COMBINATION OF COLLABORATIVE PROJECT AND COORDINATION AND SUPPORT ACTION FOR INTEGRATING ACTIVITIES

FP7 – Capacities – Research Infrastructures

European Coordination for Accelerator Research and Development

EuCARD

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Participant No.	Participant organisation name	Participant short name	Country
1	European Organization for Nuclear Research	CERN	Switzerland
2	Austrian Research Centers GmbH	ARC	Austria
3	Berliner Elektronenspeicherring - Gesellschaft für Synchrotronstrahlung mbH, Berlin	BESSY	Germany
4	Budker Institute of Nuclear Physics	BINP	Russia
5	Bergische Universität Wuppertal	BUW	Germany
6	Commissariat à l'Énergie Atomique	CEA	France
7	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	CIEMAT	Spain
8	Centre National de la Recherche Scientifique	CNRS	France
9	Columbus Superconductors SpA	COLUMBUS	Italy
10	Deutsches Elektronen-Synchrotron	DESY	Germany
11	European High Temperature Superconductors GmbH & Co. KG, Hanau	EHTS	Germany
12	Ecole Polytechnique Fédérale de Lausanne	EPFL	Switzerland
13	European Synchroton Radiation Facility, Grenoble	ESRF	France
14	Forschungszentrum Dresden-Rossendorf e.V.	FZD	Germany
15	Forschungszentrum Karlsruhe GmbH	FZK	Germany
16	Gesellschaft für Schwerionenforschung mbH, Darmstadt	GSI	Germany
17	Instituto de Fisica Corpuscular (Consejo Superior de Investigaciones Cientificas – Universitat de València)	IFIC	Spain
18	Istituto Nazionale di Fisica Nucleare	INFN	Italy
19	The Henryk Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences, Krakow	INP PAN	Poland
20	The Andrzej Soltan Institute for nuclear studies in Swierk	IPJ	Poland
21	Politecnico di Torino	POLITO	Italy
22	Paul Scherrer Institut, Villigen	PSI	Switzerland
23	Politechnika Wroclawska	PWR	Poland
24	Royal Holloway University of London	RHUL	United Kingdom
25	Russian Research Center “Kurchatov Institute”	RRC KI	Russia
26	University of Southampton	SOTON	United Kingdom
27	Science and Technology Facilities Council	STFC	United Kingdom
28	Technische Universität Darmstadt	TUD	Germany

29	Polytechnic Lodz	TUL	Poland
30	Tampere University of Technology	TUT	Finland
31	Helsingin Yliopisto (University of Helsinki)	UH	Finland
32	Université Joseph Fourier Grenoble	UJF	France
33	University of Lancaster - Cockcroft Institute	ULANC	United Kingdom
34	University of Malta	UM	Malta
35	Université de Genève	UNIGE	Switzerland
36	University of Manchester - Cockcroft Institute	UNIMAN	United Kingdom
37	The Chancellor, Masters and Scholars of the University of Oxford	UOXF-DL	United Kingdom
38	Universität Rostock	URostock	Germany
39	Uppsala Universitet	UU	Sweden
40	Politechnika Warszawska	WUT	Poland

Work program topics addressed: INFRA-2008-1.1.1

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ABSTRACT

Particle physics stands at the threshold of a new era of discovery and insight. Results from the much awaited LHC are expected to shed light on the origin of mass, supersymmetry, new space dimensions and forces. In July 2006 the European Strategy Group for Particle Physics defined accelerator priorities for the next 15 years in order to consolidate the potential for discovery and conduct the required precision physics. These include an LHC upgrade, R&D on TeV linear colliders and studies on neutrino facilities. These ambitious goals require the mobilisation of all European resources to face scientific and technological challenges well beyond the current state-of-the-art and the capabilities of any single laboratory or country.

EuCARD will contribute to the formation of a European Research Area in accelerator science, effectively creating a distributed accelerator laboratory across Europe. It will address the new priorities by upgrading European accelerator infrastructures while continuing to strengthen the collaboration between its participants and developing synergies with industrial partners. R&D will be conducted on high field superconducting magnets, superconducting RF cavities which are particularly relevant for FLASH, XFEL and SC proton linacs, two-beam acceleration, high efficiency collimation and new accelerator concepts. EuCARD will include networks to monitor the performance and risks of innovative solutions and to disseminate results. Trans-national access will be granted to users of beams and advanced test facilities. Strong joint research activities will support priority R&D themes.

As an essential complement to national and CERN programmes, the EuCARD proposal will strengthen the European Research Area by ensuring that European accelerator infrastructures further improve their performance and remain at the forefront of global research, serving a community of well over 10,000 physicists from all over the world.

Proposal

1. SCIENTIFIC AND TECHNICAL QUALITY, RELEVANT TO THE TOPICS ADDRESSED BY THE CALL

1.1 Concept and objectives

1.1.1 Context

Particle physics stands at the threshold of a new era of discovery and insight. Results from the much awaited Large Hadron Collider (LHC) are expected to shed light on the origin of the mass, on the existence of new particles predicted by supersymmetry, new forces and new dimensions of space. These observations will have relevance to fundamental questions in cosmology about antimatter, missing mass and energy. Following any discoveries, a phase of precision physics is needed to measure and validate parameters and physics models. To reach the required precision, various solutions are foreseen, including significant upgrades to increase the LHC luminosity and/or energy, and TeV scale electron accelerators. These large scientific instruments push known technologies to the limit or require innovative solutions. Hence the need of improving accelerator and technology test facilities to ensure that the demanding performance requirements are met. During the course of this process, applications in other branches of science and technology can emerge, such as superconducting accelerators for intense ion beams or a fourth generation of light sources (FEL), as well as important practical applications including non-invasive medical diagnostics, cancer therapy, biology, materials science and environmental monitoring.

The large research facilities in Europe, serving over 10’000 physicists from around the world, have made essential contributions to accelerator science throughout its history. These include the national laboratories and CERN, the largest particle physics laboratory in the world. The size, complexity and cost of their research infrastructures, coupled with the technological advances required to implement successful upgrades, clearly require that European efforts be further strengthened and integrated. Major international decisions will be made within the time scale of the FP7 program to choose and locate the next “world” accelerator. Greater integration of the European effort is therefore essential.

The FP6-CARE project was the first initiative aimed at coordinating European effort in accelerator R&D. It stimulated collaboration between the European national laboratories and CERN, historically more oriented towards its non European partners operating comparable facilities, while at the same time promoting cooperation among the European national laboratories. The CARE mid-term review in 2006 praised its scientific and integration achievements, clearly demonstrating the benefits of leveraged investment. This success, together with the intrinsic added value of an integrated activity, has triggered several complementary FP7 proposals in the field of accelerators.

1.1.2 Concept

The EuCARD concept is to improve the performance of the European accelerator infrastructures (Table 1.3 a.2) while continuing to strengthen the collaboration between its European partners. The EU Combination of Collaborative Project and Coordination and Support Action for Integrating Activities (IA) appears to be the appropriate framework to carry out these ambitious upgrades by building on and consolidating the extensive collaboration successfully initiated by CARE. In so doing, EuCARD will offer a forum to all accelerator experts, including those engaged in other FP7 topical initiatives. The relative importance of the IA components is tailored to match the specific characteristics of very large and often unique research facilities. Like in CARE, the emphasis is on Joint Research Activities, which are critical to the upgrade of installations serving thousands of end users. The proposed EU funding for JRA’s was chosen to be 30 % of their total costs to maximize the scientific yield and the involvement of laboratories. Networking activities (NA) represent a small fraction of the budget but are an essential ingredient to promote progress beyond the state of the art. In view of its importance, 100 % EU funding is requested for NA. Experts from other communities, including those outside the IA, will be invited to collaborate and promote cross-disciplinary fertilisation by providing coordination with other European actions.

Most laboratories operating very large and often unique infrastructures have long established trans-national access (TA) procedures for end users. Additional European funding for such TA’s is thus not required. However, some large test facilities will be opened for the first time to users from other fields.

1.1.3 Priorities and Objectives

The initial preparatory call for EuCARD produced a wealth of proposals with a combined value over four times the anticipated budget, even with the self imposed constraint of EU funding limited to 30% of the total cost. The selection of tasks favoured those aimed at upgrading large research infrastructures in compliance with the latest priorities defined by recognized European Associations and bodies:

a) *the initiative* for launching this proposal comes from the European Steering Group for Accelerator R&D (ESGARD), set up by the directors of CERN, CEA-DSM-IRFU, DESY, INFN-LNF, CNRS-IN2P3, PSI and STFC, in consultation with the European Committee for Future Accelerators (ECFA), for the optimisation and enhancement of R&D in the field of accelerator physics in Europe;
b) *concerning accelerators for particle physics*, the European priorities were defined by the CERN Council in its special meeting on 14/07/2006 in Lisbon, as:
   b1) fully exploit the LHC,
   b2) significantly upgrade the LHC luminosity, including R&D on high performance magnets,
   b3) develop CLIC technology,
   b4) take part in the Global Design Effort of the ILC,
   b5) investigate the technologies required by neutrino facilities;
c) *concerning accelerators for nuclear physics and light sources*, the priorities are consistent with the roadmap of the European Strategy Forum on Research Infrastructures ESFRI:
   c1) technologies for high intensity ion beams
   c2) technologies for FEL and XFEL superconducting linac-based instruments.

The following scientific objectives of EuCARD match these priorities:

- *design, study and build* prototype models of high field Nb_3Sn superconducting magnets, addressing priorities b1, b2, b3, b4 and c1, complementary to US and Japanese efforts with this forefront technology and to the more usual Nb-Ti based option, included in the SLHC-PP project.
- *design, study and test* innovative collimators (priorities b1, b2, c1), for safe handling of higher power beams.
- *improve* normal conducting linac technologies (acceleration, stabilization, vacuum dynamics), addressing priority b3 and partly b4 above.
- *explore* fundamental issues concerning the high gradient superconducting RF cavity technology, study the physics processes involved and seek for implementing innovative techniques, addressing priorities b2, b4, c2; this is going beyond the ILC-PP work based on a well- defined existing technology and aiming at improving the reproducibility of its results.
- *assess* Novel Accelerator Concepts, addressing priority b5 and emerging technologies.

