from within the collaboration. They carry out CERN's mandate as the coordinating laboratory of the FP7-IA project. To this end, they will profit from professional administrative assistance located at CERN and financed through the project funds. The PC and DPC's will devote a significant fraction of their time to the project. In order to be able to work effectively, the PC will be detached to CERN. The DPC's will also be present at CERN on a regular basis. The corresponding subsistence and travel costs will be covered by DevDet project funds.

- **Work package Leaders**

The WP Leaders will manage the coordination, support and technical activities in the framework of their own WP. They have the responsibility for ensuring the effective cooperation between the beneficiaries in each WP, for monitoring the progress of the tasks, and for producing the milestone and deliverable reports within their own work packages. They prepare all other reports on their WP's, as requested by the Management Team. They make the results of the work available to the collaboration and are in charge of providing the relevant public dissemination material to Task 2 of WP1.

- **The plenary Annual Meeting of the collaboration**

The Annual Meeting assumes a vital role for the collaboration. It serves the following purpose:

- To disseminate the scientific activities to the members of the collaboration and collect their critical scientific reactions
- To critically review the overall scientific progress of the collaboration
- To inform the members of the IB.
- To inform the members of the SAB and receive their input.
- To address any outstanding organizational issues for the consortium

The Annual Meeting consists of comprehensive presentations of the achievements of the individual activities and tasks. It includes a meeting of the Institution Board. The Annual Meeting will be hosted by one of the partners, and organised towards the end of each 12-month period of the project. In addition, the SC will organize a kick-off meeting of the consortium at the earliest convenience to launch the intensified collaboration and plan the work of the first year.

At the beginning of the project the participating institutes will formally conclude a Consortium Agreement that sets forth the terms and conditions pursuant to which the participants agree to function and cooperate in the performance of their respective tasks in the project.

In addition to the work descriptions, deliverables and milestones set out on this proposal and in the future description of work (Annex I to the Grant Agreement), the management team, with the help of the steering committee, will set up a detailed Project Management Plan. The Project Management Plan will be implemented using modern project management tools. It will contain more refined details on technical objectives and their required resources, to allow for an effective tracking of the project. Project Management Plan may be adopted by the Steering Committee from time to time. Significant changes to the Project Management Plan require the approval of the IB.

Throughout the history of particle physics, ever-larger projects have been coordinated and completed successfully at CERN and at other major European facilities. Huge particle physics experiments have been constructed and fundamental contributions have been made to the development of the technologies involved (e.g. particle detection, data acquisition, simulation and analysis techniques). The most prominent example being the recent LHC experiments constructed through collaborative efforts of up to 160 participating institutes and over 2000 scientific staff. The organisational structures of these successful projects have served as a basis for the DevDet management structure proposed here. With the common scientific aim as a main driving factor, complemented by a well-defined management structure, a democratic overall decision body and professional administrative support, the DevDet collaboration will undoubtedly bring its project to successful completion.

2.2 Individual participants

The participants in DevDet are listed in the following tables in order of participating country.

Coordinator**: CERN, Switzerland**		
Short name of participant:	CERN	European Organization for Nuclear Research

Description of participant:
CERN is the world's largest particle physics centre and operates the world's largest complex of particle accelerators. The 50-year history of CERN is marked with impressive achievements in the construction and operation of powerful linear and circular accelerators. CERN is currently installing and will soon be commissioning the Large Hadron Collider (LHC), scheduled to switch on in 2008. With proton-proton collisions at 14 TeV, the LHC will be the most powerful accelerator in the world, awaited so eagerly by the particle physics communities on all continents.

Throughout its history CERN has coordinated ever-larger particle physics experiments and has made fundamental contributions to the development of the technologies involved (particle detection, data acquisition, simulation, analysis techniques). Moreover, CERN offers unique infrastructures for the development of particle detectors. Seven general purpose test-beam lines provide beams of electrons, muons and hadrons in a very wide energy range. Testing of detector components under high irradiation doses can also be done at the CERN irradiation facilities, which provide high fluences of protons, neutrons or photons. The improvements of the beam lines and irradiation facilities foreseen within DevDet (WP9, WP10, WP11) will still increase the possibilities and flexibility offered at CERN for detector development.

CERN will actively participate in most of the Work Packages and will be the coordinating laboratory of the DevDet project. CERN has a solid experience in the EU Framework Programmes.

Tasks in DevDet
WP1, WP2, WP3, WP4, WP6, WP9, WP10, WP11 (involved in most of the tasks)

Short CV for the key persons:

- **Pere Mato:** Ph.D, leader of the Software Development for Experiments group in the CERN Physics department, and manager of the Applications Area of the LHC Computing Grid (LCG) project coordinating several common software projects. Previously, leader of the development of the core software and framework for the LHCb experiment, and responsible for the ALEPH TPC detector. Member of the LHC Committee. PhD in physics (1990) by the University of Barcelona. (WP2).
- **Alessandro Marchioro**: is an applied physicist who has been working at CERN for more than 25 years mostly in the construction of electronics and instrumentation systems for particle physics experiments. Since 1990 he has worked in the design of several digital and mixed signal circuits for the experiments. Currently he is responsible for the Microelectronics technologies unit at CERN. This unit will play a central role in the "Network for Microelectronic Technologies" activity of WP3.
- **Emanuelle Perez:** Research Physicist, Ph.D. in High Energy Physics; working for the CMS experiment (High Level Trigger); former Physics Coordinator of the H1 experiment at DESY; Physics Coordinator of the PS/SPS CERN facilities; coordinator of the WP6 Work Package.
- **Ilias Efthymiopoulos**: Physicist, Ph.D. Beam Line Physicist in the Accelerators & Beams Department of CERN. Wide experience in the design, construction and operation of particle beams and experimental areas. Section leader, team of 14 staff, responsible for the exploitation of the CERN secondary beam and experimental area facilities including the CERN Neutrino Beam to Grand Sasso, irradiation facilities, test beam areas and fixed target physics experiments. Previous experience includes R&D work in

detector computing and physics analysis in the ATLAS and ALEPH experiments. (WP6, WP9, WP10, WP11),

- **Mar Capeans:** staff physicist, Ph.D, 16 years of experience in the field of particle physics, and in particular in research, development and construction of large particle detectors systems for accelerators at CERN and DESY. Specialised knowledge in effects of radiation on materials and detector components. Has also been involved in formulating and planning FP7 EU projects for CERN. Coordinator of the WP9 Work Package.
- **Beniamino Di Girolamo:** Ph.D. in Nuclear and Subnuclear Physics. Detector physicist expert in tracking and vertex detectors (RD17 at CERN, CDF Run-II IFT at Fermilab, BaBar SVT at SLAC, ATLAS Pixels at CERN), in calorimetry (ATLAS Tilecal) and data acquisition (ATLAS TDAQ). Since 2001 ATLAS Test Beam coordinator (WP11).
- **Lucie Linssen**, PhD, has 25 years of experience in building and operating detectors for particle physics experiments. She has been responsible for the technical coordination of medium-sized experiments and was recently deputy leader of CERN's Physics department, in charge of detector and electronics activities. Presently in charge of CERN's R&D for future experiments, she coordinates the CERN activities within DevDet.
- **Prof. Steinar Stapnes** is currently Deputy Spokesperson for the ATLAS experiment at LHC. He is in particular strongly involved in the upgrade plans for ATLAS and in the SLHC experiment upgrade planning in general. He has earlier been leader of the Inner Detector in ATLAS and has a broad knowledge of the detector development issues for SLHC. He has been testbeam coordinator for the ATLAS Inner Detector and has therefore many years experience specifically relevant for testbeam systems. He is a member of the RECFA committee, and co-leader of the RECFA coordination group for detector R&D in FP7.

Country: **Austria**

Short name of participant:	OEAW	Oesterreichische Akademie der Wissenschaften/ Austrian Academy of Sciences

Description of participant:
Austria participates with one institution in the DevDet Proposal:

- The **Oesterreichische Akademie der Wissenschaften/ Austrian Academy of Sciences** is the leading organisation promoting non-university academic research institutions in Austria. More than 1100 employees carry out extensive research projects. At one institution, the **Institute for High Energy Physics (HEPHY)**, which is currently involved in the experiments BELLE and CMS, detector R&D towards the proposed International Linear Collider is performed while it participates in the upgrade projects of the existing BELLE and CMS experiments as well.

Tasks in DevDet

- WP10.2.2 and WP 10.4a

Short CV for the key persons:

- **Manfred Krammer**: managing director of the Institute for High Energy Physics, Assistant Professor at the Vienna University of Technology, RECFA representative for Austria; semiconductor tracking detectors; involvement in DELPHI and CMS.
- **Thomas Bergauer**: junior scientist; head of semiconductor research group; design and tests of silicon micro strip detectors, readout electronics; involvement in CMS and SiLC.

Country: **Belgium**

Short name of participant:	UCL	Université Catholique de Louvain
	ULB	Université Libre de Bruxelles

Description of participant:
Belgium will participate with 2 organisations in DevDet.

- Université Libre de Bruxelles: The Interuniversity Institute for High Energies (IIHE), counting 50 physicists, is involved in CMS, H1, Amanda/ICECUBE and OPERA experiments and, in collaboration with UCL, is one of the Tier-2 for the GRID. The IIHE has expertise in data acquisition and Trigger systems of large high energy physics experiments as well as in micro-pattern gaseous detectors and silicon detectors.
- Université catholique de Louvain: Founded in 1425. CP3 (Centre of Particle Physics and Phenomenology) is involved in CMS, ZEUS and FP-420 experiments and on GRID (Tier-2 in collaboration with IIHE-Bruxelles). UCL operates a set of cyclotrons with rich program in fundamental physics and in radiation testing of both electronics and materials for future experiments in High Energy Physics.

Tasks in DevDet

- Université Libre de Bruxelles: WP4, WP10.2
- Université catholique de Louvain: WP8

Short CV for the key persons:

- **G. De Lentdecker**: Research Associate of the FNRS at ULB, has contributed to the conception and the building of the CMS tracker as well as to the development of the CDF RunII Trigger system. He is now contributing to the development of the data acquisition system of a large Time Projection Chamber (TPC) prototype for a future linear collider.
- **E. Cortina Gil**: Professor at UCL; design and testing of tracker and RICH for AMS experiment; detectors for LHC upgrade and future linear collider; development and test of radiation tolerant semiconductor detectors.

Country: **Bulgaria**

Short name of participant:	INRNE	Institut for Nuclear Research and Nuclear Energy, Sofia,
	UniSofia	St. Kliment Ohridski University of Sofia, Sofia

Description of participant:

- **INRNE** is the leading Bulgarian Institute for fundamental and applied research in the field of elementary particles and nuclear physics, high energy physics and nuclear energy, radiochemistry, radioactive wastes treatment, monitoring of the environment and nuclear instruments development. The Institute's staff of about 350 (150 of them are scientific researchers) work in more than 30 research groups.
- **St. Kliment Ohridski University of Sofia** is the biggest and the oldest university in Bulgaria. There are 15 faculties in the university spanning all fields of natural and social sciences – from Mathematics to Theology. Among them the **Faculty of Physics** is one of the biggest by staff (more than 120 faculty members) and most involved in fundamental and applied research. A group of physicists from the faculty participate for a long time in the European experiments in Neutrino Physics (CHORUS, HARP, OPERA, MICE) and have accumulated broad experience in detector development, simulation and data analysis.

Tasks in DevDet

- INRNE: WP9
- UniSofia: WP2 and WP5

Short CV for the key persons:

- **Assoc. Prof. Plamen Laydjiev** (INRNE)**:** is working at CMS and Neutron CryoEDM collaborations in High Energy Physics group at INRNE. In the group are working 14 physicists and 3 \engineers - mostly at CMS. They have an experience in ECAL, HCAL, MUON-RPC parts of CMS and have an interest in WP10 as well.
- **Prof. Ivan Vankov** (INRNE): is a leader of the Electronic engineering group. They have 4 engineers and 4 technicians working for CMS – ECAL, HCAL.
- **Roumen Tsenov** (UniSofia)**:** Associated Professor in Particle Physics, leader of the Neutrino Physics group; experience in detector development and design, simulation of complex detector systems, data processing and physics analysis. Team leader of the university groups in CHORUS, HARP, MICE.

Country: **Czech Republic**

Short name of participant:	IPASCR	Institute of Physics, Academy of Sciences of the Czech Republic
	NPIASCR	Nuclear Physics Institute, Academy of Sciences of the Czech Republic
	CTU	Czech Technical University in Prague
	CU Prague	Charles University in Prague

Description of participant:
The Czech Republic consortium comprises all CZ institutions participating in the DevDet Proposal:

- **Institute of Physics AS CR:** Is the biggest institute (http://www.fzu.cz/) of the Academy of Sciences (http://www.cas.cz/en/) of the Czech Republic. The Division of Elementary Particle Physics (http://www-hep.fzu.cz/) is participating in a number of international experiments as: D0, H1, ATLAS, Auger, participates in Computing Grid for LHC and carries out R&D for development of detectors for future experiments, including those at sLHC and Linear Collider.
- **Nuclear Physics Institute AS CR:** http://www.ujf.cas.cz/. Main involvement is nuclear physics research, participating in: RHIC, GANIL, GSI Darmstadt, KATRIN etc. Institute research programme exploits also in-house facilities: research reactor LVR-15 (http://www.nri.cz/eng/rsd_services.html), Cyclotron U-120M (http://mx.ujf.cas.cz/~ou-www/Cyclotron.html) and Microtron MT25. These irradiation facilities have been already used for radiation hardening studies for LHC.
- **Czech Technical University in Prague:** Faculty of Mechanical Engineering (http://www3.fs.cvut.cz/web/?L=1) has a long term experience with design, development and testing of the thermal engineering applications in the field of particle detectors participating in projects: ATLAS, ALICE, TOTEM and AIRFLY. Further information see http://lin202.fsid.cvut.cz/eng/Cooling/Index.html **.**
- **Charles University in Prague:** www.cuni.cz . This is the oldest university in central Europe (founded 1348) and currently the largest university in the Czech Republic. It's Institute of Particle and Nuclear Physics (www-ucjf.troja.mff.cuni.cz) is involved in many international projects (D0, H1, ATLAS, Auger, Computing Grid for LHC) and carries out R&D for the development of detectors for future experiments, including those at sLHC and Linear Collider.

There are 4 participant organisations from the Czech Republic in DevDet. These participants plan to form a single Joint Research Unit for the DevDet contract phase.

Tasks in DevDet

- Institute of Physics AS CR: WP10.3.1, WP10.3.2, WP10.4
- Nuclear Physics Institute AS CR: WP8
- Czech Technical University in Prague: WP11.3
- Charles University in Prague: WP10.2.1, WP11.2

Short CV for the key persons:

Institute of Physics AS CR**:**

- **J. Cvach:** Head of the Department Experiment II – DESY; Institute representative in the H1 experiment, contact person in the EU EUDET project, leader of the Czech hadron calorimeter HCal group in the CALICE project.
- **V. Vrba:** national contact in the DevDet project. Head of the Department Experiment I – CERN; coordinator of the Czech participation in the ATLAS experiment, group leader in the ATLAS pixel detector project and responsible for pixel sensor production and testing, Institute representative in RD50 and MediPix projects, member of CALICE steering board and responsible for production and testing of silicon pad sensor for electromagnetic SiW calorimeter.

Nuclear Physics Institute AS CR**:**

- **P. Mikula:** Head of the Neutron Physics Department, a representative of CR in European Neutron Scattering Association (ENSA), a member of the Steering Committee for participation in ILL Grenoble and a number of similar international scientific bodies. Main field interest: neutron Bragg diffraction optics in neutron diffraction instrumentation, horizontally and vertically focusing monochromators/analyzers, residual strain measurements, small-angle neutron scattering.
- **J. Stursa:** Head of the Department of Accelerators, project of the axial injector of the cyclotron, project of cyclotron conversion into accelerator of negative ions H- , D-, beam diagnostics, calculation and design of beam line systems, calculation and design of various types of targets for production of radioisotopes.

Czech Technical University in Prague**:**

- **V. Vacek:** Associate Professor. A long term experience with design, development and testing of cooling systems for ATLAS and TOTEM projects, research of the thermophysical properties of the engineering fluids, both theoretically and experimentally. An author of several works on two phase flow in small diameter pipes and capillaries. He is heading the Termophysical research laboratory at CTU.

Charles University in Prague**:**

- **Z. Dolezal:** Associate professor. Institute representative in several projects (EU EUDET, ATLAS SCT, SiLC). Active in the development and production of ATLAS tracker modules (QA coordinator of end cap module production), further in the ATLAS tracker upgrade, radiation-hard detectors, vertex and tracking detectors for ILC.
- **P. Kodys:** senior researcher. Institute representative in RD50 and DEPFET projects. Active in the development and production of ATLAS tracker modules and tracker upgrade, radiation-hard detectors, vertex and tracking detectors for ILC.

Country: **Finland**

Short name of participant:	UH	Helsingin yliopisto

Description of participant:

The University of Helsinki (http://www.helsinki.fi/university/), established in 1640, is the largest and most versatile university in Finland. The Helsinki Institute of Physics, HIP (www.hip.fi), is an independent research institute of the University of Helsinki. The research activity at the institute covers an extensive range of subjects in theoretical physics, experimental particle physics and silicon and gas detectors. The institute is responsible for the Finnish research collaboration with CERN.

Tasks in DevDet

- WP2.3

- WP11.2, WP11.

Short CV for the key persons:

- Ms. Eija Tuominen: Doctor of Science in Technology (semiconductor technology); Project Leader at HU/HIP since 2000 coordinating Finnish activities to CERN CMS Tracker; coordinator of HIP Detector Laboratory since 2007; development of silicon detectors for Tracker Upgrade.

Country**: France**		
Short name of participant:	CNRS	Centre National de la Recherche Scientifique
	APC	AstroParticule et Cosmologie, Paris
	CPPM	Centre de Physique des Particules de Marseille
	IPHC	Institut Pluridisciplinaire Hubert Curien, Strasbourg
	IPNL	Institut de Physique Nucleaire de Lyon
	LAL	Laboratoire de l'Accelerateur Lineaire, Orsay
	LAPP	Laboratoire d'Annecy le Vieux de Physique des Particules
	LLR	Laboratoire Leprince-Ringuet, Palaiseau
	LPC	Laboratoire de Physique Corpusculaire de Clermont-Ferrand
	LPNHE	Laboratoire de Physique Nucléaire et de Hautes Energies, Paris
	LPSC	Laboratoire de Physique Subatomique et de Cosmologie de Grenoble
	CEA	Commissariat à l'Énergie Atomique, Saclay

Description of participant:

The CNRS carries out research in all fields of knowledge in France through its research department and Institutes. The CNRS is involved in the DevDet project through the laboratories of the IN2P3 which is the Institute for Nuclear and Particle Physics (~2500 staff with about 900 research physicists).

- **APC** : Founded in 2005, the laboratory of AstroParticles and Cosmology has made crucial contributions to key experiments for the neutrinos oscillations measurements (Borexino, Double Chooz, Minos) and is involved in detector development for future projects (Memphys,)
- **CPPM:** The laboratory has made an important contribution to the ATLAS experiment (mechanics of endcap, pixel detectors, computing) and LHCb (trigger electronics) and is also the leader laboratory of the ANTARES project. The laboratory is involved in the LHC upgrade, especially in the pixel detector.
- **IPHC:** The laboratory has a strong team of micro-electronics engineers with great expertise in CMOS electronics and has developed Monolothic Active Pixels Sensors (MAPS) with applications in the STAR pixel detectors and in medical applications. The group is involved in vertex detectors for the ILC experiment.
- **IPNL**: With more than 200 physicists, engineers and technicians, IPNL is one of the biggest French laboratories in high energy physics field. It is currently involved in many of the major experiments like CMS, D0 and OPERA. The IPNL has a long expertise in different fields but more particularly in calorimetry (L3, CMS and ILC).
- **LAL:** This Laboratory is the largest laboratory in particle physics in France (~350 staff) and is strongly involved in detector design and construction, computing as in physics. It recently played a leading role in the ATLAS electromagnetic calorimeter (mechanics + electronics) and contributed to the LHCb detector. The lab is strongly involved now in

ILC, neutrinos and SLHC developments, especially through its microelectronics design group (OMEGA) of 10 engineers.

- **LAPP:** For more than 30 years now, the LAPP is involved in international programs on experimental particle physics closed to accelerators like LEP, SLAC or LHC. With its nearest to CERN and its large contribution in detector R&D and realisation, the LAPP holds precious experience for future accelerator particle physics project.
- **LLR:** The laboratory from the Ecole polytechnique was deeply involved in the design and construction of the calorimeter for ALEPH, for CMS and is now one of the major labs of the CALICE collaboration, the large collaboration working on the design of the calorimeter for ILC. The CALICE group from LLR is involved in the ECAL and DHCAL for 8 years.
- **LPC** : The engineering groups in electronics, mechanics and software has participated in major collider experiments such as ALEPH in past and now, with ATLAS, ALICE and LHCb experiments at LHC and calorimeter R&D for ILC.
- **LPNHE:** The laboratory is involved in several important experiments in High Energy : ATLAS and LHCb at LHC, CDF and D0 at Tevatron and Babar at SLAC. The technical staff have high skills in micro-electronics Front End and readout both analogue and digital, data acquisition, mechanics and computing: the groups are involved both in SLHC and ILC R&D.
- **LPSC:** The laboratory has been involved in ATLAS presampler construction and electronics, especially automated testing system of ASIC chips with a robot. The micro-electronics team with four designers is now working in ILC electronics with the design of high dynamic ADC or DAC for the ILC calorimeter calibration.

The 10 participating laboratories from the CNRS/IN2P3 participate as a single legal entity in the DevDet proposal

- **CEA**: leading French organisation for research, development, and innovation in the fields of energy, defence, information technologies, communication and health. The IRFU institute of CEA, based at Saclay, performs research on the fundamental laws of the Universe, including Particle Physics, Nuclear Physics and Astrophysics.

Tasks in DevDet

- AstroParticule et Cosmologie (Paris) : WP5, WP11
- Centre de Physique des Particules de Marseille : WP3.1, WP3.3 and WP11
- Institut Pluridisciplinaire Hubert Curien (Strasbourg) : WP3.1, WP3.3 and WP10.2.1
- Institut de Physique Nucléaire de Lyon: WP10.3
- Laboratoire de l'Accélérateur Linéaire (Orsay): WP2.2, WP3.1, WP3.3, WP5, WP10.3 and WP11
- Laboratoire d'Annecy le Vieux de Physique des Particules : WP10.3
- Laboratoire Louis Leprince-Ringuet : WP2.2, WP4 and WP10.3
- Laboratoire de physique corpusculaire (Clermont Ferrand) : WP3.1 and WP10.3
- Laboratoire de Physique Nucléaire et des Hautes Energies (Paris): WP3.1, WP3.3 and WP10.2.2
- Laboratoire de Physique Subatomique et Cosmologie (Grenoble) : WP3.1
- Commissariat à l'Énergie Atomique : WP3.1, WP10.2.1, WP10.2.3, WP11

Short CV for the key persons:

- **C. Adloff** (LAPP): Lecturer at university of Savoie. Contribution to design and construction of AMS electromagnetic calorimeter. Team leader of the LAPP R&D group for ILC contributing to machine diagnostic and digital hadronic calorimeter.
- **D. Autiero** (IPNL) : Researcher at CNRS/IPNL; CERN staff on NOMAD up to 2002; group leader of the neutrino group at IPNL, participating to the OPERA and T2K experiments and on the R&D on future liquid argon detectors for neutrinos physics. Neutrino contact for CNRS.

- **J.C. Brient** (LLR): Researcher at CNRS/LLR: Involved in ALEPH physics related to electromagnetic calorimeter. Team leader of the ECAL development at LLR, responsible for CALICE at IN2P3 and spokesperson of CALICE for 6 years. Member of the international R&D panel, reviewing the ILC detector R&D. Member of EUDET-JRA3. Will coordinate consortium effort in WP10.
- **D. Dzahini** (LPSC): Research engineer in electronics at CNRS/LPSC; development of low noise electronics at cryogenic temperature (CMOS, ASGA). Development of high dynamic converter (12-14 bits) and high speed pipeline converters for monolithic pixels applications
- **C de La Taille** (LAL)**:** Research engineer in electronics at CNRS/LAL. Leader of development of low noise readout electronics for many experiments since 1990. (ATLAS, D0, NA48…) and now in ILC calorimeters within CALICE. Head of Microelectronics at IN2P3 and of the OMEGA pole at Orsay. Coordinator of EUDET JRA-3. Will coordinate all efforts of the consortium in microelectronics (WP3).
- **P. Gay** (LPC): Full professor at the Blaise Pascal University (Clermont Ferrand); Involved both in data analysis (ALEPH, D0…) and R&D supervision; Leader of the Future Linear Collider team at LPC with strong participation to CALICE project.
- **I. Laktineh** (IPNL): Full Professor at the Lyon University; responsible for the French scanning station of OPERA; Member of the scientific counsel of the French neutrino GDR; ILC group leader at IPNL and coordinator of the digital hadronic calorimetry in Europe within CALICE.
- **T. Patzak** (APC)**:** Full Professor at APC. Project director at APC. Activity in neutrinos physics and particle detector development, especially water cerenkov detector (MEMPHYS).
- **A. Rozanov** (CPPM)**:** Researcher at CNRS/CPPM. Design and construction of ATLAS pixels detector (electronics + mechanics). Involved in pixel upgrade in ATLAS and SLHC.
- **A. Savoy-Navarro** (LPNHE)**:** Researcher at CNRS/LPHNE**.** Experience in R&D and construction phases of experiments at Large colliders, e.g. on ATLAS electromagnetic calorimetry, on new large area silicon tracking systems, associated to innovative Front End electronics (based on DSM CMOS technology), and design and running of dedicated lab test benches and test beams. Coordinator of French effort in EUDET-FP6 program
- **L. Serin** (LAL): Researcher at CNRS/LAL; Design and testing of ATLAS Liquid Argon electromagnetic calorimeter and electronics, in charge of beam test and commissioning. Chairman of electronics department at LAL since 2006. French national contact for DevDet
- **Y. Sirois** (LLR)**:** Researcher at CNRS/LLR. Involved in CMS calorimeter and trigger electronics. Group leader of LLR-CMS and CMS-France at CNRS.
- **M. Winter** (IPHC)**:** Researcher at IPHC. Coordinating the development of a vertex detector for the ILC. Developing CMS pixel sensors for the FP6 project EUDET (JRA-1). Coordinating the ILC group at IPHC and the development of CMOS pixel sensors, including 3D integration technologies, for subatomic physics experiments and bio-medial imaging.
- **P. Colas** (CEA)**:** Researcher in Particle Physics. Member of the EUDET-JRA2 SiTPC collaboration. Member of the EUDET and LC-TPC Institution Boards. Organizer of several conferences on gas detectors and TPCs.
- **E. Delagnes** (CEA): Research Engineer in Electronics. Head of the Saclay Microelectronics laboratory. Leader of various detector electronics developments, including the AFTER-based T2K TPC readout.
- **F. Orsini** (CEA)**:** Engineer-Physicist specialized on detection for particle physics, Technical Project Leader of the ALICE-Dimuon Arm-Tracking Chambers, Project Leader of the CLIC-CTF3-CALIFES accelerator. Member of the EUDET-JRA1 Beam Telescope collaboration.
- **M. Titov** (CEA)**:** Member of the D0 and ATLAS collaborations and of the EUDET-JRA2

SiTPC group. Specialist of gaseous detectors. Organizer of several conferences in the IEEE framework.

Country: **Germany**

Short name of participant:	DESY	Stiftung Deutsches Elektronen-Synchrotron
	RWTH Aachen	Rheinisch-Westfälische Technische Hochschule Aachen
	Uni Bonn	Rheinische Friedrich-Wilhelms-Universität Bonn
	TUD	Technische Universität Dresden
	ALU-FR	Albert-Ludwigs Universität Freiburg
	Goettingen	Georg-August-Universität Göttingen
	UNI-Hamburg	Universität Hamburg
	UHEI	Ruprecht-Karls-Universität Heidelberg
	UNIKARL	Universität Karlsruhe (TH)
	JOGU	Johannes-Gutenberg-Universität Mainz
	MPG-MPP	Max-Planck-Institut für Physik München
	UNSIEG	Universität Siegen
	Wuppertal	Bergische Universität Wuppertal

Description of participant:

The German consortium participating in the DevDet proposal comprises 13 universities and research institutes which are all partners in the Strategic Alliance ‘Physics at the Terascale’ established in 2007 to structure High Energy Physics in Germany[7]. The Alliance members participating in DevDet will form a Joint Research Unit D-TERA with DESY as coordinating institute.

- **DESY:** At its two sites in Hamburg and Zeuthen is one of the leading institutes in the world for high energy and astro-particle physics, accelerator physics and research with photons (http://www.desy.de/html/home/index_eng.html). The laboratory has experience in the development, construction and operation of large accelerators like HERA and is strongly involved in the preparation of the International Linear Collider (ILC). Since 1998 DESY has an active detector development programme for the ILC detector, participating in work for the TPC, the hadronic calorimeter, and the very forward calorimeters. The laboratory operates computing facilities on the Computing Grid for LHC, HERA and LC experiments.
- **Rheinisch-Westfälische Technische Hochschule Aachen**: RWTH Aachen University has a strong focus on engineering and natural sciences. The research activities in the physics department (22 professors, www.physik.rwth-aachen.de/en/) comprise particle and astroparticle physics (CMS, D0, AMS, AUGER, AMANDA/IceCube, Double-CHOOZ experiments) as well as condensed matter physics and theoretical physics. The particle physics groups have a long track record in development and construction of detector systems such as muon chambers, silicon tracking detectors and transition radiation detectors. Among the current detector R&D projects are the upgrade of the CMS tracker for SLHC, the development of a TPC for a Linear Collider and studies on future neutrino facilities. Aachen and DESY form a federated Tier 2 in the Computing Grid for CMS.
- **Rheinische Friedrich-Wilhelms-Universität Bonn**: University of Bonn is a research oriented university with a Department of Physics and Astronomy (http://www.physik.uni-bonn.de) which covers a broad spectrum of applied and fundamental physics and astrophysics. The experimental particle physics group is led by four professors working on the ZEUS, D0 and ATLAS experiments. Major contributions have been made to the design and development of the ATLAS pixel detector and its frontend electronics. The groups are active in microelectronics and detector development for future colliders, in

[7] http://terascale.desy.de/

particular sLHC and a Linear Collider.