The integration objectives are largely developed within the JRA's. Four networks are foreseen to vigorously support all JRA's and open them to outside experts. In addition, four technological test facilities will be opened to the broad scientific community through trans-national access.

1.1.4 Relevance to the topics of the call

- **Mobilization of stakeholders:** EuCARD involves the largest accelerator research laboratories and smaller institutions whose specialised facilities and knowledge are essential ingredients. This large mobilisation is reflected in the list of work package and task coordinators (Table 2.4.b). European industry will benefit by providing state-of-the-art manufacturing facilities such as superconducting Nb_3Sn cables and RF cavities. Given the importance of this research, non European institutions such as US-LHC Accelerator Research Project/USA, KEK/Japan and BINP/Russia are associated in various ways. Official agreements have been received for all matching funds.
- **Sharing and development of existing infrastructures:** All WP and task activities aim to share and develop in common the performance of existing accelerators and test stations.
- **Structuring, integration and cross-disciplinary fertilisation:** The managerial experience of CERN in handling large scientific collaborations will allow EuCARD to gather most actors and become a focal point for European actions in the field of accelerators.
- **Dissemination, Communication and Outreach:** The actions will focus on efficient dissemination through the Web and relational databases. It is foreseen to publish a dedicated

series of monographs on advanced accelerator technology. Contact with other European projects will be encouraged and prospective meetings with regional industrial partners organised.

1.2 Progress beyond the state of the art

In order to improve significantly the performance of the accelerators and test facilities listed in Table 1.3 a.2, the EuCARD proposal addresses topics requiring vigorous R&D, and with promising progress potential beyond the present limitations of the state-of-the-art. The main subjects dealt with in the various EuCARD activities concern the development of advanced superconducting magnets beyond the Nb-Ti technology, of efficient collimation systems at high beam intensities, of acceleration schemes with very high-gradient normal-conducting cavities, of superconducting cavities with performance exceeding those already at hand and new ideas for improving collider luminosities. More precise indications on these activities are given in the following sections.

1.2.1 Networking activities

The above-mentioned developments are often at the cross-road of several technologies and branches of accelerator sciences, requiring the collaboration of various competences. In this respect, the role of the networking activities will be of a catalysis nature, by circumventing the natural fragmentation into specialties. They will foster a coherent and multi-disciplinary approach to the complex and multiform issues of upgrading highly sophisticated infrastructures.

A first domain of action shall be the efficient dissemination of information and generated results: the publications will be monitored and made accessible in a targeted manner, links will be established between close scientific fields of research inside and outside the consortium and industry will be informed and motivated to invest in the needed innovative technologies.

The second domain of action will be the scientific networks around three main scientific/technical themes: neutrino facilities, accelerators and colliders, and RF technologies. These networks shall be the backbone of the consortium, with, as the main tools, the organization of topical meetings and mini-workshops, and the capability of inviting or exchanging experts over periods of typically a week to a month. They shall contribute to the exchange of ideas and expertise between beneficiaries and between the consortium and external organizations, with the goal of identifying the most promising upgrade strategies and technologies. The networks will be the unique place where the particle physicists, users of the infrastructures, will be able to interact with the accelerator scientists at a detailed technical level and influence the upgrade paths for optimal overall performance. Indeed, none of the upgrade paths can be considered as a natural extension of the state-of-the-art. All have significant challenges and choices have large consequences on hardware and costs, including on the experimental detectors.

During the EuCARD period 2009-2012, major decisions on upgrades and new world-accelerators are expected to take place. This shall indeed concern all research accelerators dedicated to particle physics: for the neutrino facilities with a decision planned around the end of 2012, for the electron linacs with a decision between 2010 and 2012 when LHC results will be known and for the LHC major upgrade in 2010 or 2011. Given this time line, the EuCARD networks will play a central role. From the CARE experience and received expressions of interest, they are expected to attract experts and organisations beyond the Consortium, from other related EU initiatives like SLHC-PP, ILC-PP, EuroNu DS and from large non-European partners like KEK in Japan and the US accelerator laboratories. The resulting concentration of world expertise shall be a solid asset for the development of the infrastructures concerned by this proposal and for the development of a dynamical European Research Area.

1.2.2 Transnational access activities

The four trans-national accesses open innovative facilities representing some modern facets of accelerator sciences. Two are unique operational installations: the superconducting cable and magnet test stations just freed after the completion of the LHC at CERN, and FLASH-TTF at DESY, a unique FEL linac facility relying on state-of-the-art superconducting cavities. The other two facilities are in construction with completion planned before the beginning of EuCARD and will be unique as well: i) the MICE (STFC) facility for experimentalists wishing to investigate muon ionization cooling or to perform tests with high quality low energy beams of muons, electrons, protons or pions, ii) a facility on the SPS accelerator at CERN allowing to send MJ proton beams with a pulse length of a few μs to a target, and to perform experiments that are in the interest of many researchers investigating the impact of pulsed irradiation.

These facilities are also of primary importance for the beneficiaries of the Consortium within their joint research or network activities. They will guaranty for all external users access to facilities at the top of the art operated by high quality teams strongly motivated by their own research.

1.2.3 Joint research activities

To face the ambitious challenges briefly recalled at the beginning of this section, the joint research activities mobilise the largest fraction of the budget and human resources. They are organized around five themes whose added value is summarised below and described in more details in the WP description forms:

- **High field magnets:**

The goal of this theme is the development of a new generation of accelerator quality magnets (dipoles, quadrupoles, wigglers and undulators) able to double the magnetic field that can presently be achieved. The increased performance will serve the accelerator upgrades in various ways. For the LHC luminosity upgrade, the quadrupole aperture can be increased for a given gradient, thereby allowing a stronger focusing at the interaction point to produce a higher collision rate. The larger margin in critical temperature obtained with Nb_3Sn will be used to mitigate the larger heat deposition from the secondary particles emerging from the collisions. Altogether the LHC peak and integrated performance and the operation efficiency will be significantly improved, up to a factor of 10 when combined with other upgrades under other themes. The same technology can be applied to the dipole magnets receiving a large heat deposition, such as dispersion suppressor dipoles in the LHC, exposed to particles diffracted by the collimators. In combination with High Temperature Superconducting (HTS) coils the magnetic field could be further boosted. A success in increasing significantly and in a cost-effective way the field of magnets opens the possibility of doubling or tripling the LHC energy with a large enhancement of its physics reach. The wigglers and undulators for the control of the electron beam parameters share the same challenges in mastering Nb_3Sn technology and a simultaneous development under the same theme is prone to open synergies.

- **Collimators and materials:**

The unprecedented intensities of modern hadron accelerators impose special constraints on materials that are placed close to or into the high intensity beams. A specialized “collimator” community is building up in Europe and elsewhere in the world with so far independent research programs in individual laboratories. The joint research activity will foster further advances in this field. Important outcomes shall be i) a better modelling of the beam halo dynamics, a critical step in predicting the performance of collimators, ii) a selection of materials that can both sustain the very high instant energy deposition, be compatible with ultra-high vacuum and does not present to the beam a significant electro-magnetic impedance. These materials will also be characterized for their radiation resistance. Finally three technologies will be tested by prototyping and testing collimators: room-temperature, cryogenic and crystal-based collimators, the latter being totally innovative. Improving the collimation would allow increasing the beam current in the accelerators concerned. For synchrotrons, the gain in performance is linear with the beam current. For colliders, the gain can be quadratic when combined with other upgrade options studied under other themes.

- **Normal Conducting Linacs:**

NC accelerating structures presently achieve useable accelerating gradients of up to 80 MV/m; for higher gradients the breakdown rate becomes unacceptably high – an as yet unsolved issue. Demonstration of high gradient acceleration is one of the main objectives of the purpose-built CTF3 facility at CERN. Both NC and SC linear colliders require extremely small (nanometre) beam sizes at collision, so common issues concern ultra-low emittance generation and conservation and beam stability. The “NCLinac” WP focuses on major issues in high-gradient acceleration and beam stabilisation, complementary to current research programs: from simulation and understanding of break-downs in high-gradient accelerating structures to global integration of accelerator modules, mechanical and alignment constraints to the μm-scale and very high accuracy synchronisation (20 fs). The investigations on the vacuum stability and minimisation of secondary electron yield in damping rings are of general interest (DAΦNE, LHC, SPS, …). The investigations on emittance preservation methods and beam handling in the final focus (ATF2 at KEK) will provide strategies and beam diagnostics prone to improving the performance of accelerators handling beams of very small size.

- **Superconducting RF**

Pioneering R&D work on Superconducting Radio Frequency (SRF) accelerator systems was started in the field of electron storage rings for high energy physics as well as heavy ion accelerators. Meanwhile, SRF technology has matured and is in operation in many particle accelerators. Energy recovery mode is a modern accelerator concept which is made possible through the use of SRF technology. Today's applications at the frontier of SRF accelerator technology are FEL linacs (XFEL) and linear colliders for high energy physics (ILC). An operating gradient of 40 MV/m was demonstrated at the FLASH FEL. In contrast to the ILC-HiGrad Preparatory activities in FP7, which are related to establish a high performance yield in industrial fabrication, the aim of EuCARD is to push the R&D towards improving fundamental issues of superconducting RF as described below. The SRF activities in EuCARD cover a broad range from material investigation, improvements in cavity fabrication and processing, the design and fabrication of new prototypes, to beam based investigations in FLASH. The formation and coordination of a consortium of multi purpose SRF test facilities is particularly important. Linking these multinational infrastructures with their broad competence is unique in the world and opens up interesting perspectives for the understanding of SRF fundamentals as well as improving the operation of new accelerators such as LHC, XFEL and ILC.

- **Assessment of novel accelerator concepts**

This theme regroups three important topics regarding novel accelerator concepts in three different fields: high luminosity colliders, technologies required by neutrino facilities and plasma wave accelerator techniques. The new collision scheme characterized by an innovative correction of higher order optics aberrations combined with large angle beam crossing holds the promise of increasing the luminosity by more than two orders of magnitude beyond the current state-of-the-art in colliders. The planned instrumentation for the world's first so-called non-scaling FFAG (Fixed Field Alternate Gradient) (EMMA, STFC) shall allow a better knowledge of the beam dynamics, hence contributing to assess the feasibility of this innovative principle, with possible application to neutrino facilities and medicine. Finally the measurement of ultra-short electron beams is instrumental to the assessment of laser plasma acceleration.