- **Technische Universität Dresden**: The TU Dresden (http://tu-dresden.de) dates back to the Technische Bildungsanstalt Dresden, founded in 1828 and, thus, ranks among the oldest technical-academic educational establishments in Germany. Having been committed to sciences and engineering before the reunification of Germany, TU Dresden now is a multi-discipline university, also offering humanities and social sciences as well as medicine. The Institute for Nuclear and Particle Physics (http://iktp.tu-dresden.de/IKTP/english) focuses on questions in particle physics using a wide spectrum of methods ranging from particle accelerators over nuclear and radiation physics up to theoretical phenomenology. The experimental groups participate in ATLAS, BABAR, COBRA, GERDA and in detector development for future involvement in particle physics experiments.
- **Albert-Ludwigs Universität Freiburg**: The University, founded in 1457, has a large physics department where leading research into experimental particle physics is performed in the framework of the ATLAS, D0, ZEUS, COMPASS and CAST experiments. One strong area of expertise relevant for the DevDet project is development of semiconductor detectors. The physics faculty hosts a graduate school covering Physics at Hadron Colliders. The university has recently been awarded the status "University of Excellence" in a highly-competitive national selection process.
- **Georg-August-Universität Göttingen**: This is a research led university, founded in 1737 (http://www.uni-goettingen.de). The Department of Physics (http://www.physik.uni-goettingen.de) consists of about ten institutes, one of which has recently been re-founded as a new particle physics institute (http://physik2.uni-goettingen.de). The experimental group is working on the experiments D0 and ATLAS, on Grid Computing for the LHC and on internationally competitive programmes in detector development for future involvement in particle physics experiments, including those at a Linear Collider.
- **Universität Hamburg**: With approximately 35000 students (950 in physics), the University of Hamburg belongs to the larger German Universities. The research topics of the Physics Department are Particle Physics, Photonics, Nanosciences and Astrophysics. Particle physics groups work on the experiments H1, ZEUS, CMS, ATLAS, OPERA, CHOOZ-II and HESS. In addition there are strong activities on the preparation of experimenting at the ILC, and on detector and accelerator R&D. With several institutes located at the DESY site there is close collaboration with DESY.
- **Ruprecht-Karls-Universität Heidelberg**: The University of Heidelberg is the oldest German University and considered as one of the leading Universities in physics. It has about 26,000 students, among them more than 5,000 from other countries in- and outside Europe, and is regarded as an important centre of modern research and study in Germany. Its Faculty of Physics and Astronomy is the biggest German Physics Faculty. It has a long tradition in high energy particle physics concerning both detector R&D and data analysis. Presently it is involved in three of the four CERN experiments (ALICE, ATLAS and LHCb), in the analysis of Babar and H1 data and in calorimeter R&D for the Linar Collider done in the framework of the CALICE collaboration.
- **Universität Karlsruhe (TH)**: This is the oldest technical university in Germany, founded in 1825. At present, the university and the nearby located Forschungszentrum Karlsruhe FZK are merging into the Karlsruhe Institute of Technology (KIT) (http://www.kit.edu/). One of the major research entities in KIT is the Center for Elementary Particle Physics and Astroparticle Physics (http://www.ceta.uni-karlsruhe.de/index.html). The experimental particle physics groups are working on the experiments BABAR, CDF, CMS, on the Computing Grid for the LHC and carry out an internationally competitive programme in detector development for future involvement in particle physics experiments, including those at a Linear Collider and the Super LHC.
- **Johannes-Gutenberg-Universität Mainz**: The Johannes Gutenberg-University (http://www.uni-mainz.de) is one of the biggest research oriented universities in Germany, being founded in 1477. The faculty of physics, mathematics and informatics (http://phmi.uni-mainz.de) has a strong group working on experimental particle physics,

with involvements in the ATLAS experiment at LHC, the D0 experiment at Tevatron, the NA48 and NA62 experiments at CERN and the Amanda/IceCube experiment at the South Pole.

- **Max-Planck-Institut für Physik München**: This is one of the about 80 institutes within the Max-Planck-Society (MPG), a German organisation for basic research in various fields of sciences. The Institute (see http://www.mppmu.mpg.de) has large groups working in particle physics (e.g. ATLAS, H1, ZEUS) and astro-particle physics (e.g. MAGIC, GERDA, CRESST). The Institute also has a large theory group working in precision electroweak calculations, QCD, super symmetry and string theory. The Institute is also strongly involved in detector development for particle and astro-particle physics experiments, including those at a future Linear Collider. The institute operates a semiconductor laboratory for the development and production of advanced silicon detectors.
- **Universität Siegen**: The University Siegen has a long history in developing detectors for experiments in high energy physics (e.g. ALEPH, ZEUS) and in the analysis of their data. The particle physics group is currently working on the ATLAS experiment, the HEP Grid and on preparations for a Linear Collider. The members of this group have experience in the development and production of detectors, like silicon pixel detectors, micromegas and alignment systems and in the development and production of digital electronics.
- **Bergische Universität Wuppertal**: University with strong natural science as well as engineering departments. The department of Physics consists of strong groups in experimental particle, astroparticle and theoretical particle physics. The department is heavily involved in high performance computing (lattice gauge calculation as well as GRID computing). The experimental group is working on the experiments DZero, ATLAS and detector development for sLHC and ILC.

Tasks in DevDet

- DESY: WP2, WP4, WP10
- Rheinisch-Westfälische Technische Hochschule Aachen: WP5, WP 11
- Rheinische Friedrich-Wilhelms-Universität Bonn: WP3, WP10, WP11
- Technische Universität Dresden: WP10
- Albert-Ludwigs Universität Freiburg: WP10 WP11
- Georg-August-Universität Göttingen: WP 10, WP 11
- Universität Hamburg: WP 10
- Ruprecht-Karls-Universität Heidelberg: WP 10
- Universität Karlsruhe (TH): WP8, WP9, WP10
- Johannes-Gutenberg-Universität Mainz: WP 10
- Max-Planck-Institut für Physik München: WP3, WP10
- Universität Siegen: WP 10
- Bergische Universität Wuppertal: WP 10

Short CV for the key persons:

- **Joachim Mnich**: Leading Scientist at DESY, coordinator of the EUDET project, working on LC detector R&D and analysis preparation for the CMS experiment at CERN.
- **Lutz Feld**: Professor of Physics at RWTH Aachen; silicon tracking detector development and construction, member of the CMS collaboration with participations in the tracking system and in physics analyses; member of the CMS Tracker Management Board.
- **Achim Stahl**: Full professor, RWTH Aachen University; reactor neutrino experiment DoubleChooz; long baseline neutrino experiment T2K; expertise in trigger electronics and data analysis.
- **Norbert Wermes**: full professor of physics at Bonn University; Higgs and top physics at the LHC, silicon pixel detectors, ASIC development. Spokesperson of German universities in ATLAS FSP-101).
- **Klaus Desch**: full professor of physics at Bonn University; Search for new physics at the

LHC, gaseous detectors for a Linear Collider. Steering committee member of EUDET.

- **Michael Kobel:** Professor for Experimental Particle Physics, member of ATLAS and BABAR collaborations, member of ATLAS LAr calorimetry project; development of fast electronics for future detectors, member of BMBF Research Center ATLAS and Helmholtz-Alliance "Physics at the Terascale", Coordinator of International Particle Physics Masterclasses
- **Karl Jakobs**: Chaired Professor at Albert-Ludwigs-Universität Freiburg, member of ATLAS and D0 collaborations, ATLAS Physics Coordinator, former member of European Committee for Future Accelerators (ECFA), former member of US DOE Particle Physics Project Prioritization Panel (P5).
- **Arnulf Quadt**: Professor of Physics at the University of Goettingen; ZEUS MVD track trigger; test of CMS silicon strip detector; calibration and commissioning of D0 silicon strip detector; ATLAS pixel upgrade.
- **Robert Klanner:** Professor, former director of Research of DESY, spokesperson of the ZEUS collaboration and member of the CMS collaboration. Long-term experience in silicon detectors. Coordinator of several R&D projects of detectors for particle physics and photon research.
- **Hans-Christian Schultz-Coulon**: Professor of Physics, Heidelberg (since 2004) Research Interest: Trigger, Calorimeter R&D for SLHC & ILC; proton structure, jet physics, search for extra dimensions & SUSY Collaborations: ATLAS, CALICE, H1
- **Thomas Müller:** Professor and head of institute at Universität Karlsruhe (TH). R/D on calorimeters, gaseous detectors, supervision of construction and quality control of silicon strip detector systems for CDF, CMS and sLHC; member of ECFA, head of German HEP advisory board (Gutachterausschuss).
- **Stefan Tapprogge**, associate professor at Mainz University, hadron collider physics, precision measurements and searches for new physics, calorimetry and trigger/data acquisition for ATLAS/LHC, LHC upgrade studies
- **Christian Kiesling**: Project Leader at the Institute, Professor of Physics at the Ludwig-Maximilians-University of Munich, design, construction, testing and deployment of various types of calorimeters and trigger systems for high energy physics experiments (e.g. H1 at HERA), R&D in hadronic calorimetry for future hep experiments.
- **Hans-Günther Moser:** Senior Physicist at the Max-Planck-Institut für Physik, München, head of the semiconductor laboratory. Research interests: silicon detector systems (hybrid and active pixel detectors, SiPMs, radiation hardness), b-physics. Collaborations: ATLAS (SCT and Pixel), RD50, DEPFET.
- **Ivor Fleck**: Associate Professor at University Siegen, analysis of data of high energy physics experiments (OPAL, DZERO), coordination of analysis groups, coordination of production of muon alignment system for ATLAS, development of readout electronics
- **Christian Zeitnitz**: Professor of experimental Physics, Physics analysis at the LHC detector ATLAS, detector development for sLHC as well as ILC (calorimeter), GRID Computing - chair of the German Tier-1 Advisory Board, Member of the ATLAS Upgrade Steering Group

Country: **Greece**

Short name of participant:	NTUA	National Technical University of Athens
	NRCPS	National Center for Scientific Research "Demokritos"

Description of participant:

The Greek consortium comprises all Greek institutions participating in the DevDet Proposal:

- **National Technical University of Athens:** This is the oldest and most prestigious educational institution of Greece in the field of technology, and has contributed unceasingly to the country's scientific, technical and economic development since its foundation in 1837 (www.ntua.gr). The department of physics (www.physics.ntua.gr) includes a group of faculty members and graduate students working on ATLAS experiment and on the Computing GRID for LHC.

- **National Center for Scientific Research "Demokritos":** This institute was founded in 1959, as a decentralized public service centre. The scientific activities of the Centre take place in eight administratively independent Institutes; among them scientists from the Institute of Nuclear Physics (www.inp.demokritos.gr) are participating in experiments CMS, CAST and on the Computing GRID for LHC.

There are 2 participant organisations from Greece in DevDet. These participants plan to form a single Joint Research Unit for the DevDet contract phase, with NTUA the contact institute for DevDet.

Tasks in DevDet

- National Technical university of Athens: WP11
- National Center for Scientific Research :Demokritos": WP8

Short CV for the key persons:

- **T. Alexopoulos:** Associate Professor at NTU-Athens; construction, certification, installation, commissioning of the MDT-BIS chambers of the ATLAS muon spectrometer; DCS coordinator for the MDT-HV/LV chambers; member of the RECFA committee.
- **E.N. Gazis:** Professor at NTU-Athens; construction, certification, installation, of the MDT-BIS chambers of the ATLAS muon spectrometer; Deputy Delegate of Greece to CERN Council; General Secretary of the Greek Committee for CERN; member of the national research council.

Country**: Republic of Hungary**

Short name of participant:	KFKI-RMKI	KFKI Research Institute for Particle and Nuclear Physics of the Hungarian Academy of Sciences

Description of participant:

The KFKI Research Institute for Particle and Nuclear Physics of the Hungarian Academy of Sciences (http://www.rmki.kfki.hu) located at Budapest, Hungary, became an independent legal entity on 1st January 1992. Before that it worked within the framework of KFKI (Central Research Institute for Physics) which was founded in 1950. Main activities: experimental particle physics, theoretical physics, nuclear physics, space physics, plasma physics, biophysics. Main CERN-related activities: CMS, ALICE, TOTEM, NA61. In addition, smaller groups and individuals are working in other different areas

Tasks in DevDet

- WP11.2

Short CV for the key persons:

- **T G. Vesztergombi:** Head of the Particle Physics Department, Professor at the Eotvos Lorand University, Budapest, group leader of the Hungarian CMS-group, co-spokesperson of the NA61/SHINE experiment. Leader of various projects on design, production and test of TOF, Calorimeter and DAQ systems for different experiments.

Country**: Israel**

Short name of participant:	Weizmann	Weizmann Institute of Science
	TAU	Tel Aviv University
	Technion	Israeli Institute of Technology

Description of participant:

The Israel-GIF consortium comprises 3 Israeli institutions participating in the CERN-GIF facility of the DevDet Proposal:

- **Weizmann Institute of Science**: This is a research Institution that includes a Department of High Energy Physics. The ATLAS group has developed and constructed a large part (5,000m**2) of the End-Cap MUON Trigger Detectors of the ATLAS Experiment (TGC's) as well as its readout electronics. It has a photon irradiation facility, chemical analysis facility, engineering services and large mechanical workshop. The group will be involved in the ATLAS data analysis and in the development of detectors for SLHC. It will contribute to the mechanical and electronics infrastructure of the future CERN Irradiation facility.
- **Tel Aviv University**: This is the largest research led university in Israel. Its Experimental High Energy Group working in the ATLAS Experiment has developed a testing station where over 1,000 TGC detectors were qualified. It has developed the various data-bases for the running of the ATLAS End-Cap MUON Trigger. The group is active in the ATLAS Physics analysis, as well as in the developments for a TGC upgrade for SLHC. Its role in the CERN Irradiation facility will be establishing a general data base to control the system. The ZEUS group has a strong participation in the ZEUS experiment as well as in development work for the ILC.
- **Technion**: Being part of a Technical University, the group has access to various facilities. It was the first group to develop a testing facility for the TGC detectors, where more than 1,600 detectors were qualified. The group developed and constructed the Detector Control System (DCS) and the alignment system for the End-Cap Muon Trigger of ATLAS. Furthermore, the group has developed the 2^{nd} level trigger for the End-Cap region, as well as one of the 3 tracking algorithms for MUON's in ATLAS. The group is also very active in searches for SUSY particles at LHC, as well as in detector development using the TGC's for SLHC. The role of the group in the CERN Irradiation facility will be in developing the general DCS for the facility.

There are 3 participant organisations from Israel in the CERN Irradiation Facility of DevDet. These participants plan to form a single Joint Research Unit for the Devdet contract phase. The Tel Aviv group participates also in the development of a test facility for ILC detectors, in particular in the infrastructure for Forward calorimeters.

Tasks in DevDet

- Weizmann Institute: WP9.1, WP9.3
- Tel Aviv University: WP9.3, WP10.3.3
- Technion: WP9.1, WP9.3

Short CV for the key persons:

- **E. Etzion:** Associate Professor, Tel Aviv University. Testing of ATLAS Trigger Chamber. Data-Base coordinator of the ATLAS MUON Spectrometer.
- **H. Abramowicz:** Professor, recent Physics Chair of the ZEUS Collaboration, member of the SPSC at CERN, recipient of the Lisa Meitner Humboldt Research Prize.
- **S. Tarem:** Associate Professor, Technion. Testing of ATLAS Trigger Chambers, developed and constructed the alignment and DCS for the End-Cap Trigger Chambers. DCS Coordinator of the ATLAS MUON Spectrometer
- **G. Mikenberg:** Professor, Weizmann Institute. Development and construction of the ATLAS MUON End-Cap Trigger Chambers. ATLAS MUON Project leader from 1999 to 2008.

Country: **Italy**

Short name of participant:	INFN	Istituto Nazionale Di Fisica Nucleare
	INFN-BA	Bari Research Unit
	INFN-BO	Bologna Research Unit
	INFN-FE	Ferrara Research Unit
	INFN-GE	Genova Research Unit
	INFN-LNF	Laboratori Nazionali di Frascati
	INFN-LE	Lecce Research Unit
	INFN-MI	Milano Research Unit
	INFN-LNL-PD	Padova Research Unit/Laboratori Nazionali di Legnaro
	INFN-PV	Pavia Research Unit
	INFN-PG	Perugia Research Unit
	INFN-PI	Pisa Research Unit
	INFN-ROMA1	Roma 1 Research Unit

Description of participant:

INFN (Istituto Nazionale di Fisica Nucleare) is the Italian leading public research organization in Nuclear and Particle Physics. About 2000 INFN employees and a similar number of Research Associates from Italian Universities are grouped in 19 units and 4 National Labs, providing a significant and relevant contribution since 1951 to the advances in Nuclear and Sub-nuclear physics, all over the world.

The involved units and National Labs represent the significant commitment by INFN on future Elementary Particle experimental activities; in particular:

- Milano, Ferrara, Lecce and Roma 1 hosts teams participating in the International Linear Collider development; the units in Milano and Ferrara are part of EUDET, the I3 project funded by the EC within the FP6
- Pisa, Ferrara, LNF, Perugia are among the leading institutions in the future SuperB factory project
- Pavia, Bari, Bologna, Genova and Padova coordinate the targeted microelectronics development for ASICS and monolithic detectors
- Bari is involved in the software development for the SLHC
- Laboratori Nazionali di Legnaro are offering Transnational access to a state-of-the art irradiation facility.

Tasks in DevDet

- INFN-BA: WP2.2, WP3.2
- INFN-BO: WP3.2
- INFN-FE: WP11.1, WP10.6
- INFN-GE: WP3.2, WP3.1
- INFN-LNF: WP11.1
- INFN-LE: WP2.2
- INFN-MI: WP2.2, WP10.6, WP4.2
- INFN-LNL-PD: T8.1, WP3.1
- INFN-PV: WP3.1, WP3.3
- INFN-PG: WP11.1
- INFN-PI: WP11.1
- INFN-ROMA1: WP10.4

Short CV for the key persons:

- **Massimo Caccia:** associate professor at Universita' dell'Insubria in Como and research associate at INFN-Milano, he is the reference person for the INFN related activities within DevDet. He is leading the ILC detector R&D project in Italy, also within EUDET, an IA-FP6 project. Member of the DELPHI Vertex Detector team at the DELPHI experiment at CERN, he was Principle Investigator and European coordinator of the EC-FP5-Growth project named SUCIMA (contract no. G1RD-CT-2001-00561); currently, he is PI and European coordinator of the EC-FP6-CRAFT project identified as RAPSODI (Coop-32993).

- **Francesco Forti:** associate professor at University of Pisa and member of the LHC Committee, he is leading the SuperB related activities. Involved in the development of the Aleph Vertex Detector, and in charge of the construction of the Babar Silicon Vertex Tracker, he is currently member of Babar executive board. Spokesperson of the INFN project SLIM5, focused on advanced monolithic position sensitive thin sensors, he is also lading the detector R&D for the SuperB facility.
- **Valerio Re:** full professor of Electronics at University of Bergamo and research associate at INFN-Pavia. Principle investigator in national and international R&D projects on advanced analog front-end devices and deep submicron CMOS rad-hard circuits for radiation detectors. Recently he focused on innovative monolithic active pixel sensors for experiments at high luminosity colliders.
- **Lucia Silvestris:** first class Research Officer at INFN-Bari, with a focus on software development for HEP experiments. Person in charge of the on-line and off-line software of Aleph Hadron Calorimeter and VertexDetector, she is currently coordinator of the CMS Tracker software group, Project Leader of the CMS Offline project and member of CMS management Board.

Country: **Lithuania**

Short name of participant:	VU	Vilnius University

Description of participant:

Vilnius University is a research led university and is the oldest university in Lithuania, founded in 1579 (http://www.vu.lt/). The Institute of Materials Science and Applied Research (http://www.mtmi.vu.lt/) has a New Materials Research and Measurement Technology Department concentrated now on the investigation of properties of defects in semiconductors and developing the semiconductor parameters measurement methods and equipment. This activity is within the framework of the CERN RD39 and RD50 collaborations.

Tasks in DevDet

- WP 9.2

Short CV for the key persons:

- **J.Vaitkus:** professor at Vilnius University, design and use of different semiconductor materials and devices parameters measurement, investigation of irradiated semiconductor detector properties; Vilnius University Team leader at CERN
- **E.Gaubas:** chief researcher at Vilnius University and leading scientist for WP9.2 contribution - design and testing methods and equipment for free carrier lifetime measurement, research of differently irradiated semiconductors in a frame of CERN RD39 and RD50 collaboration.

Country: **The Netherlands**

Short name of participant:	FOM	National institute for subatomic physics

Description of participant:

National institute for subatomic physics in the Netherlands, in which the Foundation for Fundamental Research on Matter (FOM), the University of Amsterdam (UvA), the Free University of Amsterdam (VU), the Radboud University Nijmegen (RU) and the University of Utrecht (UU) collaborate. Nikhef coordinates and supports all activities in experimental subatomic (high energy) physics in the Netherlands. The academic staff consists of about 120 physicists of whom more than half are Ph.D. students and postdoctoral fellows. Technical support is provided by well equipped mechanical, electronic and information technology departments with a total staff of about 100

Tasks in DevDet

- WP1, WP3.1, WP3.2, WP10.3, WP11.2.2, WP11.3

Short CV for the key persons:

- **Prof. Dr. Ir. E.N. Koffeman** Senior Researcher/ Lecturer: Development of vertex detector for ZEUS/DESY and project leader ATLAS/SCT commissioning at Nikhef. Lecturer on instrumentation in Particle Physics at the University of Amsterdam. National contact person of DevDet.
- **Dr. N.P. Hessey** Senior Researcher: Experience as project leader of ATLAS/SCT Endcap at Nikhef. Currently ATLAS High-Luminosity Upgrade coordinator at CERN. Will be DevDet Project Coordinator and WP1 Leader.
- **Dr. J. Timmermans** Senior Researcher: As group leader and spokesperson of a large experiment he is currently working on the development/construction (classical) drift chambers and the development of a (pixelised) MPGD readout of gas detectors ('digital' TPC). Supervisor of several particle physics PhD students.
- **Ing. R. Kluit** Senior Electronic Engineer: Coordinator micro-electronics design activities at Nikhef electronics group. Experience with design and test of electronic components for ALICE (LHC) and involved with R&D on gaseous pixel detector electronics

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Country: **Norway**

Short name of participant:	UiB	University of Bergen

Description of participant:

Norway participates with one institution in the DevDet Proposal:

- **University of Bergen:** This research-led institution, founded in 1946, is the third largest university in Norway, (http://www.uib.no/). The Department of Physics and Technology (http://web.ift.uib.no/) has a mid-size experimental group in Subatomic Physics working on the experiments BABAR, ATLAS, ALICE, and carries out an internationally competitive program in detector R&D for future involvement in particle physics experiments, including those at a Linear Collider.

Tasks in DevDet

- WP10.4b

Short CV for the key persons:

- **G.Eigen**: Professor at the University of Bergen, design and tests of calorimeters, tracking detectors and Cherenkov detectors, optimization of photon readout, and characterization of photodetectors; involvement in Calice since 2003.
- **D.Röhrich**: Professor at the University of Bergen, design and tests of tracking detectors, calorimeters, readout electronics, high-level trigger, and data acquisition.

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Country: **Poland**

Short name of participant	AGH-UST	AGH University of Science and Technology
	IFJPAN	Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences
	UJ	Jagiellonian University
	UW	University of Warsaw

Description of participant:

The Polish consortium comprises all Polish institutions participating in the DevDet Proposal:

- **AGH University of Science and Technology, Cracow:** This is one of the largest and leading technical universities in Poland, employing about 4000 people. The Department of Particle Interactions and Detector Techniques, in the Faculty of Physics and Applied Computer Science (http://www.ftj.agh.edu.pl/), participates in several HEP experiments. Main contributions have been given to design and construction of ZEUS, NA50, ATLAS, LHCb experiments and to R&D projects RD20, RD42, RD49. Presently the group is involved in development of semiconductor detector systems, in particular the design of front-end electronics ASICs for future experiments in particle physics, including those at an International Linear Collider and SLHC.

- **Henryk Niewodniczanski Institute of Nuclear Physics, Polish Academy of Sciences, Cracow:** One of the leading and of the largest Polish institutes carrying out basic and applied research in physics. The studies include particle physics and astrophysics, nuclear and strong interactions physics, condensed matter physics, medical physics, dosimetry, biophysics, radiochemistry, nuclear geology, materials engineering and other. Over fifty years experience in high energy physics, the recent activities in ALTAS, LHCb, H1, ZEUS, ALICE, T2K, Belle, AUGER, PHOBOS, ICARUS. The Institute participates in detector R&D for future International Linear Collider, B-factory and neutrino physics (http://www.ifj.edu.pl/).
- **Jagiellonian University, Cracow:** One of the oldest Europe universities and one of the largest Polish ones. The Theoretical Physics group at the Faculty of Physics, Astronomy and Applied Computer Science (http://www.fais.uj.edu.pl/) has a longstanding experience in HEP theory, phenomenology and Monte-Carlo simulations. Members of our group participate in HERA and LHC collaborations.
- **University of Warsaw:** One of the largest Polish universities. The Department of Physics (http://www.fuw.edu.pl/) has a large Particle Physics Experimental group working on the experiments CMS, ZEUS, COMPASS, NA49, MINOS, Super-Kamiokande as well as on detector development for future particle physics experiments, including those at a Linear Collider.

There are 4 participant organisations from Poland in DevDet. The legal participant in the project will be AGH-UST. The IFJPAN, UJ and UW will be the “third parties carrying out part of the work”, covered by special clause 10, case Groupings (treated as JRU). All participants are members of the Polish Network for Physics and Technology of High Energy Linear Accelerators, created in 2007.

Tasks in DevDet

- AGH University of Science and Technology: WP3.1, WP3.2, WP10.3
- Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences: WP10.3, WP11.2
- Jagiellonian University: WP10.3
- University of Warsaw: WP10.2

Short CV for the key persons:

- **W. Dąbrowski:** Professor at the AGH University of Science and Technology, Cracow; leader of the Nuclear Electronics and Radiation Detection Group; coordinator of front-end electronics for ATLAS Semiconductor Tracker, construction and testing of SCT modules, development of front-end ASIC for ATLAS Inner Detector Upgrade
- **M. Idzik:** Assoc. professor at the AGH University of Science and Technology, Cracow; chairmen of the Polish Network for Physics and Technology of High Energy Linear Accelerators; development of silicon detector systems for NA50 experiment, ALICE at LHC, Forward Calorimeter at future International Linear Collider.
- **W. Słomiński:** Assoc. professor at the Jagiellonian University, NLO QCD calculations, photon and electron hadronic structure, QCD expertise in the ZEUS experiment, detector positioning for EUDET, physics simulations for the ILC forward detectors, JU representative to the Polish Network for Physics and Technology of High Energy Linear Accelerators.

- **A. Zalewska:** Professor at the Institute of Nuclear Physics PAN (IFJPAN) in Cracow, head of the Department of Neutrino and Dark Matter Studies, experience in high energy and neutrino physics, IFJPAN representative to the Polish Network for Neutrino Physics.
- **L. Zawiejski:** Assoc. Professor at the Institute of Nuclear Physics PAN in Cracow, head of Department of Linear Collider; participates in the Polish Network for Physics and Technology of High Energy Linear Accelerators; study of the properties of the hadronic final state in the ZEUS experiment; study on Top couplings to Z and W bosons at ILC and work on laser alignment system for luminosity detector in EUDET project.
- **A.F. Żarnecki**: Professor at the University of Warsaw, deputy director of the Institute of Experimental Physics, coordinator of the Polish Network for Physics and Technology of High Energy Linear Accelerators; search for new physics in the ZEUS experiment; study of the Higgs boson production and CP properties at the LHC, ILC and the Photon Collider, analysis and simulation framework for the EUDET telescope

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Country: **Romania**

Short name of participant:	UVT	West University of Timisoara

Description of participant:

Romania comprises one institution participating in the DevDet Proposal:

- **West University of Timisoara:** This is one of the main universities in Romania, founded in 1944 (http://www.uvt.ro/). The Department of Physics (http://www.physics.uvt.ro/) developed recently (five years ago) a Particle Physics Experimental group (http://www.physics.uvt.ro/uvthep/) which carries on a competitive programme in detector development and physics studies for future International Linear Collider and currently negotiates to join the ATLAS and ZEUS experiments.

Tasks in DevDet

- WP10.3

Short CV for the key persons:

- **A. Rosca:** Assoc. Professor at the West University of Timisoara (Professor from April 2008); meson spectroscopy for Obelix; Higgs physics for L3; testing HCAL prototype for LHCb; physics studies and detectors for future Linear Collider facility.

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Country**: Slovenia**

Short name of participant:	JSI	Jožef Stefan Institute

Description of participant:

- Slovenian national institute for natural sciences and technology. Experimental Particle Physics Department has a 30 year old tradition in collaboration with CERN, DESY and KEK. Currently member of ATLAS and Belle collaborations, as well as CERN RD-39, 42 and 50. JSI includes the Reactor Infrastructure Centre, running a TRIGA experimental reactor

Tasks in DevDet

- WP 8.2

Short CV for the key persons:

- **M. Mikuž:** Professor at University of Ljubljana and Head of Experimental Particle Physics Department of JSI; member of ATLAS collaboration: construction of semiconductor tracker, beam conditions monitor, Grid computing; detector development for sLHC upgrade also in framework of CERN RD-39, 42 and 50.
- **M. Ravnik**: Head of Reactor Infrastructure Centre, Professor at University of Ljubljana, reactor physics. Experience: power reactor core designing and fuel management, research reactor safety analysis and operation, design calculations of TRIGA reactor,

reactor fuel and core management for experiments with neutrons .