1.3 Methodology and associated work plan

1.3.1 Overall strategy

EuCARD has selected the high performance, and sometimes unique, research infrastructures of the particle accelerator community, and defined the following strategy with the aim of improving them:

1) establish a framework that will allow researchers from different scientific and cultural backgrounds to collaborate on clearly defined problems,
2) combine resources for targeted RTD tasks to make significant improvements in the field of accelerator-based physics (high energy and FEL light sources),
3) open some world class research facilities to a wider community of scientific users, including particle accelerators and special purpose test facilities.

The strategy for networks is to enlarge their content and appeal, possibly resulting in new synergies, while limiting the scope sufficiently to allow highly productive participation. They are closely linked to the RTD activity described below and bring together the teams performing the technology research, but address in general a wider audience. According to these principles, two independent networks are foreseen: the accelerator neutrino community network NEU2012 and the accelerator technology network AccNet. The latter consists of two sub-units, EuroLumi for issues related to collective effects for higher brightness beams and RFTech which focuses on the issues of RF acceleration, control, power generation and distribution.

The goal for the RTD activity was to separate tasks only when the overall productivity would benefit, and combine where feasible in order to bring together experts in the same field, even if they are working on different projects in different accelerator facilities. These separate technological fields can be characterized as follows:

- HFM: superconducting high field magnets,
- ColMat: high performance collimation of intense beams,
- NCLinac: high gradient normal-conducting acceleration and beam stability issues for future linear colliders,
- SRF: exploration of new technologies to obtain higher performance superconducting cavities, and

- ANAC: assessment of novel accelerator concepts, including schemes for increasing the accelerator yield capacity and a promising laser-plasma technique for electron acceleration.

A number of excellent and unique research facilities were identified which could benefit potential users outside the accelerator community and the traditional user community of high energy physicists. CryoMagNet, HiRadMat, and FLASH are purpose-built facilities to test superconducting magnets and coils, materials subjected to extremely high radiation and superconducting RF cavities, respectively. MICE on the other hand is an accelerator facility built for muon cooling experiments, which provides a unique muon beam with well controlled characteristics. EuCARD will open these facilities for the first time to other fields such as plasma fusion, materials science, and aerospace.

The integration of the various activities creates natural links and synergies (Figure 1). For example:

- the accelerator neutrino community network is closely linked to the muon cooling facility MICE and to the task aimed at improving the electron model for muon acceleration (EMMA) within the ANAC JRA.
- access to the magnet test facility CryoMagNet at CERN is intimately linked to the tasks within the HFM JRA.
- the community of experts working on collimators for very high intensity beams opens the facility HighRadMat for trans-national access.
- the FLASH-TTF facility at DESY complements the RFTech network; the latter has strong links to several tasks inside both NCLinac and SRF.
- The coordinated actions of overall project management and DCO (Dissemination, Communication and Outreach) extend to all other work packages, allowing progress monitoring and information dissemination.

Figure 1 Diagram showing interdependencies

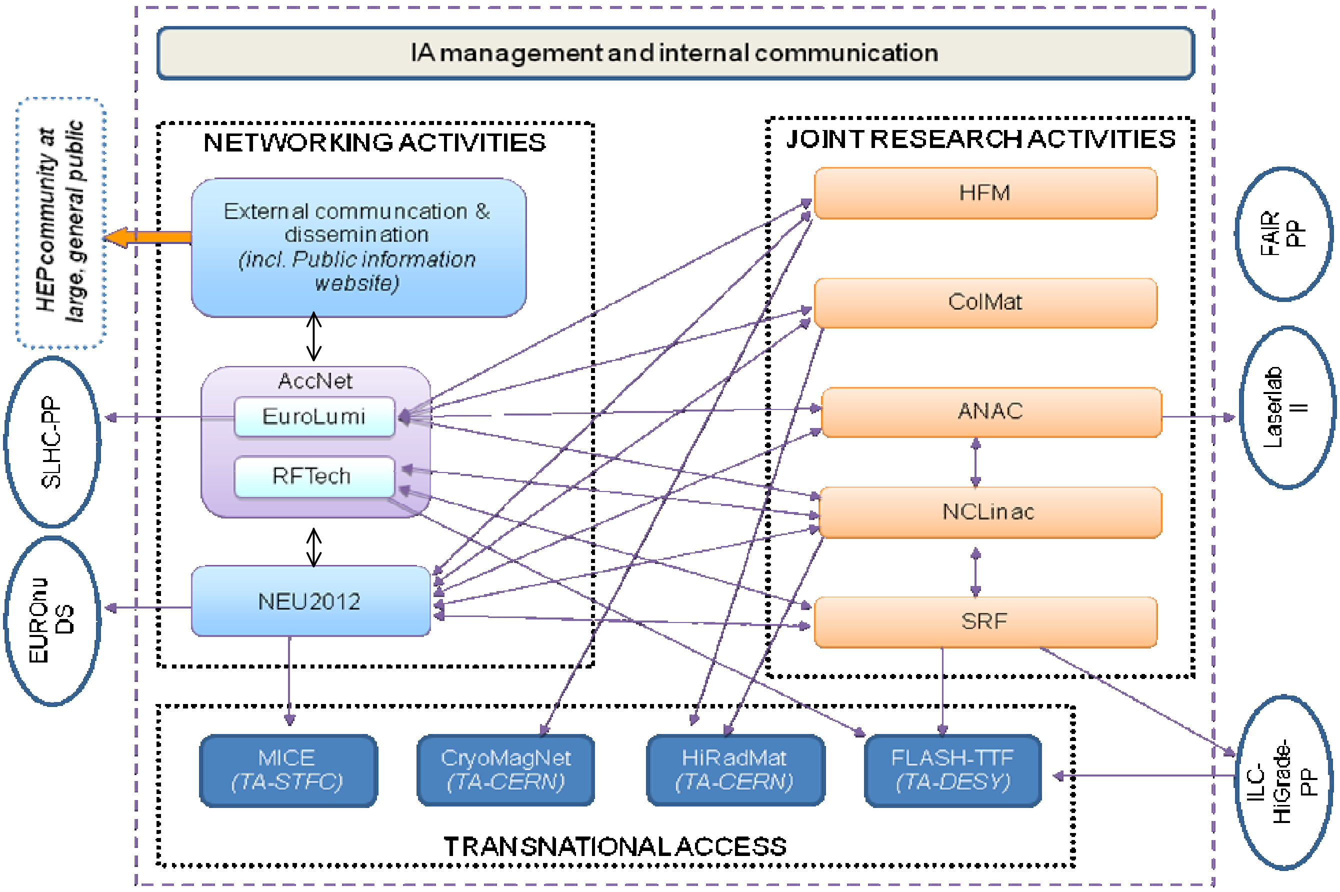


Table 1.3 a.1: List of the Work Packages with the lead participants and their respective Personnel efforts

WP No	Work Package Title	Type of Activity	Lead Particpant No.	Lead Participant short name	Person Month (P·M)	Start Month	End Month
WP1	Project management	MGT	1	CERN	91	M1	M48
WP2	Dissemination, Communication and Outreach	COORD	40, 1	WUT, CERN	26	M1	M48
WP3	Structuring the accelerator neutrino community	COORD	18	INFN	24	M1	M48
WP4	Accelerator Science Networks: EuroLumi and RFTech	COORD	1, 8	CERN, CNRS	24	M1	M48
WP5	TA-CERN: Open Accelerator Science Facilities	SUPP	1	CERN	4	M1	M48
WP6	TA-DESY: Open Accelerator Science Facilities	SUPP	10	DESY	2	M1	M48
WP7	TA-STFC: Open Accelerator Science Facilities	SUPP	27	STFC	2	M1	M48
WP8	Superconducting High Field Magnets	RTD	1, 6	CERN, CEA	515	M1	M48
WP9	Collimators and materials	RTD	1, 16	CERN, GSI	321	M1	M48
WP10	Technology for normal conducting linear accelerators	RTD	1, 24	CERN, RHUL	781	M1	M48
WP11	Superconducting RF technology for proton accelerators and electron linear accelerators	RTD	10, 6	DESY, CEA	783	M1	M48
WP12	Assessment of novel accelerator concepts	RTD	18, 27	INFN, STFC	304	M1	M48
		TOTAL	**P·M**		2876		

Table 1.3 a.2: List of Infrastructures concerned by the project with their relationship with the EUCARD WPs, The Transnational accesses are highlighted

Laboratory	Infrastructure	Description	NA	JRA
CERN, Geneva	LHC	7 TeV hadron collider	4	8, 9, 11, 12
	LHC Injectors	Proton linac, booster, PS, SPS synchrotrons	3, 4	8, 9, 11
	SPS-CNGS	450 GeV p beam on target	3	
	CTF3	2 beam CLIC test facility	4	10
	SRF test facility	Facility for the processing and test of superconducting RF cavities	4	11
	HiRadMat (SPS)	Beam induced shocks	4	9
	CryoMagNet	Superconducting magnet test facilities	4	8
INFN, Frascati	DAΦNE	0.51 GeV e+e- collider, Φ-factory,	4	10, 12
	SPARC Lab	e- linac based VUV FEL as test facility for SPARCX	4	12
STFC Daresbury	EMMA	20 MeV non-scaling FFAG e- ring	3	12
GSI, Darmstadt	SIS, FAIR	Heavy ion acceleration	4	9
DESY, Hamburg	FLASH	Superconducting 1 GeV electron Linac/FEL	4	11
	PETRA III	6 GeV X ray light source		10
	TTF	Superconducting RF cavity processing facility: CHECHIA, clean rooms, EP,…	4	11
FZD Dresden, Rossendorf	ELBE	Quasi continuous wave mode Superconducting 12 MeV to 40 MeV electron linac based light and radiation source,		11
FZK, Karlsruhe	ANKA	2.5 GeV synchrotron based light source		8
LOA/CNRS Paris		Plasma wave acceleration test station	4	12
CEA, Saclay	SupraTech RF infr.	1,3 GHz, 700 MHz, CryHoLab,	4	11
LAL Orsay	SupraTech RF infr	Coupler test facility	4	11
TUD, Darmstadt	Furnace	UHV furnace facility	4	11
BESSY, Berlin	Hobicat	CW RF cryo test facility	4	11
Cockcroft I. Daresbury	SRF test facility	RF infrastructure, ERLP, 4GLS	4	11
RAL, Oxford	MICE	Muon Ionization/Cooling Experiment	3	