Country: **Spain**		
Short name of participant:	IFIC	Instituto de Física Corpuscular - CSIC/UVEG
	IFCA	Instituto de Física de Cantabria - CSIC
	CNM-IMB	Centro Nacional de Microelectrónica - CSIC
	UB	Universidad de Barcelona
	USC	Universidad de Santiago de Compostela
	CIEMAT	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas

Description of participant:

The Spanish groups participate in the DevDet as three different partners at submission time with the idea in mind of reducing that number further in the future if at all possible.

- **Consejo Superior de Investigaciones Científicas (CSIC)**: It is the largest public multidisciplinary research organization in Spain. It has 116 institutes or centres distributed throughout Spain. There is also a delegation in Brussels. Three of the institutes participating in this proposal belong to CSIC.

  - IFIC: It is a Nuclear and Particle Physics institute where ongoing research activities include experimental and theoretical work with application in near-term and far-future projects. The institute has been participating in leading particle physics experiments since 1950 when it was founded. It has a long tradition on detector development and computing for HEP. The group participating in the project has been involved in collider experiments (DELPHI, ATLAS) and neutrino experiments (NOMAD, HARP, K2K and T2K)
  - IFCA: It is a joint Institution of the University of Cantabria and CSIC. IFCA is oriented towards basic research in the fields of Particle Physics, Astrophysics and non-linear Systems. The High Energy Physics group has participated actively in the DELPHI experiment at LEP and is now involved in the CDF experiment at Fermilab, the CMS experiment at CERN, several grid computing projects and detector R&D activities within the FP6 project Eudet
  - CNM: is the largest public microelectronics research and development centre in Spain. Moreover, CNM-IMB is a National Large Facility with a 1.500 square meters Clean Room for silicon device and circuit micro and nanofabrication. The Radiation Detector Group started its activities 12 years ago and belongs to the Micro and Nanosystems Department.
  - UB: This is the second largest university in Spain and one of the leading ones in research. The participating group is formed by people from the Electronics Department and the Estructura i Constituients de la Materia, with extensive experience in ASIC design, including ASICs for HEP

- **Universidad de Santiago de compostela**: The Department of Particle Physics has a High Energy Physics Experimental group working on the experiments LHCb, Dirac , GLAST, on the Computing Grid for the LHC and carries out a programme in silicon detectors development for future involvement in particle physics experiments, including those at the International Linear Collider.

- **Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT)**: is a Public Research Laboratory working in the fields of energy, environment, technology and some lines of fundamental research. The High Energy Physics group belongs to the Basic Research Department and has a large experience on Particle Physics experiments: Detector R&D and construction, data analysis and Grid Computing. The group is involved in CMS, CDF, Double Chooz and FAST experiments, as well as in the CALICE Collaboration.

Tasks in DevDet

- IFIC: WP2, WP5
- IFCA: WP 10.2, WP. 11
- CNM-IMB: WP3
- UB: WP3
- USC: WP2
- CIEMAT: WP10

Short CV for the key persons:

- **C. Lacasta:** Tenured researcher at IFIC-CSIC. Working on development of semiconductor sensors for future accelerators and Medical Physics. A particle physicist, working in the area since 1990, with experience in data analysis and detector construction (DELPHI, ATLAS). Participating in design and construction of silicon vertex detectors (ILC) and trackers (SLHC) for future particle physics experiments.
- **A. Cervera:** Tenured researcher at IFIC-CSIC. Has participated in NOMAD, HARP, K2K and T2K. Deputy analysis coordinator in HARP. Coordinator of calibration and high level reconstruction software in T2K-ND280 near detector.Deputy coordinator of FP7 EURONU-detector group.
- **I. Vila:** Tenured researcher at IFCA-CSIC, research topics: design and characterization of amorphous silicon sensors for muon alignment at CMS; building, commissioning and operation of ToF system at CDF; first direct determination of Bs mixing frequency Dms; R&D for future tracking detectors for the next linear collider.
- **M. Lozano:** Professor of Research at CNM-IMB CSIC. Clean room microfabrication. Microelectronic device electrical characterization. Electronic circuit design. Technological and electrical computer simulation. Physical device characterization. Radiation detection and measurement. X-ray imaging techniques. Device degradation by irradiation (gamma, protons, neutrons)
- **A. Dieguez:** Associate professor at the University of Barcelona and coordinator of VLSI design activities. He has participated in ASIC design for LHCb.
- **A. Gallas:** Researcher “Ramón y Cajal program” at the University of Santiago de Compostela. Design and construction of muon, tracking and RICH detectors. Construction and commissioning of Silicon Tracker for the LHCb experiment.
- **M.C. Fouz:** Researcher staff at CIEMAT. Responsibility on CMS Muon Chambers testing. Coordinator of the Muon Drift Tube Detector Performance Group of the CMS experiment. R&D of a Digital Hadron Calorimeter for CALICE. Spanish representative on the CALICE steering board.

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Country**: Sweden**

Short name of participant:	SWEDET	
	UUpps	Uppsala University
	ULund	Lund University

Description of participant:

The collaboration **SWEDET** with participants from **Lund University** and **Uppsala University** was formed to coordinate in Sweden the detector development for future collider physics experiments. The high energy physics groups at the universities have long experience with research at international research facilities BNL, CERN, DESY and Fermilab. For LHC the groups contributed to the development, construction and commissioning of the ATLAS (Lund and Uppsala) and ALICE (Lund) detectors. This is not the first time the groups collaborate. The LHC work is since many years successfully run in a consortium (LHCK) with participation from all high energy physics groups in Sweden. Another example is the development of the GRID infrastructure in Sweden (SWEGRID) that has been by developers from Lund and Uppsala.

Tasks in DevDet

- Lund University: WP10.3c
- Uppsala University: WP3.3, WP8

Short CV for the key persons:

- **Richard Brenner:** Associate Professor at Uppsala University. Silicon detector expert, coordinated the development, production and quality assurance of silicon microstrip detector modules for ATLAS SemiConductor Tracker (SCT) in Scandinavia. Project leader of the Detector Control System for ATLAS SCT.
- **- Leif Jonsson:** Professor at University of Lund, development of read out electronics and data acquisition system for a high resolution TPC, convener of WP electronics development for a TPC at the ILC, chairman of the EUDET Institution Board.
- **- Alexander Prokofiev:** Associate Professor at The Svedberg Laboratory (TSL), Uppsala University. Leader of the Irradiation Facilities group at TSL that provides neutron and proton beams for users.

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Country: **Switzerland**

Short name of participant:	ETHZ	Eidgenössische Technische Hochschule Zürich
	PSI	Paul Scherrer Institut Villigen
	UNIBE	Universität Bern
	UNIGE	Université de Genève
	UNIZH	Universität Zürich

Description of participant:

The Swiss consortium comprises all Swiss institutions participating in the DevDet Proposal:

- ETHZ: The Swiss federal institutes of technology have three missions: education, research and technology transfer at the highest international level. Associated with several specialised research institutes, the two institutes form the EPF domain, which is directly dependent on the Federal Department of Home Affairs. ETH Zurich is the study, research and work place of 18,000 people from 80 nations. About 350 professors in 16 departments teach mainly in the engineering sciences and architecture, system-oriented sciences, mathematics and natural sciences areas and carry out research that is highly valued worldwide.
- PSI: Research institute annexed to the Swiss institutes of technology. In the Swiss research and education landscape PSI plays a special role as a user lab, developing and running large, complex research facilities, including accelerators and a synchrotron light source. Since the start of PSI twenty years ago, 15,000 to 20,000 external researchers have performed experiments in the fields of physics, chemistry, biology, material sciences, energy technology, environmental science and medical technology. Also during this time some 1,500 dissertations have been successfully completed, with most doctoral candidates having been accompanied by the experienced staff of PSI. After concluding their research the majority of these young people find a profession in business or in a university. The support of education and training is, and will remain, a core business of PSI.
- Universität Bern: General purpose university. University of Bern is the third largest university in Switzerland. The Laboratory for High Energy Physics (LHEP) is a division of the Physics Institute at the University of Bern, Switzerland. It conducts research in the field of experimental particle physics. The main subjects are high-energy collider physics, neutrino physics development of novel particle detectors and medical physics. The LHEP has also been involved in experiments on low energy QCD studies, search for dark-matter, strange-matter, quark-gluon plasma, etc.
- Université de Genève: General purpose university. Science at University of

Geneva is characterized by the excellence of its researchers and its openness to the outside world. The European Union has selected Geneva to be among the twelve founding members of the League of European Research Universities (LERU). This deliberate orientation towards research results in an excellent impact record of its scientific publications, which places Geneva at the forefront of research world-wide in several disciplines. In the University of Geneva faculty of science, 25% of the professors and 50% of its students are foreigners. It participates currently in 26 research programs of the European Union. Among its 2104 science students, 569 are at a post-graduate level. It is also found a the top of research funds attributed by the Swiss National Fund for Scientific Research and hosts two national poles of research, in genetics and in physics.

- Universität Zürich: General purpose university. It enjoys international renown as a place of education and research. Two thousand lecturers in 140 special institutes provide the broadest range of subjects and courses available from any Swiss institution of higher education. With 24,000 students and 1,900 graduates every year, Zurich is also Switzerland's largest university. The University provides academic services, works with the private sector and considers itself part of a national and global network for the acquisition and dissemination of knowledge. Zurich's international reputation is based on groundbreaking research, particularly in molecular biology, brain research and anthropology, and on the work of the University Hospital and Veterinary Hospital. University of Zurich is also a member of LERU.

There are five participant organisations from Switzerland in DevDet. These participants plan to form a single Joint Research Unit for the Devdet contract phase. The scientific coordination will be with the Swiss Institute of High Energy Physics (CHIPP). The leading house will be University of Geneva.

Tasks in DevDet

- ETHZ: WP 4, WP 11
- PSI: WP 8
- UNIBE: WP 11
- UNIGE: WP 4, WP 10, WP 11
- UNIZH: WP 5

Short CV for the key persons:

- **Alain Blondel**: Full professor at Unversity of Geneva.
- **Allan Clark**: Full professor and head of the Département de physique nucléaire et corpusulaire (DPNC) at University of Geneva.
- **Günther Dissertori**: Full professor at ETHZ.
- **Antonio Ereditato**: Full professor and head of the Laboratory for High Energy Physics (LHEP).
- **Woytek Haydas**: Senior researcher at PSI and responsible for irradiation facilities.
- **Martin Pohl**: Full professor and head of the physics department at University of Geneva. Member of the executive board of the Swiss Institute of Particle Physics (CHIPP).
- **André Rubbia**: Full professor and head of the Institute of Particle Physics (IPP) at ETHZ.

Country**: United Kingdom**		
Short name of participant:	UNIVBRIS	University of Bristol
	UBRUN	Brunel University
	UCAM	University of Cambridge
	UEDIN	University of Edinburgh

	UNIGLA	University of Glasgow
	UNILIV	University of Liverpool
	UNIMAN	University of Manchester
	UOXF	University of Oxford
	QMUL	Queen Mary, University of London
	STFC-RAL	STFC Rutherford Appleton Laboratory
	RHUL	Royal Holloway, University of London
	USFD	University of Sheffield

Description of participant:

The United Kingdom consortium comprises all UK institutions participating in the DevDet Proposal:

- **University of Bristol:** Bristol is the largest academic institution in the South-West of Britain, and is one of the leading research Universities in the UK, with a strong focus on science, engineering and medicine. The particle physics group carries out research within the CMS, LHCb, CDF and CLEO-C collaborations, and also has a leading role in applied software and computing research in support of current and future experiments, and detector development towards the LHC upgrade and ILC programmes.
- **Brunel University:** This is a research intensive university (http://www.brunel.ac.uk). The School of Engineering and Design is one of the largest in the UK and has a Particle Physics Group working on CMS, BaBar, MICE, R&D for future neutrino factories, and Grid Computing for the LHC. It is heavily involved in detector development for both future particle physics experiments and related areas including space missions.
- **Cambridge University** is one of the world's leading Universities. The Department of Physics is located in the Cavendish Laboratory and is one of the largest in the UK. It has a long and distinguished history and is associated with many notable discoveries, including the electron and the structure of DNA. The Particle Physics group is working on the ATLAS, LHCb and MINOS experiments and is playing a leading role in detector research and development for a future Linear Collider.
- **University of Edinburgh.** The University of Edinburgh (www.ed.ac.uk) is over 400 years old and is one of the largest in the UK. It is Scotland's premier research university and graded among the top British universities in the 2001 national Research Assessment Exercise**.** The Particle Physics Experiments' group within the School of Physics (www.ph.ed.ac.uk) participates in the BaBar, LHCb experiments, Grid Computing for the LHC, and R&D for a future linear collider. A strong theoretical particle physics group researching LHC phenomenology and lattice QCD complements this work.
- **University of Glasgow:** This is a research led university, and is the second oldest university in Scotland, founded in 1451 (http://www.gla.ac.uk). The Department of Physics and Astronomy (http://www.physics.gla.ac.uk) has a large Particle Physics Experimental group working on the experiments CDF, ZEUS, ATLAS, LHCb, on the Computing Grid for the LHC and carries out an internationally competitive programme in detector development for future involvement in particle physics experiments, including those at a Linear Collider and future Neutrino Facilities.
- **University of Liverpool:** The Physics department hosts the Liverpool Semiconductor Detector Centre where the LHCb vertex detector modules and forward silicon tracker of ATLAS were built. The particle physics group is one of the largest in the UK and supports a broad portfolio of projects: ALPHA, ATLAS, BaBar, CDF, H1, ILC, LHCb, LHeC, MICE, SLHC, and T2K. The principal investigators for the UK's ILC vertex detector proposal (LCFI) and of the ATLAS Tracker Upgrade programme for Super-LHC are both staff at Liverpool. The group enjoys international leadership in developing radiation hard silicon microstrip detectors for particle physics.
- **University of Manchester**: Britain's largest single-site university, with an exceptional record of generating and sharing new ideas and innovations. The School of Physics and Astronomy at The University of Manchester is one of the largest and most active schools of physics in the United Kingdom and includes the Jodrell Bank Observatory. Its large

particle physics group is active in many areas of physics research (both theoretical and experimental), detector development and e-science. Activities include the ATLAS, Babar and DØ experiments, neutrino physics at Nemo3, detector R&D for a future Linear Collider and SuperNemo, hosting a tier 2 centre for the LHC computing grid and accelerator design and construction as a founder member of the Cockcroft Institute.