	EUCARD: WORK PACKAGE DESCRIPTIONS	1st YEAR												2nd YEAR											
		Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8		
				3			6			9			12			15			18			21			24
WP1.	**IA Management**																								
Task 1.1													A		D										A
WP2.	**Dissemination, Communication and Outreach**																								
Task 2.1	Coordination and communication												A												A
Task 2.2	Dissemination and Outreach	D																							D
WP3.	**NEU2012: Structuring the neutrino community**																								
Task 3.1	Management & communication						DM						A												A
Task 3.2	Getting the most out of existing neutrino facilities																								M
Task 3.3	Road map to next European accelerator neutrino facility																								M
WP4.	**AccNet: Accelerator Science Networks**																								
Task 4.1	Coordination and communication		D										A												A
Task 4.2	EuroLumi		D										M												M
Task 4.3	RFTECH		D										M												M
WP8.	**HFM: Superconducting High Field Magnets for higher luminosities an energies**																								
Task 8.1	Coordination and communication												A												A
Task 8.2	Support studies												M												2M
Task 8.3	High Field Model																								
Task 8.4	Very high field dipole insert												M												M
Task 8.5	High Tc Superconducting Link																								
Task 8.6	Superconducting wiggler for ANKA																								M
Task 8.7	Short period helical superconducting undulator																								
WP9.	**ColMat: Collimators & Materials for higher beam power beam**																								
Task 9.1	Coordination and communication												A												2DA
Task 9.2	Modelling, Materials, Tests for Hadron Beams												2M												M
Task 9.3	Collimator Prototyping and Testing for Hadrom Beams										M										M		M		M
WP10.	**NCLinac: Technology for normal conducting higher energy linear accelerators**																								
Task 10.1	Coordination and communication												A												A
Task 10.2	Normal Conducting High Gradient																								2M
Task 10.3	Linac & FF stabilisation						M																		5M
Task 10.4	Beam Delivery System																		2M						
Task 10.5	Phase control																								
Task 10.6	Damping Ring Vacuum						M																		
WP11.	**SCRF technology for higher intensity proton accelerators and higher energy electron linacs**																								
Task 11.1	Coordination and communication												A												A
Task 11.2	Single Crystal Cavities																								
Task 11.3	Electro -polishing and surface investigations																								M
Task 11.4	SC Cavities for proton linacs																								
Task 11.5	LHC Crab cavities									2M									2M					M	
Task 11.6	Thin Films												DM						M						
Task 11.7	HOM Distribution																								
Task 11.8	LLRF at FLASH																		M						3M
Task 11.9	SCRF gun at ELBE												M						M						DM
Task 11.10	SRF TEST infrastructures																M		M				M		3M
WP12.	**ANAC: Assement of Novel Accelerator Concepts**																								
Task 12.1	Coordination and communication												A												A
Task 12.2	Design of intraction regions for high luminosity colliders		M																2M						
Task 12.3	Upgrade of the EMMA FFAG ring										M								M						
Task 12.4	Instrumenttion for Novel Accelerators																								

A = MILESTONE: annual report
M = MILESTONE
D = DELIVERABLE

Figure 2a Timing of the WPs, tasks, Milestones and Deliverables, first 2 year

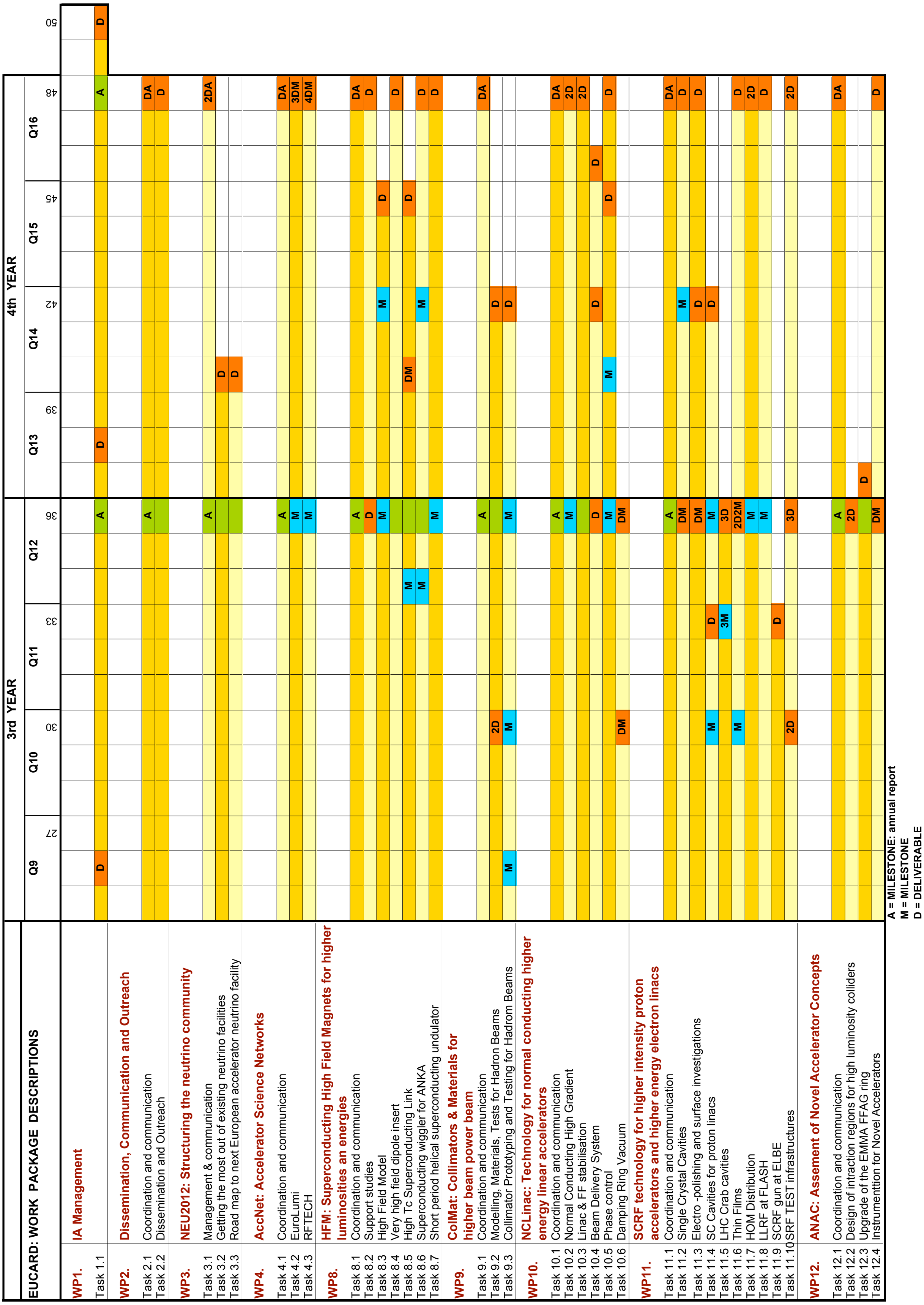


Figure 2b Timing of the WPs, tasks, Milestones and Deliverables, last 2 years

Table 1.3 b1.1: Deliverables List first year

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date
2.2.1	EuCARD web site operational	2	R	PU	M1
4.1.1	Continually updated AccNet web site	4	O	PU	M2
4.2.1	Continually updated EUROLUMI web site	4	O	PU	M2
4.3.1	Continually updated RFTECH web site	4	O	PU	M2
3.1.1	NEU2012 Website operational	3	O	PU	M6
11.6.1	QE data for Pb/Nb deposited photo cathode samples	11	R	PU	M12

Table 1.3 b1.2: Deliverables List second year

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date
1.1	1st annual EuCARD report	1	R	PU	M14
9.1.2	Collimator specification for LHC upgrade parameters	9	R	PU	M24
9.1.3	Collimator specification for FAIR	9	R	PU	M24
11.9.1	Results of slice measurements	11	R	PU	M24

Table 1.3 b1.3: Deliverables List third year

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date
1.2	2nd annual EuCARD report	1	R	PU	M26
9.2.1	One ‘phase 2’ secondary collimator (P1), tested with beam	9	P	PU	M30
9.2.3	One cryogenic collimator (P3), tested with beam	9	P	PU	M30
10.6.1	Simulation of vacuum pressure distribution, final report	10	R	PU	M30
10.6.2	Selected vacuum chamber coating properties and production final report	10	R	PU	M30
11.10.6	Operation of a 1800°C UHV furnace for heat treatment of niobium cavities at 3 GHz	11	R	PU	M30
11.10.7	Operation of 2nd IOT-based RF station operational at HoBiCaT as demonstrated by cavity test	11	R	PU	M30
11.4.1	Results of SC proton cavity tests (beta=1 and 0.65)	11	R	PU	M33
11.9.2	Results for GaAs photocathodes	11	R	PU	M33
8.2.2	Thermal model for a dipole Nb_3Sn model magnet	8	R	PU	M36
10.4.1	Prototype Crab Cavity at CTF3	10	P	PU	M36
10.6.3	Vacuum chamber coating system for large scale production	10	P	PU	M36
11.2.1	Summary of single crystal niobium properties	11	R	PU	M36

11.3.1	Reproducibility of the process as a Function of the EP-Mixture	11	R	PU	M36
11.5.1	LHC crab cavity design complete	11	R	PU	M36
11.5.2	CLIC crab cavity design complete	11	R	PU	M36
11.5.3	LHC and CLIC LLRF design complete	11	R	PU	M36
11.6.2	RF measurements on thin film deposited QRW prototype	11	R	PU	M36
11.6.3	Cold test results for the test cavities w/out the deposited lead photo cathode	11	R	PU	M36
11.10.3	RF tests of nine-cell cavities processed in new processing stations at Saclay	11	R	PU	M36
11.10.4	Test and operation of the upgraded coupler coating bench and coupler processing stations at LAL-Orsay	11	R	PU	M36
11.10.5	New results on annealing niobium samples and RF cavities at IPN-Orsay	11	R	PU	M36
12.2.1	DAΦNE IR design for the upgraded KLOE detector	12	R	PU	M36
12.2.2	Study of an IR design for LHC upgrade	12	R	PU	M36
12.4.2	Prototype of 3 GeV, high energy resolution electron spectrometer	12	P	PU	M36