- **The University of Oxford** has a long-term, successful relationship with the European Union's research programmes. On average, Oxford has approximately 240 ongoing contracts with the Commission at any given time, producing ca. £8.2 million per annum in research income (out of ca. £248 million annual external research income plus £98 million in government research grants in 2006/07). Over the last couple of years Oxford has had an average of 80 new EU contracts per year with a total worth of £7.6 million. Oxford has a total staff of over 8,500, including about 4,860 research-active personnel. Amongst its 20,000 students, a quarter are of European and international origins, covering 130 nationalities. The University consists of over 100 departments structured into four academic Divisions and housing a variety of sub-departments, schools, institutes and research centres of international standing.
- **Queen Mary, University of London:** This is a research lead university originally founded as Queen Mary College in 1887 (http://www.qmul.ac.uk/). The Physics Department (http://hepwww.ph.qmul.ac.uk/) is home to the Particle Physics Research Center (PPRC). Members of the PPRC are actively working on ATLAS, BaBar, H1, T2K, GRID based computing, and the centre is involved in R&D toward involvement in future particle physics experiments including the ATLAS upgrade programme and SuperB.
- **STFC Rutherford Appleton Laboratory** is the largest establishment (http://www.scitech.ac.uk/About/Find/RAL/Introduction.aspx) of the UK Science and Technology Facilities Council (http://www.scitech.ac.uk/Home.aspx). The Particle Physics and Technology Departments both have a long history of successful collaborative work in High Energy Physics. Current projects include major shares of ATLAS, CMS, and LHCb.
- **Royal Holloway, University of London:** Royal Holloway has earned a world-class reputation for developing original research. The Department of Physics is one of the major centres for Physics teaching and research in the University of London. The Centre for Particle Physics is currently heavily involved on ATLAS (of which Royal Holloway was one of the founding institutes) and on future accelerators, as a founding member of the John Adams Institute. The group is also involved in R&D activities related with future detectors at a linear collider with involvement in CALICE, centered on DAQ activities as well as physics studies.
- **University of Sheffield:** The University, established in 1905 is at the forefront of world research. The Particle Physics & Particle Astrophysics group www.pppa.group.shef.ac.uk based in the Department of Physics & Astronomy has a history of involvement with successful international Detector Development programmes. It participates in active research for many experiments including, ATLAS at LHC, ATLAS-upgrade for SLHC, NorthGrid/GridPP, MICE & Neutrino Factory R&D, T2K, HARP plus others all contributing to a dynamic research environment.

There are 12 participant organisations from the United Kingdom in DevDet. These participants plan to form a single Joint Research Unit for the DevDet contract phase.

Tasks in DevDet

- University of Bristol: WP2.3
- Brunel University: WP2.2, WP8
- Cambridge University: WP2.2, WP4.3
- University of Edinburgh: WP2.1,
- University of Glasgow: WP1, WP2.1, WP3.3, WP5, WP9.2, WP9.3, WP11
- University of Liverpool: WP3.3, WP9.2

- University of Manchester: WP4.3, WP10.3.1
- University of Oxford: WP2.2.
- Queen Mary, University of London: WP2.1
- STFC Rutherford Appleton Laboratory: WP3.1, WP3.2, WP3.3, WP9.3,
- Royal Holloway, University of London: WP4.3
- University of Sheffield: WP9.2

Short CV for the key participants:

- **D. Bailey:** Lecturer in Physics at the University of Manchester; Babar physics and computing; R&D for future linear collider detectors; advanced computing algorithms using massive multithreading on CPUs
- **A.J. Bevan:** Lecturer at Queen Mary, University of London, Matter-antimatter asymmetry measurements of Unitarity Triangle angles alpha and beta at BaBar; Runs the Q2B working group on BaBar; Measurement of beam phase-space parameters at PEP-II; Studying physics potential of SuperB.
- **V. Boisvert:** Lecturer at Royal Holloway, University of London; current ATLAS member with activities in trigger in addition to physics analysis, former member of RD50 which performs R&D on radiation hard semiconductor devices for very high luminosity colliders
- **G.L. Casse** is responsible for detector R&D in Liverpool, convener of a research group in detectors in the RD50 experiment, involved in the design and testing LHCb-VELO detectors, ATLAS SCT detectors, leader of the sensor Work Package of the ATLAS Upgrade UK program.
- **R S French:** Engineer at the University of Sheffield working on ATLAS SCT detector, primarily SCT end-cap macro assembly, installation & commissioning. SCT end-cap cooling WP leader. Detector development for HEP applications. Working on SLHC Thermal Management and Engineering.
- **J. Greenhalgh**: Leader of Advanced Materials Group in STFC's Technology Department; recently completed a role as project engineer for the endcaps of the CMS Electromagnetic Calorimeter. Currently managing the UK part of the upgrade to the Laser Interferometer Gravitational-Wave Observatory (LIGO).
- **P.R. Hobson:** Professor at Brunel University, HEP Group Leader, design and testing photodetectors for CMS, development of radiation tolerant glasses, CMS tracker for SLHC.
- **V.J.Martin**: Lecturer at the University of Edinburgh, ILC group leader at Edinburgh, software development for ILC vertex detector, analysis of W and Z bosons events at the CDF experiment.
- **D. Newbold:** Reader at University of Bristol; design and development of CMS Level-1 trigger; design and commissioning of CMS computing and data-handling systems; CMS computing resources manager; CMS track trigger design and simulation for SLHC.
- **A Nomerotski:** Lecturer at Oxford University; in charge of Si development for linear colliders; extensive experience of tracking for particle physics from CDF.
- **F.J.P. Soler:** Reader at University of Glasgow; design and testing RICH detectors LHCb; detectors for future neutrino facilities; member council for Neutrino Factory International Design Study; EuroNu coordinator Detector Work Package.
- **M.A. Thomson:** Reader in Experimental Particle Physics at the University of Cambridge; research activities include: particle flow calorimetry; linear collider detector design; neutrino oscillation physics; UK MINOS Spokesperson; leader of the ILD detector optimisation studies for the ILC.
-

2.3 Consortium as a whole

There is participation from 87 institutions from ~21 European countries in the Integrating Activity DevDet. As listed in Table 2.1, many countries group their efforts into scientific consortia, joining the proposal as a single legal entity:

- Bulgaria, 2 institutes, 1 legal entity
- Czech Republic, 4 institutes, 1 legal entity
- France, 11 institutes, 2 legal entities
- Greece, 2 institutes, 1 legal entity
- Israel, 3 institutes, 2 legal entities
- Italy, 12 institutes, 1 legal entity
- The Netherlands, 1 national laboratory
- Poland, 4 institutes, 1 legal entity
- Spain, 6 institutes, 3 legal entities
- Sweden, 2 institutes, 1 legal entity
- Switzerland, 5 institutions, 1 legal entity

Other countries such as Germany (13 institutes) and United Kingdom (13 institutes) are still in the process of defining a clustering of their efforts into joint research units. There are currently 50 legal entities signing the proposal. This is expected to decrease to 25 beneficiaries for the project phase.

The DevDet project aims at improving the necessary European infrastructures in view of the upcoming detector development efforts for the four largest future projects in European particle physics (SLHC, Linear Collider, Neutrino and SuperB experiments). It will give access to these facilities to thousands of particle physicists and users from outside the field. At present CERN alone has 8000 registered users, who all use directly, or sometimes indirectly, the infrastructures and networks linked to the DevDet project. The important changes to those infrastructures, described in the proposal, clearly address urgent needs in order to perform the development towards detectors of the required performance, stability and radiation hardness for these four major future projects in an effective manner. While many users have already used the facilities extensively and are well aware of their present limitations, others are awaiting the improvements described in DevDet before making effective use of the facilities.

This explains why many institutes throughout Europe are ready to contribute with their own funds to the improvements of the infrastructures and the developments of the networking activities around common software, microelectronics design tools and project offices.

The backbone of the present consortium is based on a combination of solid experience and competence, combined with an established common need for the proposed infrastructure improvements, networking developments and access provisions.

By forming work-packages spanning across the four future detector development projects DevDet ensures a substantial increased cross-participation and effective use of resources. It strengthens the links between the four communities through a large collaborative effort. The National Contact Group forms an effective backbone for this collaborative project, and this group has already proven its effectiveness in the proposal phase by streamlining the participation of their in the proposal.

CERN has the Coordinator has organisational structures that have successfully supported development and construction of accelerator and experimental systems for more than 50 years. Furthermore, CERN and DESY are the largest particle physics laboratories in Europe and have a history of providing access to test beam facilities for development of particle physics experiments and detectors. They will provide complementary test beams for the specific needs of the DevDet consortium, in order to satisfy the largest possible user base. Other laboratories providing irradiation and test facilities for trans-national access have already demonstrated their qualities by their track record of making their facilities available for outside users.

The participants are carefully selected and their roles defined to be able to address the objectives of the project in the best possible way, and to give overall coherence to the consortium and the project execution. The selection of groups has also been restrictive, choosing balanced groups behind every deliverable, taking advantage of the fact that the expertise of most of these groups are known to the management of the project. We are greatly helped by that the participating organisations have a long history of collaborative links in a number of projects, as shown in section 2.2. Furthermore, by their commitment to the future detector development projects mentioned, and the process of defining crucial infrastructures for these projects, they are committed to carry out the work described in this proposal. The proposal addresses the core research programs of the participating groups, and gives way to many more researchers inside and outside Europe to make use of these facilities.

In the future, new partners may want to join the DevDet Consortium. This process will be defined in the Consortium, and will involve discussions in the Steering Group and approval of the Institute Board The main criteria for admission will be linked to the objectives (deliverables and milestones) of DevDet. Such processes are common in our field of large collaborative efforts and we have a good record of being inclusive and at the same time improving the collaborations capabilities.

The detector developments that are made possible and supported by the DevDet infrastructures entail countless links to industries and SME across Europe and also outside. Most of these detector developments are carried out in close collaboration with industry, and the results flow directly back to the industry. This in turn, allows industry to push their technologies further, profiting their technology base and R&D in an important way. This applies across large industrial areas as sensors, electronics, software, materials, mechanical and thermal engineering, component quality, etc. The detector developments are also among the most important educational projects in particle physics, with a large numbers of students achieving outstanding skills in advanced instrumentation and scientific engineering. The large majority of these students continue their careers in industry, bringing with them an exceptional knowledge of how R&D, prototyping and technology development are done, and in some cases with clear ideas of how research results in our field can exploited and used in industrial or medical instrumentation.

No sub-contracting is foreseen in this proposal.

Country	**Participant Full Name**	**Participant Short Name**	**Legal Entity Short Name**
CERN	European Organization for Nuclear Research - COORDINATOR	CERN	CERN
Austria	Oesterreichische Akademie der Wissenschaften/AustrianAcademy of Sciences	OEAW	OEAW
Belgium	Université Catholique de Louvain	UCL	UCL
	Université Libre de Bruxelles	ULB	ULB
Bulgaria	Institute for Nuclear Research and Nuclear Energy	INRNE	INRNE
	St. Kliment Ohridski University of Sofia	UniSofia	
Czech Republic	Institute of Physics, Academy of Sciences of the Czech Republic	IPASCR	IPASCR
	Nuclear Physics Institute, Academy of Sciences of the Czech Republic	NPIASCR	
	Czech Technical University in Prague	CTU	
	Charles University in Prague	CU Prague	
Finland	Helsingin yliopisto	UH	UH
France	Centre National de la Recherche Scientifique / Institut National de Physique Nucléaire et de Physique des Particules (Lead beneficiary)	CNRS	CNRS
	AstroParticule et Cosmologie	APC	
	Centre de Physique des Particules de Marseille	CPPM	
	Institut Pluridisciplinaire Hubert Curien	IPHC	

	Institut de Physique Nucleaire de Lyon	IPNL	
	Laboratoire de l'Accelerateur Lineaire	LAL	
	Laboratoire d'Annecy le Vieux de Physique des Particules	LAPP	
	Laboratoire Leprince-Ringuet	LLR	
	Laboratoire de Physique Corpusculaire de Clermont-Ferrand	LPC	
	Laboratoire de Physique Nucleaire et de Hautes Energies	LPNHE	
	Laboratoire de Physique Subatomique et de Cosmologie de Grenoble	LPSC	
	Commissariat à l'Énergie Atomique	CEA	CEA
Germany	Rheinisch-Westfälische Technische Hochschule	RWTH Aachen	RWTH Aachen
	Stiftung Deutsches Elektronen-Synchrotron	DESY	DESY
	Max-Planck-Institut fuer Physik, Munich	MPG-MPP	MPG-MPP
	Universität Karlsruhe (TH)	UNIKARL	UNIKARL
	Rheinischen Friedrich Wilhelms Universität Bonn	Uni Bonn	Uni Bonn
	Technische Universität Dresden	TUD	TUD
	Albert-Ludwigs Universität	ALU-FR	ALU-FR
	Georg-August-Universitaet Goettingen	Goettingen	Goettingen
	University of Hamburg	UNI-Hamburg	UNI-Hamburg
	Ruprecht-Karls-Universität Heidelberg	UHEI	UHEI
	Johannes-Gutenberg-Universitaet Mainz	JOGU	JOGU
	Universität Siegen	UNSIEG	UNSIEG
	Bergische Universität Wuppertal	Wuppertal	Wuppertal
Greece	National Technical University of Athens	NTUA	NTUA
	National Center for Scientific Research "Demokritos"	NRCPS	
Hungary	KFKI Research Institute for Particle and Nuclear Physics of the Hungarian Academy of Sciences	KFKI-RMKI	KFKI-RMKI
Israel	Weizmann Institute of Science	Weizmann	Weizmann
	Israel Institute of Technology, Haifa	Technion	
	Tel Aviv University	TAU	TAU
Italy	Istituto Nazionale di Fisica Nucleare	-	INFN
	Bari	INFN-BA	
	Bologna	INFN-BO	
	Ferrara	INFN-FE	
	Genova	INFN-GE	
	Laboratori Nationall di Frascati	INFN-LNF	
	Lecce	INFN-LE	
	Milano	INFN-MI	
	Padova/Legnaro	INFN-LNL-PD	
	Pavia	INFN-PV	
	Perugia	INFN-PG	
	Pisa	INFN-PI	
	Roma I	INFN-ROMA1	
Lithuania	Vilniaus Universitetas	VU	VU

Netherlands	Stichting voor Fundamenteel Onderzoek der Materie	FOM	FOM
Norway	Universitetet i Bergen	UiB	UiB
Poland	AGH University of Science and Technology	AGH-UST	AGH-UST
	Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences	IFJPAN	
	University of Warsaw	UW	
	Jagellonian University, Cracow	UJ	
Romania	West University of Timisoara	UVT	UVT
Slovenia	Jozef Stefan Institute	JSI	JSI
Spain	Consejo Superior de Investigaciones Científicas	CSIC	CSIC
	CNM Centro Nacional de Microelectronica de Barcelona	CNM-IMB	
	Instituto de Fisica de Cantabria	IFCA	
	Instituto de Fisica Corpuscular, Valencia	IFIC	
	Universitat de Barcelona	UB	
	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	CIEMAT	CIEMAT
	Universidade de Santiago de Compostela	USC	USC
Sweden	Uppsala University	UUpps	SWEDET
	Lund University	ULund	
Switzerland	Universite de Geneve	UNIGE-DPNC	UNIGE
	Eidgenoessiche Technische Hochschule Zuerich	ETHZ	
	Paul Scherrer Institut	PSI	
	Universität Zürich	UNIZH	
	Universität Bern	UNIBE	
UK	Science & Technology Facilities Council	STFC	STFC
	University of Bristol	UNIVBRIS	UNIVBRIS
	Brunel University	UBRUN	UBRUN
	The Chancellor, Masters and Scholars of the University of Cambridge	UCAM	UCAM
	University of Edinburgh	UEDIN	UEDIN
	University of Glasgow	UNIGLA	UNIGLA
	University of Liverpool	UNILIV	UNILIV
	The University of Manchester	UNIMAN	UNIMAN
	University of Oxford	UOXF	UOXF
	Queen Mary and Westfield College, University of London	QMUL	QMUL
	Royal Holloway and Bedford New College	RHUL	RHUL
	The University of Sheffield	USFD	USFD

Table 2.1. List of participants and consortia participating in DevDet.