Table 1.3 b1.4: Deliverables List fourth year

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date
1.3	3rd annual EuCARD report	1	R	PU	M38
3.2.1	Performance analysis and physics potential of upgrades of existing neutrino facilities	3	R	PU	M40
3.3.1	Proposal of the next global accelerator neutrino facility for Europe to build or help build.	3	R	PU	M40
8.5.1	HTS 20 m 600 A link assembled	8	P	PU	M40
12.3.1	Results from the operation of EMMA using the new diagnostics	12	R	PU	M40
9.2.2	One primary collimator with crystal feature (P2), tested with beam	9	P	PU	M42
9.3.1	FAIR type collimator P2 tested	9	R	PU	M42
9.3.2	Crystal type collimator P3 tested	9	R	PU	M42
10.4.2	ATF2 tests and CLIC IR study	10	R	PU	M42
11.3.2	Summary of test results with vertical EP	11	R	PU	M42
11.4.2	Tests results in horizontal cryostat with power coupler	11	R	PU	M42
8.3.1	Dipole model test results analyzed	8	R	PU	M45
8.5.2	Design of HTS 20 m 13000 A link	8	R	PU	M45
10.5.1	RF phase monitor final report	10	R	PU	M45
10.4.3	Laser Wire and Beam Position Monitor tests	10	R	PU	M46
2.1.1	Final report of the work package WP2	2	R	PU	M48

	DCO				
2.2.2	EuCARD web site completed	2	R	PU	M48
3.1.2	NEU2012 Information and knowledge disseminated	3	O	PU	M48
3.1.3	Final NEU2012 guidelines for an accelerator neutrino experiments programme	3	R	PU	M48
4.1.2	AccNet Strategy for future proton & electron facilities in Europe	4	R	PU	M48
4.2.2	EUROLUMI Strategy for LHC IR and beam-parameter upgrade path(s), with comment on longer-term prospects	4	R	PU	M48
4.2.3	EUROLUMI Strategy and issues for LHC injector upgrade	4	R	PU	M48
4.2.4	EUROLUMI Strategy and issues for FAIR	4	R	PU	M48
4.3.2	RFTECH strategy/result for cavity design	4	R	PU	M48
4.3.3	RFTECH strategy/result for LLRF & HPRF systems	4	R	PU	M48
4.3.4	RFTECH strategy/result for LLRF&HPRF & cavity-design integration	4	R	PU	M48
4.3.5	RFTECH RF costing tools	4	R	PU	M48
8.1.1	HFM web-site linked to the technical and administrative databases	8	O	PU	M48
8.2.1	Certification of the radiation resistance of coil material	8	R	PU	M48
8.4.1	A HTS dipole insert coil constructed	8	D	PU	M48
8.6.1	Final SC wiggler report	8	R	PU	M48
8.7.1	Final prototype SC helical undulator fabricated and measured	8	R	PU	M48
9.1.1	ColMat web-site linked to the technical and administrative databases	9	O	PU	M48
10.1.1	NCLinac web-site linked to the technical and administrative databases	10	O	PU	M48
10.2.1	Simulation and experimental results with report on the theoretical and scientific aspects of the CLIC module	10	R	PU	M48
10.2.2	Prototypes with descriptive report (technical, design and fabrication) of the hardware prepared for the test module.	10	P	PU	M48
10.3.1	CLIC Module final report	10	R	PU	M48
10.3.2	Final Focus final report	10	R	PU	M48
10.5.2	Electro optical monitor final report	10	R	PU	M48
11.1.1	SRF web-site linked to the technical and administrative databases	11	O	PU	M48
11.2.2	Summary report on single crystal niobium cavities	11	R	PU	M48
11.3.3	Evaluation of enhanced field emission in Nb samples	11	R	PU	M48
11.6.4	New thin film techniques for SC cavities	11	D	PU	M48
11.7.1	HOM electronics and code to probe beam centring on 3.9 GHz cavities	11	R	PU	M48
11.7.2	Report on HOM experimental methods and code	11	R	PU	M48

11.8.1	Report on system test and performance	11	R	PU	M48
11.10.1	A European Infrastructure for R&D and Test of SRF cavities and cryo-modules (summary report)	11	R	PU	M48
11.10.2	A Central Infrastructure at CERN for R&D and Test of Superconducting Radio-Frequency Cavities and Cryo-modules	11	R	PU	M48
12.1.1	ANAC web-site linked to the technical and administrative databases	12	O	PU	M48
12.4.1	Electron beam emittance measurement report	12	R	PU	M48
1.1	Final report on accomplishments, use of resources and impacts of the EuCARD IA on integrating activities.	1	R	PU	M50

Note for tables 1.3 b1:
R = Report, P = Prototype, D = Demonstrator, O = Other
PU = Public

Table 1.3 b2: Summary of Transnational access provisions

Participant Number	Organization 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
			Nbr	Short name						
1	CERN	CryoMagNet	1	FRESCA	CH	1 test	20000	8	7	7
1	CERN	CryoMagNet	1	Strand test	CH	1 test	4000	100	10	2
1	CERN	CryoMagNet	1	Block 4	CH	1 week @cold	10000	10	5	5
1	CERN	CryoMagNet	1	SM 18	CH	1 week @cold	20000	5	2	2
1	CERN	CryoMagNet	1	Magnetic meas.	CH	1 day meas.	500	50	10	5
1	CERN	HiRadMaT	1	SPS Hi-RadMat	CH	hour	2693	96	50	6
10	DESY	FLASH-TTF	1	FLASH-linac	D	4 hr shift	1753	140	23	23
27	STFC-RAL	MICE-	1	MICE	UK	Two weeks	8710	8	8	8

Table 1.3 c1: List of milestones first year

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
12.2.3	Requirements for electron beam diagnostics	12	M2	milestone report to coordinator
3.1.1.2	Calendar of workshops & conferences concerning NEU2012	3	M6	milestone report to coordinator
10.3.5	Installation of ATF2 final-focus alignment monitoring system	10	M6	milestone report to coordinator
10.6.1	Thin film materials selected	10	M6	milestone report to coordinator
11.5.1	LHC crab cavity specifications completed	11	M6	milestone report to coordinator
11.5.4	CLIC crab cavity specifications completed	11	M6	milestone report to coordinator
9.3.2.3	Crystal type collimator P3 designed	9	M10	milestone report to coordinator
12.3.1	Construction of the electron beam diagnostics completed	12	M10	milestone report to coordinator
1.1	1st annual EuCARD meeting	1	M12	milestone report to coordinator
2.1.1	Annual status of DCO, first year	2	M12	milestone report to coordinator
4.1.1	Annual AccNet steering meeting, first year	4	M12	milestone report to coordinator
4.2.1	Annual EUROLUMI workshop, first year	4	M12	milestone report to coordinator
4.3.1	Annual RFTECH workshop, first year	4	M12	milestone report to coordinator
8.1.1	1st annual HFM review meeting	8	M12	milestone report to coordinator
8.2.2	Preliminary heat deposition model for a dipole Nb_3Sn model magnet	8	M12	milestone report to coordinator
8.4.1	HTS conductor specifications for insert coils	8	M12	milestone report to coordinator
9.1.1	1st annual ColMat review meeting	9	M12	milestone report to coordinator
9.2.1	Functional specification LHC of beam loss and collimator design	9	M12	milestone report to coordinator
9.2.3	Functional specification FAIR of beam loss and collimator design	9	M12	milestone report to coordinator
10.1.1	Annual NCLinac review first year	10	M12	milestone report to coordinator
11.1.1	Annual review SRF first year	11	M12	milestone report to coordinator
11.6.1	Lead deposition on samples for photocathode development	11	M12	milestone report to coordinator
11.9.1	Preparation system for GaAs finished	11	M12	milestone report to coordinator
12.1.1	1st annual ANAC review meeting	12	M12	milestone report to coordinator

Table 1.3 c2: List of milestones second year

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
11.10.6	Test completed of loaned IOT tubes at low power with existing power supply	11	M16	milestone report to coordinator
10.4.1	Training at ATF3	10	M18	milestone report to coordinator
10.4.2	LW and BPMs installed	10	M18	milestone report to coordinator
11.5.2	LHC model crab cavity completed	11	M18	milestone report to coordinator
11.5.5	CLIC model crab cavity completed	11	M18	milestone report to coordinator
11.6.2	Lead deposition on half cells and 1.5 cell cavities	11	M18	milestone report to coordinator
11.8.1.	Design and manufacturing of the carrier board prototypes.	11	M18	milestone report to coordinator
11.9.2	Installation spectrometer dipole	11	M18	milestone report to coordinator
11.10.5	First 3 GHz cavity treated	11	M18	milestone report to coordinator
12.2.1	DAΦNE beam parameters definition for KLOE	12	M18	milestone report to coordinator
12.2.2	Compatibility of new IR scheme and LHC	12	M18	milestone report to coordinator
12.3.2	Commissioning of EMMA completed	12	M18	milestone report to coordinator
9.3.1.1	LHC type collimator P1 designed	9	M20	milestone report to coordinator
9.3.3.1	Crystal type collimator P3 constructed	9	M22	milestone report to coordinator
11.10.2	Design of the electro-polishing station for multi-cell cavities at CEA-Saclay	11	M22	milestone report to coordinator
11.5.7	Development of LHC LLRF system	11	M23	milestone report to coordinator
1.2	2nd annual EuCARD meeting	1	M24	milestone report to coordinator
2.1.2	Annual status of DCO, second year	2	M24	milestone report to coordinator
3.1.2.1	Mid-term summary of NEU2012 recommendations on neutrino experiments	3	M24	milestone report to coordinator
3.2.1.1	Midterm review of NEU2012 recommendations on existing accelerator neutrino facilities.	3	M24	milestone report to coordinator
3.3.1.1	Midterm review of NEU2012 recommendations on new accelerator neutrino facilities.	3	M24	milestone report to coordinator
4.1.2	Annual AccNet steering meeting, second year.	4	M24	milestone report to coordinator

4.2.2	Annual EUROLUMI workshop, second year.	4	M24	milestone report to coordinator
4.3.2	Annual RFTECH workshop, second year.	4	M24	milestone report to coordinator
8.1.2	2nd annual HFM review meeting	8	M24	milestone report to coordinator
8.2.1	Methodology for the certification of radiation resistance of coil material	8	M24	milestone report to coordinator
8.2.3	Engineering heat deposition model for a dipole Nb_3Sn model magnet	8	M24	milestone report to coordinator
8.4.2	Two HTS solenoid insert coils	8	M24	milestone report to coordinator
8.6.1	SC wiggler completed in industry	8	M24	milestone report to coordinator
9.1.2	2nd annual ColMat review meeting	9	M24	milestone report to coordinator
9.2.2	Upgrade LHC collimator specification	9	M24	milestone report to coordinator
9.3.2.1	FAIR type collimator P2 designed	9	M24	milestone report to coordinator
10.1.2	Annual NCLinac review second year	10	M24	milestone report to coordinator
10.2.1	Modification of NCLinac computer codes and first round of simulations.	10	M24	milestone report to coordinator
10.2.2	Design of NCLinac hardware for test module	10	M24	milestone report to coordinator
10.3.1	Commissioning of CLIC quadrupole module	10	M24	milestone report to coordinator
10.3.2	Characterization of noise/ vibrations sources in an accelerator	10	M24	milestone report to coordinator
10.3.3	Quadruple mock-up manufactured and ready for installation	10	M24	milestone report to coordinator
10.3.4	Installation of interferometers at CTF3 Module	10	M24	milestone report to coordinator
10.3.6	Installation of ILC prototype FB/FF at ATF2	10	M24	milestone report to coordinator
11.1.2	Annual review SRF second year	11	M24	milestone report to coordinator
11.3.1	Tests achieved for 1st recipe	11	M24	milestone report to coordinator
11.8.2	Design and manufacturing of the AMC and RTM IO modules	11	M24	milestone report to coordinator
11.8.3	Design and manufacturing of the AMC IO modules	11	M24	milestone report to coordinator
11.8.4	Design and fabrication of AMC modules for controling step motors, piezo and waveguide tuners	11	M24	milestone report to coordinator
11.9.3	GaAs photocathodes produced	11	M24	milestone report to coordinator

11.10.1	Processing, assembly and RF test of cavities (LHC type, 1500 MHz), cryo-modules and samples (RF and DC)	11	M24	milestone report to coordinator
11.10.3	Upgrade of the coupler coating bench and coupler processing stations finished	11	M24	milestone report to coordinator
11.10.4	900°C UHV furnace installed at IPN Orsay	11	M24	milestone report to coordinator
12.1.2	2nd annual ANAC review meeting	12	M24	milestone report to coordinator

Table 1.3 c3: List of milestones third year

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
9.3.1.2	LHC type collimator P1 constructed	9	M26	milestone report to coordinator
9.3.1.3	LHC type collimator P1 tested	9	M30	milestone report to coordinator
10.6.2	Selected materials fully characterized	10	M30	milestone report to coordinator
11.4.1	Cavity fabrication (proton linac)	11	M30	milestone report to coordinator
11.6.3	QWR sputtering with Nb using the magnetron technique	11	M30	milestone report to coordinator
11.5.3	LHC input and mode coupler design development finished	11	M33	milestone report to coordinator
11.5.6	CLIC input and mode coupler design development finished	11	M33	milestone report to coordinator
11.5.8	Development of CLIC LLRF system	11	M33	milestone report to coordinator
8.5.1	Final design report HTS link	8	M34	milestone report to coordinator
8.6.2	SC wiggler ready for beam in ANKA	8	M34	milestone report to coordinator
1.3	3rd annual EuCARD meeting	1	M36	milestone report to coordinator
2.1.3	Annual status of DCO, third year	2	M36	milestone report to coordinator
4.1.3	Annual AccNet steering meeting, third year.	4	M3	milestone report to coordinator
4.2.3	Annual EUROLUMI workshop, third year.	4	M36	milestone report to coordinator
4.3.3	Annual RFTECH workshop, third year.	4	M36	milestone report to coordinator
8.1.3	3rd annual HFM review meeting	8	M36	milestone report to coordinator
8.3.1	Dipole Nb_3Sn coils finished	8	M36	milestone report to coordinator
8.7.1	Short prototype SC helical undulator fabricated and tested	8	M36	milestone report to coordinator
9.1.3	3rd annual ColMat review meeting	9	M36	milestone report to coordinator

9.3.2.2	FAIR type collimator P2 constructed	9	M36	milestone report to coordinator
10.1.3	Annual NCLinac review third year	10	M36	milestone report to coordinator
10.2.3	Prototype components for CLIC module prepared	10	M36	milestone report to coordinator
10.5.1	RF phase monitor prototype finished	10	M36	milestone report to coordinator
10.6.3	Coating production strategy ready	10	M36	milestone report to coordinator
11.1.3	Annual review SRF third year	11	M36	milestone report to coordinator
11.2.1	Investigation properties finished	11	M36	milestone report to coordinator
11.3.2	Tests achieved for 2nd recipe	11	M36	milestone report to coordinator
11.4.2	Proton beam Instabilities studies	11	M36	milestone report to coordinator
11.6.4	Report on new thin film coating techniques for SC cavities	11	M36	milestone report to coordinator
11.6.5	Improved RF-design of 1.5 cell	11	M36	milestone report to coordinator
11.7.1	HOM alignment for 3.9 GHz cavity electronics verification	11	M36	milestone report to coordinator
11.8.5	Report on longitudinal beam parameter studies and their controllability by fast feedback systems in conjunction with the LLRF system	11	M36	milestone report to coordinator
12.1.3	3rd annual ANAC review meeting	12	M36	milestone report to coordinator
12.4.1	Electron beam emittance meter finished	12	M36	milestone report to coordinator

Table 1.3 c4: List of milestones fourth year

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
8.5.2	20 meter HTS link ready for test	8	M40	milestone report to coordinator
10.5.2	Electro optical monitor prototype finished	10	M40	milestone report to coordinator
8.3.2	Dipole Nb_3Sn model magnet finished	8	M42	milestone report to coordinator
8.6.3	Magnetic and beam measurements on SC wiggler completed	8	M42	milestone report to coordinator
11.2.2	Development fabrication procedure finished	11	M42	milestone report to coordinator
11.4.3	Definition of cryomodule interface	11	M42	milestone report to coordinator
1.4	Final annual EuCARD meeting	1	M48	milestone report to coordinator

2.1.4	Final status of DCO	2	M48	milestone report to coordinator
4.1.4	Final AccNet steering meeting	4	M48	milestone report to coordinator
4.2.4	Final EUROLUMI workshop	4	M48	milestone report to coordinator
4.3.4	Final RFTECH workshop	4	M48	milestone report to coordinator
8.1.4	Final HFM review meeting	8	M48	milestone report to coordinator
9.1.4	Final ColMat review meeting	9	M48	milestone report to coordinator
10.1.4	Final NCLinac review	10	M48	milestone report to coordinator
11.1.4	Final SRF review	11	M48	milestone report to coordinator
12.1.4	Final ANAC review meeting	12	M48	milestone report to coordinator

1.3.2 Risks and contingency plans

The EuCARD work packages and tasks, even though inter-related, are not critically interlinked, as can be observed on Figure 2. Indeed several upgrade possibilities are explored in parallel with the final upgrades being a combination of the successful partial ones. Hence a partial failure in one of the 43 tasks is not going to compromise the success of the whole IA. Most of the deliverables are scientific/technical in nature and aim at an improvement in performance beyond the “state-of-the-art”. For this reason the achievement of the results cannot be guaranteed at 100%. The associated risks will be mitigated by the support of the best world experts in the field and a strong support, including financial, from their home institutes. Furthermore, the goals underlying the deliverables, even though beyond the state-of-the-art, have been judged reasonable given the duration and funding level of the IA, and the available expertise within the consortium. Some external risks are listed in Table 1.3 c5. Each work package involves collaboration from 3 to 14 institutes allowing mitigation by the WP coordinators in case of delays or excessive work load. Risks in terms of coordination have been mitigated by choosing two co-coordinators per WP. There is a certain risk that the scientific manpower to be hired is not immediately available on the market with the correct competence profile. In such a case, the workload will have to be re-distributed and/or specialised training will be organized. This would delay the production of the deliverables concerned. Failures in timely delivery of components to the specification may disorganise a task work plan or even endanger it. Constant project monitoring done at three levels (tasks, WP’s, IA) will help detecting critical situations early. CERN has a long-standing tradition in the implementation of complex projects in terms of technical progress and financial follow-up, and modern project management tools will be employed to insure the consistent review of expenditures and achievement of technical milestones and deliverables, so that appropriate counter-measures can be initiated in a timely manner by the Project Steering Committee. The most likely consequence is a delay in producing deliverables. In the unlikely event that significant delays or major disruptions of the work programme occur, the Governing Board will be convened and corresponding adjustments of the work programme and schedule will be agreed upon by the Consortium. In such a case, the EC Project Officer will be notified immediately of the situation, and the proposed adjustments of the work programme will be discussed.

Table 1.3 c5: Significant risks and contingency

WP	Significant risks	contingency
3	Missing conclusions from neutrino facility studies outside IA	Continuous follow-up and collaboration, otherwise delay.
8	FP6-CARE-NED Nb3Sn conductor not available from supplier	2 alternative suppliers available
10	Unavailability of ATF2 (Japan)	Reschedule, identify what can be done in ANKA and DAΦNE
11.2	Central crystal can be occasionally too small in ingots	foresee the production of several single-crystal cavities
11.8	Too few beam time in FLASH	carry all tests not involving beam cavity interactions in the CHECHIA cryostat facility

1.3.3 Management and Dissemination

Table 1.3 d1: Work package description WP1: IA management

Work package number	WP1	**Start date or starting event:**			M1		
Work Package title	IA management						
Activity type	MGT						
Participant number	1						
Participant short name	**CERN**						
Person-months per participant	91						

Objectives:
- management and steering of the project
- monitoring and reporting of scientific and technical progress
- contractual and financial follow-up

Description of work:
This task comprises a number of management and coordination activities under the responsibility of the Project Coordinator, the Deputy Project Coordinator and the Administrative Manager. The management duties are carried out within the proposed management structure of the project, as described in Section 2.1. They include the overall coordination of the activities, ensuring the consistency of the project and continuous monitoring of the progress in each Work Package, the organization of the Project Governing-Board and Steering-Committee meetings, the preparation of the annual review meeting with all the beneficiary contributors as well as the regular communication with the EU Commission. The links between the work packages wherever necessary and the consequent coordination will also be covered in these tasks. The administrative and contractual follow-up of EuCARD will be carried out in this WP under the responsibility of the Administrative Manager. This work includes the preparation of the periodic and final activity reports and the reviewing of the Deliverable and Milestone reports. The financial follow-up encompasses the distribution and payments of the EU funding, the budget control, the cost reporting and the collection of the forms on Financial Statements. Finally, the project management unit will set up with the support of the CERN services and of the available tools a finance management system and a monitoring structure, making use of data bases and information storage. The management will use the Dissemination Network for communicating inside and outside the consortium activities and results.
The funding of the management budgets either for the manpower or for the material necessary for covering the tasks described above will be provided by the coordinating organization, CERN, and no costs will be charged to the EU Commission except travel.