2.4 Resources to be committed

The tables below give a detailed breakdown of the resources to be committed for each of the work packages and for each of the participants.

Work package	Type	PM	Personnel cost (Euro)	Subcontracting (Euro)	Consumables and prototypes (Euro)	Travel (Euro)	Indirect costs (Euro)	Access costs (Euro)	Total budget (Euro)	Requested EC contribution (Euro)
WP1	MGT	108	643,200	0	0	335,000	586,920	0	1,565,120	800,000
WP2	COORD	385	2,173,100	0	0	76,500	1,362,350	0	3,611,950	1,200,000
WP3	COORD	437	2,375,800	0	750,000	279,000	2,227,338	0	5,632,138	1,200,000
WP4	COORD	338	1,969,400	0	30,000	138,000	1,282,440	0	3,419,840	523,000
WP5	COORD	68	367,700	0	0	100,000	276,426	0	744,126	250,000
WP6	SUPP	2	12,000	0	12,000	117,000	84,600	0	225,600	150,000
WP7	SUPP	2	11,600	0	34,000	48,500	56,460	0	150,560	100,000
WP8	SUPP	10	50,600	0	0	189,600	124,785	494,400	859,385	750,000
WP9	RTD	176	945,400	0	815,000	90,000	1,145,220	0	2,995,620	1,000,000
WP10	RTD	1198	5,822,300	0	1,864,265	322,600	4,935,849	0	12,945,014	3,140,000
WP11	RTD	539	2,774,400	0	630,000	145,000	2,104,500	0	5,653,900	1,885,000
Total		**3263**	**17,145,500**	**0**	**4,135,265**	**1,841,200**	**14,186,888**	**494,400**	**37,803,253**	**10,998,000**

Table 2.2 Overview of resources per work package for the full duration of the project. A breakdown of the cost into personnel cost, materials and consumables, travel and access costs is given.

Participant number	Short name	PM	RTD	Coordination	Supprt	Management	total	requested EU contribution (Euro)
1	CERN	440	3,486,080	2,242,400	225,600	992,000	6,946,080	2,443,400
2	OEAW	64	520,716	0	0	0	520,716	122,600
3	UCL	4	0	0	195,120	0	195,120	164,100
4	ULB	34	160,000	239,360	0	0	399,360	75,300
5	INRNE	36	200,000	0	0	0	200,000	66,700
6	IPASCR	126	980,640	0	120,360	0	1,101,000	337,300
7	UH	16	172,480	0	0	0	172,480	57,500
8	CNRS	431	3,254,880	1,700,000	0	0	4,954,880	1,295,100
9	CEA	63	669,830	92,848	0	0	762,678	219,700
10	RWTH_Aachen	29	294,720	62,400	0	0	357,120	119,200
11	DESY	207	947,144	1,399,680	150,560	0	2,497,384	564,700
12	MPG_MPP	45	401,500	405,000	0	0	806,500	189,700
13	UNIKARL	75	662,240	0	96,080	0	758,320	251,700
14	Uni_Bonn	86	357,120	548,800	0	151,360	1,057,280	306,000
15	TUD	24	228,480	0	0	0	228,480	57,400
16	ALU_FR	31	321,280	0	0	0	321,280	105,600
17	Goettingen	24	238,720	0	0	0	238,720	42,500
18	UNI_Hamburg	18	189,440	0	0	0	189,440	57,100
19	UHEI	16	228,960	0	0	0	228,960	59,600
20	JOGU	19	193,920	0	0	0	193,920	63,100
21	UNSIEG	12	111,360	0	0	0	111,360	0
22	Wuppertal	18	268,640	0	0	0	268,640	59,300
23	NTUA	20	188,800	0	0	0	188,800	63,200
24	KFKI_RMKI	18	139,200	0	0	0	139,200	46,400
25	Weizmann	24	216,960	0	0	0	216,960	72,100
26	TAU	24	228,160	0	0	0	228,160	44,200
27	INFN	292	1,754,720	1,523,040	0	0	3,277,760	937,200
28	VU	8	70,400	0	0	0	70,400	23,500
29	FOM	82	368,000	284,800	0	270,400	923,200	253,100
30	UiB	18	268,640	0	0	0	268,640	59,300
31	AGH_UST	139	750,400	169,600	0	0	920,000	222,500
32	UVT	24	80,740	0	0	0	80,740	31,000
33	JSI	1	0	0	140,525	0	140,525	139,200
34	CSIC	168	557,424	1,008,973	0	0	1,566,397	403,200
35	CIEMAT	23	196,280	0	0	0	196,280	50,200
36	USC	12	0	74,400	0	0	74,400	24,800
37	SWEDET	33	234,240	127,360	123,520	0	485,120	204,200
38	UNIGE	269	1,238,400	1,708,640	108,260	0	3,055,300	717,200
39	STFC	37	234,020	276,910	0	0	510,930	134,100
40	UNIVBRIS	12	0	118,560	0	0	118,560	39,500
41	UBRUN	13	0	118,560	75,520	0	194,080	99,100
42	UCAM	36	0	350,080	0	0	350,080	96,800
43	UEDIN	10	0	112,323	0	0	112,323	33,400
44	UNIGLA	81	509,760	324,960	0	151,360	986,080	333,000
45	UNILIV	25	215,040	116,160	0	0	331,200	94,800
46	UNIMAN	36	295,840	120,160	0	0	416,000	90,700
47	UOXF	12	0	118,560	0	0	118,560	39,500
48	QMUL	4	0	44,320	0	0	44,320	15,000
49	RHUL	12	0	120,160	0	0	120,160	20,200
50	USFD	12	159,360	0	0	0	159,360	53,000
		3263	**21,594,534**	**13,408,054**	**1,235,545**	**1,565,120**	**37,803,253**	**10,998,000**

Table 2.3 Overview of resources for each of the participants for the full duration of the project. A breakdown of the total cost (including indirect cost) is given for each type of activity (RTD, COORD, SUPP, MGT).

The total estimated budget is based on the experience of the participants in carrying out R&D programmes associated with the engineering-oriented design of complex facilities for which advanced medium-to-high-risk technologies are employed. Planning and optimisation of financial and human resources have been done according to schemes used by European research laboratories with international reputations in carrying out similar projects. The total estimated budget related to the Integrating Activity includes the cost of: (1) staff and temporary contract salaries of scientists, engineers and technicians, (2) post-doctoral fellowships, (3) consumables relating to prototyping activities, (4) travel and subsistence costs for research, technological and managerial activities and attendance at the planned meetings and workshops.

All participants involved in the Integrating Activity already have activities in fields related to it and have existing sources of funding for this work. They have utilised these sources to determine their contribution and verified that the funds will be available to carry out the work. In this process of checking the available funding, the individual participants, as well as their respective National contacts have been involved.

The total expected budget for all the activities planned within the Integrating Activity is 37.8 M€. The financial contribution required from the EU of 11 M€ covers 29% of this total budget. The total financial contribution required by each participant for all the Integrating Activity tasks is such that the EU funding is generally well below the relevant upper limit permitted by the EC. The required contribution for Management activities is 1.6 M€, i.e. 4% of the total estimated budget and some 7% of the total requested budget. The Coordination activities cover 36% of the total budget, and 29% of the requested EU budget. The RTD activities towards the improvement of the infrastructures cover 57% of the total budget and 55% of the requested EU funds.

The transnational access Support activities cover 1.2 M€ of which 1.0 M€ requested from the EU. The total budget for transnational access is low, because the managements of several facilities have agreed to offer Access either at zero cost (CERN, DESY, UNIKARL and PSI (UNIGE) EH facilities) or at a fraction of the actual operating costs (UCL). For CERN and DESY alone, these operating cost represent already a major budget of 62.5 M€. The requested EC contribution for Access costs (operation of the infrastructures) represents 0.5 M€, whereas 0.4 M€ will be devoted to offering travel and subsistence support for the users of the facilities, the remaining 0.1 M€ are used for advertising and to the coordination of the transnational access.

The expenditures in the Coordination activities are dominated by personnel costs. This is directly linked to the complexity and time-consuming nature of the microelectronics design, software and data acquisition development activities in particular.

Besides substantial personnel investments, the RTD activities also comprise a few larger materials investments. In particular, for the upgrading of the irradiation facilities in WP9, major investments are needed to refurbish experimental areas, including the installation of services and controls, as well as for the purchase of a more intense GIF++ source. In WP10 sizeable materials investments are needed for the adaptation of the experimental area and counting room, as well as for the technical equipment of the EUVIF facility. The reference facility has to be of sizeable dimensions to contain hadronic showers in order to effectively test the individual detectors in the context of a particle flow assessment. In WP11, the upgrading a test beam providing low-energy particles with excellent particle identification for the neutrino detector developments is a cost-driver.

It is planned that the EC contribution will be received by the Coordinating institute and promptly distributed to the relevant authorities of the participants. The sums distributed will be as specified in the contract. The EC contribution will be integrated with the participant contribution using the usual financial procedures of that participant. All receipts for expenditure using these funds will be kept for the duration of the Project and time sheets will be maintained for all staff using these funds. An amount of 5 k€ is the estimated cost of the required Audit Certification. This figure is based on the assumption that for the major Governmental and Public Institutions, an internal certification will be accepted.

WP6, CERN

Calculation of the Unit Cost for Transational Access

Participant number	1	**Organisation short name**		CERN	
Short name of Infrastructure	**SPS-PS-beams**	**Installation number**	**0.1**	**Short name of Installation**	
Name of Installation	**SPS test beams, GIF and PS East hall iradiation facilities**			**Unit of access**	**8 hour**

	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ū)**
	Electricity consumption			11,500,000
	Maintenance cost (including fluids and materials)			14,500,000
	Total A			**26,000,000**
	of which subcontracting (AŌ			
	Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	Technical staff (acceleration operation and maintenance)	236,000	52	12,272,000
	Scientific staff (accelerator operation and maintenance)	288,000	65	18720000
				0
				0
				0
				0
				0
				0
				0
	Total B			**30,992,000**
C. Indirect eligible costs = 7% x ([A-AŌ]+B)				3,989,440
D. Total estimated access eligible costsŹ = A+B+C				60,981,440
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				12,600
F. Fraction of the Unit cost to be charged to the proposal [1]				0%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**0**
H. Quantity of access offered under the proposal (over the whole duration of the project)				1,200

WP7, DESY

Calculation of the Unit Cost for Transational Access

Participant number	11	**Organisation short name**		DESY	
Short name of Infrastructure	**DESY-TB**	**Installation number**	**7.1**	**Short name of Installation**	**DESY-TB**
Name of Installation	**DESY testbeam infrastructure**			**Unit of access**	**TB week**

	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ū)**
	Electricity consumption for 3 years			750,000
	Maintenance and material cost for 3 years			210,000
	Total A			**960,000**
	of which subcontracting (AŌ			
	Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	Technical staff (maintenance)	500	52	26,000
	Scientific staff (maintenance and user support)	4,400	65	286000
	Scientific staff (user support)	4000	65	260000
				0
				0
				0
				0
				0
				0
	Total B			**572,000**
C. Indirect eligible costs = 7% x ([A-AŌ]+B)				107,240
D. Total estimated access eligible costsŹ = A+B+C				1,639,240
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				100
F. Fraction of the Unit cost to be charged to the proposal [1]				0%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**0**
H. Quantity of access offered under the proposal (over the whole duration of the project)				30
I. **Access Cost [2] = G x H**				**0**

WP8.1, UCL

Calculation of the Unit Cost for Transational Access

Participant number	**3**	**Organisation short name**	**UCL**		
Short name of Infrastructure	**CRC**	**Installation number**	**8.1**	**Short name of Installation**	**NIF,LIF,GIF**
Name of Installation	**Centre de Recherches du Cyclotron (CRC)**			**Unit of access**	**Beam hour**

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ū)**
Electricity			1,292,600
Maintenace (Consumables,Dosimetry)			821,532
Total A			**2,114,132**
of which subcontracting (AŌ			
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
Scientific Staff (2 FTE)	14400	44.22	636,768
Enginneers (3 FTE)	21600	41.4	894240
Technical Staff (10 FTE)	72000	25.11	1807920
			0
			0
			0
			0
			0
			0
Total B			**3,338,928**
C. Indirect eligible costs = 7% x ([A-AŌ]+B)			381,714
D. Total estimated access eligible costsŹ = A+B+C			5,834,774
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			10,000
F. Fraction of the Unit cost to be charged to the proposal [1]			50%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)			**291.74**
H. Quantity of access offered under the proposal (over the whole duration of the project)			350
I. **Access Cost** [2] **= G x H**			**102,109**

WP8.2, JSI

Calculation of the Unit Cost for Transational Access

Participant number	**33**	**Organisation short name**	**JSI**		
Short name of Infrastructure	**JSI**	**Installation number**	**8.2**	**Short name of Installation**	**JSI**
Name of Installation	**J. Stefan Institute TRIGA reactor**			**Unit of access**	**beam hour**

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ū)**
electricity, security, water, heating, cleaning			224,000
maintenance			340,000
QA, library, computer network			40,000
secretariat			92,000
travels			10,000
Total A			**706,000**
of which subcontracting (AŌ			
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
technical staff (operators)	27,200	17.5	476,000
			0
researchers (irradiation preparation and supervision)	13600	33	448800
			0
			0
			0
			0
			0
			0
Total B			**924,800**
C. Indirect eligible costs = 7% x ([A-AŌ]+B)			114,156
D. Total estimated access eligible costsŹ = A+B+C			1,744,956
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			4,000
F. Fraction of the Unit cost to be charged to the proposal [1]			50%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)			**218.12**
H. Quantity of access offered under the proposal (over the whole duration of the project)			450
I. **Access Cost** [2] **= G x H**			**98,154**

WP8.3, UNIKARL, (sub-contracted to Zyklotron AG)

Calculation of the Unit Cost for Transational Access

Participant number	13	**Organisation short name**		UNIKARL	
Short name of Infrastructure	UNIKARL	**Installation number**	8.3	**Short name of Installation**	UNIKARL
Name of Installation	Zyclotron AG			**Unit of access**	Beam hour

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (€)**
	17280 hours at Zykoltron AG (450 EUR/hour)			7,776,000
	Total A			**7,776,000**
	of which subcontracting (A')			***7776000***
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff (scientific and technical only)**	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
				0
				0
				0
				0
				0
				0
				0
				0
				0
	Total B			**0**
C. Indirect eligible costs = 7% x ([A-A']+B)				0
D. Total estimated access eligible costs = A+B+C				7,776,000
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				17,280
F. Fraction of the Unit cost to be charged to the proposal [1]				100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**450**
H. Quantity of access offered under the proposal (over the whole duration of the project)				120
I. Access Cost [2] = G x H				**54,000**