Deliverables of tasks	**Description/title**	**Nature**[1]	**Delivery month**[2]
1.1	1st annual EuCARD report	R	M14
1.2	2nd annual EuCARD report	R	M26
1.3	3rd annual EuCARD report	R	M38
1.4	Final report on accomplishments, use of resources and impacts of the EuCARD IA on integrating activities.	R	M50

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
1.1	1.1	1st annual EuCARD meeting	O	M12	
1.2	1.1	2nd annual EuCARD meeting	O	M24	
1.3	1.1	3rd annual EuCARD meeting	O	M36	
1.4	1.1	Final annual EuCARD meeting	O	M48	

Table 1.3 d2: Work package description WP2: Dissemination, Communication and Outreach

In the CARE program for accelerator R&D, management included dissemination activities which were represented throughout the program by the Dissemination Board. The DB cooperated directly with the NA and JRA management to ensure the widest possible dissemination of research results in the form of technical reports, workshop proceedings, and conference and journal papers. These activities were directed mainly at the CARE program community.
Dissemination, Communication and Outreach (DCO) is raised to the level of a separate WP in EuCARD as a result of the rich experience gained in CARE and other common community activities initiated by ESGARD. It will provide a source of added value due to the creation of strong synergies between research laboratories, industrial collaborations and universities. This will enhance the productivity of EuCARD partners by sharing resources and information. Project management will benefit from this approach by having online access to all the information needed to monitor and control the project.
Outreach will take on an educational component through the dissemination of information and ideas, providing an opportunity for students to participate in research and development. In addition, it is foreseen to publish a dedicated series of monographs on advanced accelerator technology.

Work package number	WP2		**Start date or starting event:**			M1	
Work Package title	Dissemination, Communication and Outreach						
Activity type	COORD						
Participant number	40	1					
Participant short name	**WUT**	**CERN**					
Person-months per participant	12	14					

Objectives:
- coordinate and schedule DCO tasks,
- monitor the work and inform the project management and participants within the JRA
- follow-up the DCO budget
- create a DCO network allowing EuCARD and the interested community at large to share information and resources, and exploit new results in accelerator science and technology
- provide web-based tools to support EuCARD project management
- publish a periodic EuCARD Newsletter
- establish tools and procedures to facilitate the creation of a public database of accelerator science and technology
- build a dissemination web site and relational documentation database
- encourage the development of synergies between the accelerator science community and regional industrial partners through prospective meetings and workshops
- promote awareness and understanding of accelerator science in the community at large, which includes industrial partners, academics in other fields, teachers and students, by organizing public talks, lectures, workshops and online outreach via the web
- publish a dedicated series of monographs on advanced accelerator technology

Description of work:

Task 1. Coordination and Communication.

The purpose of this task is to oversee and coordinate all aspects of the DCO work package and ensure its consistency according to the project plan. The coordination duties include organizing DCO internal steering and annual meetings, setting up formal reviews, reporting to the project management and the EU, and distributing detailed information throughout the project. The task could include organizing workshops and specialized working sessions.

Task 2. Dissemination and Outreach.

The infrastructure and IT support needed by the DCO network will be set up in this task. Extensive use

will be made of web-based technology and a relational database system to implement convenient information storage and recovery mechanisms for documents, publications, engineering data and properties of materials, engineering methods and techniques, publications templates and links to a dedicated series of monographs on advanced accelerator technology as they become available.
The same platform will be used to provide EuCARD management, coordination and scheduling tools, including calendars of meetings and workshops, an inventory of human resources skills and expertise, an overview of transnational access facilities, a periodic newsletter, intellectual property rights monitoring tools and links to other EuCARD sites.
The last component of DCO will be an Education and Public Outreach (EPO) web site which will promote awareness and understanding of accelerator science in the community at large, including potential industrial partners, students and teachers.

Deliverables of tasks	**Description/title**	**Nature**[1]	**Delivery month**[2]
2.1.1	Final report of the work package WP2 DCO	R	M48
2.2.1	EuCARD web site operational	R	M1
2.2.2	EuCARD web site completed	R	M48

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
2.1.1	2	Annual status of DCO, first year	R	M12	
2.1.2	2	Annual status of DCO, second year	R	M24	
2.1.3	2	Annual status of DCO, third year	R	M36	
2.1.4	2	Final status of DCO	R	M48	

1.3.4 Networking activities

Table 1.3 d3: Work package description WP3: NEU2012: Structuring the accelerator neutrino community

The “European Strategy for Particle Physics” emphasizes the importance of accelerator-based neutrino experiments, and sets the milestone for the next major undertaking in this field in 2012: Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino program based on the information available in around 2012.
A vigorous networking activity is necessary to ensure that the technical information on accelerator technologies and the scientific arguments are gathered, developed, and discussed within and outside the neutrino community.
The NA intends to deliver at the end of 2012 an agreed programme of neutrino experiments, based on upgrades of existing infrastructures and/or on the proposal of a new one.
The evolving CERN proton complex has always driven the world most powerful neutrino beams of their time, first at the PS, then in the SPS West Area and now in the SPS North Area where the new, stronger, CERN to Gran Sasso facility (CNGS) has started. Addition of storage/decay rings for neutrino parents promise further large upgrade factors. Similar possibilities may also come from upgrades of ISIS at RAL.
Among the possibilities the following will be considered and evaluated:

- Upgrade of CNGS; understanding of the ultimate upgrade potential (neutrino flux, neutrino spectra, flux monitoring and far detector design and location).
- A new neutrino facility, including a ring, (beta-beam or a neutrino factory complex) offering much higher rate and purer flavour content, allowing for a more ambitious programme of complete determination of the physical quantities governing neutrino oscillations: mass splits, flavour mixings and charge-parity violating phase.

The NA will be rooted in the FP6-BENE NA, itself rooted in ECFA Study Groups active since 1998. The existence of an organized open discussion and dissemination forum joining the EU accelerator & particle physicists active or being attracted in the sector has proven decisive over almost a decade. The European activity is embedded in an international effort with the yearly “NuFact” International Workshops on Neutrino Factory, Superbeam and BetaBeam“. It is an extremely fruitful example of collaboration of accelerator and particle physics from Europe, America and Asia.
The objective of this NA represents the natural completion of this process. It should be the forum where the community will discuss. the results of the CNGS upgrade studies, the solutions proposed by EuroNu for its beam options, the outcome of international design studies in progress in Japan and USA and of the state of the art R&D projects in progress or being proposed, in particular, in the framework of EuCARD.
The ultimate goal should be consensus on the best global next neutrino facility that Europe should build or help build. Decisive task of the NA will thus also be to have its final proposal backed by the widest possible majority of the EU community active in neutrino accelerator infrastructures worldwide, at the CNGS, at NuMI in the US and at the upcoming Japanese T2K facility.

Work package number	WP3		**Start date or starting event:**				M1	
Work Package title	NEU2012							
Activity type	COORD							
Participant number	18	1	35					
Participant short name	**INFN**	CERN	UNIGE					
Person-months per participant	4	16	4					

Objectives:
• Coordination and scheduling of the WP tasks • monitoring the work, informing the project management and participants within the NA • WP budget follow-up

- Perform vigorous networking activities to ensure that the technical information on accelerator technologies and the scientific arguments are gathered, developed and discussed within and outside the neutrino community
- Define the optimal program of accelerator neutrino experiments based on the information available in around 2012
- Ensure that the experience of operating neutrino facilities is disseminated and used in the design and construction of on-going projects.
- Evaluate the coherence of possible upgrades of operating neutrino facilities with physics needs.
- Synthesise the new facility options, including risk analysis
- Propose a roadmap to the next accelerator neutrino facility, in agreement with physics needs.

Description of work:

Task 1. Coordination and Communication

The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.
The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.
Main scientific responsibility of Task1 will be in the end to propose an agreed programme of neutrino experiments, based on upgrades of existing infrastructures and/or on the proposal of a new one.

- **Subtask 1:** Ensure the coordination of the contractual, financial and administrative aspects of the network

- **Subtask 2:** Ensure protection, use and dissemination of the knowledge

- **Subtask 3:** Provide both the scientific orientation of the NA, and the final overall guidelines for an agreed programme of accelerator neutrino experiments

Task 2. Getting the most out of existing neutrino facilities

This task will scrutinize the performance of operating neutrino facilities, i.e. of the CNGS in its international context. The upgrade potential will be evaluated by combination of improved neutrino flux, neutrino spectra, flux monitoring abilities and far detector design and location.

- **Subtask 1:** Assess the performance and outcome of operating neutrino facilities.

- **Subtask 2:** Assess the CNGS intensity limitation for future upgrades. Synthesise the upgrade options, including risk analysis. Clarify the possible upgrade path and flexibility.

- **Subtask 3:** Evaluate the adaptation of the CNGS neutrino spectrum and of flux monitoring to physics needs.

- **Subtask 4:** Assess the physics potential of upgrades.

Task 3. Road map to the next European accelerator neutrino facility

This task will synthesise the European and worldwide research performed on possible future new facilities while surveying the coherence with the physics needs. It will conclude with recommendation for the choice of the next global accelerator neutrino facility, taking into accounts the technological risks and possible synergies with all other programmes worldwide.