WP8.4.1, IPASCR-NPL

Calculation of the Unit Cost for Transational Access

Participant number	6	**Organisation short name**		IPASCR	
Short name of Infrastructure	NPL	**Installation number**	8.4.1	**Short name of Installation**	NPL
Name of Installation	Nuclear Reactor LVR-15			**Unit of access**	hours

	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ũ)**
	The reactor operation and beam costs corresponding to 1 offered facility (NRI, plc.)			420,000
	Costs for laboratory space and utilities paid to NRI, plc.			20,000
	Maintenance and consumables			16,000
	Management activities			7,200
	All items are related to 4 years			
	Total A			**463,200**
	of which subcontracting (AČ			
	Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	Scientists 1x full time, per 4 years	8,096	17.3	140,061
	Technicians 1x full time, per 4 years	8,096	10.3	83388.8
				0
				0
				0
				0
				0
				0
				0
	Total B			**223,450**
C. Indirect eligible costs = 7% x ([A-AÕ]+B)				48,065
D. Total estimated access eligible costsŹ = A+B+C				734,715
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				4,000
F. Fraction of the Unit cost to be charged to the proposal [1]				100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**183.68**
H. Quantity of access offered under the proposal (over the whole duration of the project)				150
I. Access Cost [2] = G x H				**27,552**

WP8.4.2, IPASCR-U-120M

Calculation of the Unit Cost for Transational Access

Participant number	6	**Organisation short name**		IPASCR	
Short name of Infrastructure	U-120M	**Installation number**	8.4.2	**Short name of Installation**	U-120M
Name of Installation	Isochronous cyclotron U-120M			**Unit of access**	beam hour

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			Eligible Costs (Ū)
Electricity, cooling, liquid nitrogen			460,131
Maintenance			536,403
Others			120,659
Travels			60,000
Total A			1,177,193
of which subcontracting (AÕ			
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
Scientific staff	14,400	21	302,400
Engineer staff	57400	16	918400
Technical staff	96000	11	1056000
			0
			0
			0
			0
			0
			0
Total B			2,276,800
C. Indirect eligible costs = 7% x ([A-AÕ]+B)			241,780
D. Total estimated access eligible costsŽ = A+B+C			3,695,773
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			12,000
F. Fraction of the Unit cost to be charged to the proposal [1]			100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)			307.98
H. Quantity of access offered under the proposal (over the whole duration of the project)			100
I. **Access Cost** [2] **= G x H**			30,798

WP8.4.3, IPASCR-microtron

Calculation of the Unit Cost for Transational Access

Participant number	6	**Organisation short name**		IPASCR	
Short name of Infrastructure	Microtron lab	**Installation number**	8.4.3	**Short name of Installation**	microtron
Name of Installation	Microtron lab			**Unit of access**	beam hour

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			Eligible Costs (Ū)
Electricity			35,000
Maintenance			105,000
Travels			30000
Others			14000
Total A			184,000
of which subcontracting (AÕ			
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
Scientific Staff	2,400	21	50,400
Engineer Staff	18000	16	288000
Technical Staff	3600	11	39600
			0
			0
			0
			0
			0
			0
Total B			378,000
C. Indirect eligible costs = 7% x ([A-AÕ]+B)			39,340
D. Total estimated access eligible costsŽ = A+B+C			601,340
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time			6,000
F. Fraction of the Unit cost to be charged to the proposal [1]			100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)			100.22
H. Quantity of access offered under the proposal (over the whole duration of the project)			50
I. **Access Cost** [2] **= G x H**			5,011

WP8.5, UBRUN

Calculation of the Unit Cost for Transational Access

Participant number	**41**	**Organisation short name**		**UBRUN**		
Short name of Infrastructure	**UBRUN**	**Installation number**	**8.5**	**Short name of Installation**	**UBRUN**	
Name of Installation	**Gamma Irrradiation Facility**			**Unit of access**	**Beam hour**	

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .				**Eligible Costs (Û)**
Annual cost of running facility				342,312
Sources				220,000
Maintenance				22,000
			Total A	**584,312**
			of which subcontracting (AÕ	
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**		**(3) = (1) x (2)**
Scientific Staff	1200	75		90,000
Engineer Staff	0	0		0
Technical Staff	3200	28		89600
				0
				0
				0
				0
				0
				0
			Total B	**179,600**
C. Indirect eligible costs = 7% x ([A-AÕ]+B)				53,474
D. Total estimated access eligible costsŽ = A+B+C				817,386
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				50,000
F. Fraction of the Unit cost to be charged to the proposal [1]				100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**16.35**
H. Quantity of access offered under the proposal (over the whole duration of the project)				2,000
I. **Access Cost** [2] **= G x H**				**32,700**

WP8.6, UUpps

Calculation of the Unit Cost for Transational Access

Participant number	**37**	**Organisation short name**		**Uupps**		
Short name of Infrastructure	**TSL**	**Installation number**	**8.6**	**Short name of Installation**	**TSL**	
Name of Installation	**The Svedberg Laboratory**			**Unit of access**	**Beam hour**	

Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .				**Eligible Costs (Û)**
Electrical power				1,278,720
Maintenance, utilities, consumables				551,400
			Total A	**1,830,120**
			of which subcontracting (AÕ	
Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**		**(3) = (1) x (2)**
Scientific staff (2 fte)	13,120	52.22		685,126
Scientific staff (control etc) (3 fte)	19680	41.58		818294.4
Engineers (5 fte)	32800	34.16		1120448
Technicians (5 fte)	32800	28.53		935784
				0
				0
				0
				0
				0
			Total B	**3,559,653**
C. Indirect eligible costs = 7% x ([A-AÕ]+B)				377,284
D. Total estimated access eligible costsŽ = A+B+C				5,767,057
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				10,000
F. Fraction of the Unit cost to be charged to the proposal [1]				100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**576.71**
H. Quantity of access offered under the proposal (over the whole duration of the project)				150
I. **Access Cost** [2] **= G x H**				**86,507**

WP8.7.1, UNIGE-PSI-PIF

Calculation of the Unit Cost for Transational Access

Participant number	**38**	**Organisation short**		**PSI**	
Short name of Infrastructure	**PSI-PIF**	**Installatio n number**	**8.7.1**	**Short name of Installation**	**PIF**
Name of Installation	**Proton Irradiation Facility**			**Unit of access**	**beam hour**

A. Estimated direct eligible costs of providing access within the project life-time excluding personnel costs	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (€)**
	Total A			**0**
	of which subcontracting (A')			
B. Estimated personnel direct eligible costs needed to provide access within the project life-time	**Category of staff (scientific and technical only)**	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	1 scientist	2,560	85.63	219,213
	1 manager	960	101.88	97,805
	1 technician	1920	59.48	114,202
	1 operator	2560	59.48	152,269
				0
				0
				0
				0
				0
	Total B			**583,488**
C. Indirect eligible costs = 7% x ([A-A']+B)				40,844
D. Total estimated access eligible costs = A+B+C				624,332
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				2,560
F. Fraction of the Unit cost to be charged to the proposal [1]				100%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**243.88**
H. Quantity of access offered under the proposal (over the whole duration of the project)[3]				250
I. **Access Cost [2] = G x H**				**60,970**

WP8.7.2, UNIGE-PSI-EH

Calculation of the Unit Cost for Transational Access

Participant number	**38**	**name**		**PSI**	
Short name of Infrastructure	**EH Facilities**	**Installation number**	**8.7.2**	**Short name of Installation**	**EH Facilities**
Name of Installation	**Pion/Muon Beamline**			**Unit of access**	**8 hour**

	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .			**Eligible Costs (Ū)**
	Maintenance, repair & leasing			87,171
	Water, Energy, waste treatment			141,965
	Administrative expenses & central costs			508,085
	Cost Distribution			2,714,769
	Total A			**3,451,990**
	of which subcontracting (AÕ			
	Category of staff (scientific and technical only)	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	Scientist			622,374
	Technician			431574
	Services from Large Facilities Department (GFA)			4184231
				0
				0
				0
				0
				0
				0
	Total B			**5,238,179**
C. Indirect eligible costs = 7% x ([A-AÕ]+B)				608,312
D. Total estimated access eligible costsŹ = A+B+C				9,298,481
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time				12,600
F. Fraction of the Unit cost to be charged to the proposal [1]				0%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**0**
H. Quantity of access offered under the proposal (over the whole duration of the project)[3]				TBD
I. **Access Cost [2] = G x H**				**0**

3. Impact

3.1 Expected impacts listed in the work programme

The main impact of the DevDet Integrated Activity will be to coordinate the majority of detector development programmes for future particle physics experiments around a series of key European infrastructures based around some of the main laboratories in Europe (CERN, DESY, Laboratorio Nazionale di Frascati). As this proposal covers detector R&D crucial for all the future accelerator facilities listed by the European Strategy for Particle Physics document (Super-LHC, Linear Colliders, all future Neutrino Facilities and Super-B Flavour Physics Facilities), it will impact on most particle physics institutions in Europe (87 institutions from 21 different countries).

Each of these individual future accelerator facilities have expected budgets ranging between 500 million to 6 billion euros so many countries will be expected to contribute to their construction. In order to be able to exploit the physics from these accelerator facilities, advanced detector concepts that can operate under the individual conditions of each of the accelerators (radiation environment, data throughput, challenging luminosity and occupancy conditions, spatial constraints, etc.) at a reasonable cost need to be developed. Building, upgrading and developing the infrastructures needed to perform detector R&D tests (test beams and irradiation facilities), coordinating the development for new microelectronic designs, developing the software tools that will meet the challenges of the experiments, as well as coordinating the work on Linear Collider and Neutrino Facility Detectors, will benefit a community of around eight thousand collaborators from all around the world that will work on these experiments in the future. The involvement of the EU in forging the DevDet consortium will catalyse a collaborative approach to detector development throughout Europe and facilitate high quality research everywhere.

Detector development projects until now have been quite diverse and focused on the individual experimental needs. By coordinating all the detector development activities for future facilities in Europe, it will provide solutions for common problems with the synergy derived from extracting expertise from different communities, thereby increasing the efficiency of the detector development cycle. The DevDet Integrating Activity will be able to implement the coordination of the R&D detector development tasks in line with the vision for a common European Strategy for Particle Physics. A European approach is needed to ensure that the common strategy for particle physics is carried out and to maximise the synergy in detector development between different communities.

The main stakeholders that will benefit from this Integrating Activity will be Research Institutes, Universities and Funding Agencies that will participate in the future accelerator particle physics programme. The coordination and organisational efforts will aim to involve the key stakeholders that drive detector development in SLHC, Linear Collider, neutrino facilities and Super-B factories, in addition to creating a link to the design teams for each of the individual accelerator facilities. The main benefit will be to define the detector concepts that can be included as part of Conceptual or Engineering Design Reports for each of the future facilities. This will allow the management for those facilities to make informed choices on the technical feasibility of realising the experiments at the facilities. This will be the basis on which these future facilities and the experiments to be built at them can then be built with confidence.

Future accelerator facilities are an indispensable step towards improving our understanding in the determination of the Standard Model parameters and of the parameters of New Physics, resulting from possible discoveries. Creating this framework for cooperation in future detectors at these facilities will allow Europe to maintain the leadership in particle physics by providing solid ground for fundamental advances in the technology that drives detector development. The technical work to be carried out aims at mastering technologies that not only meet the needs of the future generation particle physics experiments but also will have significant impact on other European or global infrastructures using similar detector components, such as the nuclear physics, astrophysics, space science, medical physics and condensed matter (synchrotron and spallation source) communities.

Through the detector development cycle, partnerships will be forged with the European detector and microelectronics industry resulting in improved technical capabilities for European businesses that will increase the competitiveness of European industry.

3.2 Dissemination and/or exploitation of project results, and management of intellectual property

The dissemination of the knowledge acquired during DevDet will receive particular attention. It will occur in three ways:

1. A Web-based information system (DevDet website)
2. Publications in refereed journals and a system of DevDet reports
3. Presentation of results at the Annual DevDet Workshop, at conferences and related workshops.

It is the responsibility of the Management Team together with the Work Package Leaders to ensure the operation, quality and success of this knowledge dissemination scheme.

1. Web-based information system

A web-based information-system (the DevDet website) will be created and maintained by the management support team. The DevDet website will act as the central hub of knowledge dissemination inside the consortium and to the scientific community as well as industry. It allows for the rapid distribution of all information relevant to the project. It will consist of an overview section for non-experts (in several European languages), expert information on the goals and status of the individual work-packages, user access information and information for industrial partners as well as internal information with managerial and technical information. Centrally managed tools will be a content management system for the website maintenance, a repository for internal and public reports and publication and the agenda and information system Indico for the organisation and documentation of meetings, a recruitment centre to announce open positions and a related link section.

2. Publications and reports

Written publications and reports are the main means of persistent dissemination of the scientific outcome of the project. A staged system consisting of rapid reports (memos), internally refereed reports and publications in externally-refereed journals will be pursued. Technical information mainly relevant for the consortium partners will be published as memos. All achieved milestones will be accompanied by a written report. The Management Team, with the help of the Work Package Leaders, will encourage the publication of scientific results in refereed journals and ensure the quality of the publications by assigning referees prior to journal submission.

3. Presentation of results

The results of the project will be continuously made public by presentation at public scientific conferences and at the Annual Participant Meeting of the project. The latter is open to the participants of the project but also to the interested user community from which active feedback is sought. The Annual Participant Meeting will enhance the flow of information and the interaction between the participants and the community, strengthening the consensus and the support of the community for the future facilities. Scientific results will be presented at international conferences. The Management Team will actively seek talks at the relevant workshops and conferences.

4. Ethical Issues

No ethical issues are expected to arise during the course of the Integrating Activity.

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?		
• Does the proposal involve Human Foetal Tissue / Cells?		
• Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
• Does the proposal involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?		
Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloning farm animals?		
• Are those animals non-human primates?		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Benefit to local community (capacity building i.e. access to healthcare, education etc)		
Dual Use		
• Research having potential military / terrorist application		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	Yes	

5. Consideration of gender aspects

Recent surveys have shown that female students and scientists are under-represented in many engineering and scientific fields. Particle Physics is one of these fields. Gender balance or, in more general terms, equal opportunities have moved into the focus of the human resource policy of many research organizations. Most of the partners in the proposal are organizations with an established policy of equal gender opportunities.

The project management will strive to ensure equal opportunity, according to EU rules and guidelines, when hiring the new project staff. At the time the proposal is submitted already three work package coordinators are women. In seminars, workshops and conferences, particular attention will be paid to choose, whenever possible, women scientists as speakers and convenors in order to provide positive role models to young female scientists.

To ensure positive action in all job categories and at all levels, the gender distribution is monitored and statistics are published annually. This can easily be implemented as the timesheets will be collected centrally through an electronic database for the project. As part of the annual meeting a special meeting will be held to monitor status and progress. Apart from striving for a better gender balance the DevDet community is committed to a fair treatment in recruitment and career development regardless of sex, ethnic origin, physical handicap, sexual orientation or religion, nationality, etc. Equally important are respect and dignity in the workplace and appropriate support for those who are taking care of a child.