- **Subtask 1:** Evaluate the potential of existing accelerators for a new neutrino facility. Clarify their possible upgrade path and flexibility.
- **Subtask 2:** Complete assessment of the future new neutrino facility options. using all the results available by then from all design studies worldwide.
- **Subtask 3:** Evaluation of technological risks of the proposed options
- **Subtask 4:** Evaluation of the synergies with other physics programs
- **Subtask 5:** Identification and proposal of the next global accelerator neutrino facility

Recipients will make the NA budget available to contributors from the many institutes have expressed interest in the NEU2012 activities. In addition to CEA (F), STFC (UK), IFIC (Spain), these include a larger number in several countries that will be involved through UCLN (Belgium), UniSofia (Bulgaria), CNRS-IN2P3 (F), CHIPP(CH), MPG-MPIK (D), Crackow U (Poland), UAM (Spain), Imperial (UK). Outside Europe, Osaka U. and KEK (J), FNAL/BNL/LBNL (USA), TIFR (India).

Deliverables of tasks	**Description/title**	**Nature**[1]	**Delivery month**[2]
3.1.1	NEU2012 Website operational	O	M6
3.1.2	NEU2012 Information and knowledge disseminated	O	M48
3.1.3	Final NEU2012 guidelines for an accelerator neutrino experiments programme	R	M48
3.2.1	Performance analysis and physics potential of upgrades of existing neutrino facilities	R	M40
3.3.1	Proposal of the next global accelerator neutrino facility for Europe to build or help build.	R	M40

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
3.1.1.2	3.1.1	Calendar of workshops & conferences concerning NEU2012	O	M6	
3.1.2.1	3.1.2	Mid-term review of NEU2012 recommendations on neutrino experiments	R	M24	Road map for a programme of neutrino experiments
3.2.1.1	3.2.1	Midterm review of NEU2012 recommendations on existing accelerator neutrino facilities.	R	M24	Road Map for upgrading existing accelerator neutrino facilities
3.3.1.1	3.3.1	Midterm review of NEU2012 recommendations on new accelerator neutrino facilities.	R	M24	Road Map to new accelerator neutrino facilities

Table 1.3 d4: Work package description WP4: AccNet: Accelerator Science Networks

AccNet will coordinate and integrate the activities of the European accelerator communities in order to guide significant upgrades of European research infrastructures planned in various fields of science, and to prepare the way for new infrastructures, within a time scale of four years. In particular AccNet aims at realizing the full potential of the LHC, at optimizing the upgrades of other high-energy hadron and electron facilities (GSI/FAIR, PSI, LHC injector complex, FLASH, CTF3), at advancing novel extremely bright light sources (XFEL), and at laying the foundation for a future linear collider (ILC or CLIC). The synergy and activities introduced by AccNet will push the technology of particle accelerators far beyond the present state of the art. AccNet consists of two accelerator networks, EUROLUMI and RFTECH, which form the “glue”, and foster close collaboration, between the EuCARD Joint Research Activities on high field magnets (HFM), collimators & materials for high beam power (ColMat), normal conducting linacs (NCLINAC), superconducting rf for high energy accelerators (SRF), and assessment of novel accelerator concepts (ANAC), plus the open accelerator science facilities (TAs). Specifically, inside AccNet, EUROLUMI supports the upgrades of the LHC, LHC injectors, SIS and FAIR, by linking beam dynamics issues and parameter optimization, magnet R&D, magnet design, and collimator development for the next generation of high-energy proton accelerators, while RFTECH supports the various rf developments for present and future electron and proton linear accelerators plus their associated research infrastructures, such as FLASH, XFEL, SPL, CLIC and ILC, as well as storage rings. The two networks inside AccNet communicate with each other on joint issues, for example, the RFTECH developments for a superconducting proton linac as part of the LHC injector chain and for LHC crab cavities as an integral part of the LHC upgrade studies in EUROLUMI.

Work package number	WP4		**Start date or starting event:**		M1			
Work Package title	AccNet							
Activity type	COOR							
Participant number	1	8	10	32				
Participant short name	**CERN**	**CNRS**	DESY	UJF				
Person-months per participant	12	4	4	4				

Objectives:

- form networking interface between the five Joint Research Activities and the Transnational Access Activity within EuCARD
- provide a platform for information exchange and collaboration between various presently separated communities (e.g. proton and electron accelerators; magnet designers and collimation experts; FLASH upgrade, XFEL, CLIC and ILC technology; DAΦNE and LHC upgrade; European industry, European universities and laboratories)
- lay the groundwork for the next generation of accelerators in Europe and push the frontier of particle accelerators

Coordination and Communication:

- Coordination and scheduling of the WP tasks
- monitoring the work, informing the project management and participants within the JRA
- WP budget follow-up monitor progress in EUROLUMI and RFTECH
- ensure compliance with contract obligations
- disseminate achievements

EuroLumi:

- identify & characterize *LHC luminosity limitations* in theory, simulations, & experiments
- optimize various *LHC upgrade paths* in view of beam dynamics, magnets and collimation
- provide guidance for the *LHC injector upgrade*
- provide guidance for the *SIS upgrade and FAIR*
- explore paths for the *longer-term future*

RFTECH:

- provide a platform for the information exchange and close collaboration between the European, and worldwide, experts on accelerator RF systems
- improve the design of RF cavities
- advance the state of the art in low-level and high-power RF systems
- optimize the integration of low-level RF, cavity design and high power
- develop RF costing tools

Description of work:

Task 1 – Coordination and communication

The activities of this task are to oversee and coordinate the EUROLUMI and RFTECH networks, to ensure the consistency of the WP work according to the project plan and to coordinate the technical and scientific tasks of EUROLUMI and RFTECH with the tasks carried out by the other EuCARD work-packages when relevant. The coordination duties also include the organization of AccNet internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within AccNet as well as to the other work-packages running in parallel. The task also covers the organization of and support to the annual meetings dedicated to the EuCARD activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

- annual meetings together with network coordinators
- representation of AccNet at general EuCARD meetings and EuCARD steering meetings
- allocate and control network budgets
- exchange information between the two networks
- dissemination of network results by journal publications and by seminars at partner institutes, conferences, and European universities, and via web documentation, e.g. web databases
- annual AccNet steering meetings
- annual workshops inside the two work packages
- accompanying topical mini-workshops
- attendance of, and contributions to, related events in the US and Japan
- participation in laboratory testing and beam experiments
- support of visitors and of visitor exchanges between partner institutes
- training of summer students, support for technical students, PhD students and postdocs/fellows
- dissemination of network results by journal publications and by seminars at partner institutes, conferences, and European universities, and via web documentation, e.g. web databases

Task 2 – EuroLumi

EUROLUMI will coordinate and integrate the activities of the accelerator and particle physics communities towards *realizing the full potential of the LHC*, by means of LHC *luminosity upgrades* and *new or enhanced LHC injectors*. Several scenarios for increasing the LHC performance by at least an order of magnitude were developed in the FP6 CARE-HHH network. They all combine an upgrade of the two high-luminosity interaction regions (IRs), with modified beam parameters, and with an enhanced higher-brightness injector complex. EUROLUMI will create strong synergies by also supporting the *SIS upgrade* and the *FAIR* project at GSI, another major hadron facility in Europe.
Taking into account the results of CARE-HHH and interfacing with the US-LARP programme, the EUROLUMI network will be *THE European forum for discussing performance limitations of high-intensity high-brightness hadron accelerators*, *and for analyzing and optimizing the proposed upgrade paths* of these facilities. EUROLUMI will bring together experts in *beam dynamics* with specialists of *magnets* and *collimation* to arrive at optimum upgrade solutions with minimum risk. EUROLUMI will also help guiding the FP7 CNI for the LHC IR upgrade. Calculations performed within EUROLUMI can be benchmarked via beam experiments at the operating LHC, as well as at PS, SPS, RHIC, Tevatron, or DAΦNE. EUROLUMI will integrate the efforts of the large laboratories, smaller institutes and universities, and it will form and maintain a community capable of advancing the technical realization & scientific exploitation of the European hadron facilities. The following institutes have expressed interest in the EUROLUMI activities: BINP (R), BNL (USA), Bologna U (I), CERN (CH), CI (UK), CINVESTAV (Mexico), CNRS-LAL (F), CNRS-LPSC (F), CSIC-IFIC (E), DESY (D) , FNAL (USA), GSI (D), IFIC

(SP), IHEP (R), INFN –LNF (I), JINR (R), KEK (J), Kurchatov (R), LBNL (USA), RHUL (UK), UJF (F), UM (M), Sannio U. (I), SLAC (USA), STFC (UK), Texas A&M (USA), TU Berlin (D).

- annual workshops continuing the productive CARE-HHH series with publication of proceedings
- accompanying topical mini-workshops, similar to past HHH mini-workshops
- attendance of, and contributions to, US-LARP events
- participation in beam experiments, e.g. at SPS, RHIC, Tevatron, DAFNE, LHC, PS, PS booster
- support of visitors and of visitor exchanges between partner institutes
- training of summer students, support for technical students, PhD students and postdocs/fellows
- dissemination of network results by journal publications and by seminars at partner institutes, conferences, and European universities, and via web documentation, e.g. web databases

Task 3 – RFTECH: Exploitation of synergy on developments of high and low power rf systems for new accelerator projects

RFTECH will coordinate and integrate the European development of radiofrequency (rf) technology for future particle accelerators and associated research infrastructures, in a worldwide context. RFTECH will lead to significant upgrades of existing infrastructures (e.g. FLASH, CTF3, LHC injector complex, GSI), support the building of new facilities (e.g. XFEL), and prepare the terrain for new frontier research facilities in Europe (e.g. CLIC, ILC). Great synergy is created by bringing together formerly separated rf experts from many different laboratories and projects (e.g. SPL, LHC, FLASH, XFEL, ILC, CLIC, FAIR) working on similar rf devices, for the first time ever. RFTECH encompasses all aspects of rf technology, e.g. klystron development, rf power distribution system, cavity design, and low-level rf system, for linear accelerators and storage rings, including transversely deflecting (crab) cavities. The following institutes have expressed interest in the RFTECH activities: BNL (USA), CEA-DSM (F), CERN (CH), CI (UK), CNRS-LPNHEP (F), CNRS-LPSC (F), DESY (D) , FNAL (USA), GSI (D), INFN – LNF (I), JLAB (USA), KEK (J), LBNL (USA), INP PAN (P), PSI (CH), SLAC (USA), STFC (UK), THALES (F), TUL (P), UJF (F), WUT (P).

- annual workshops, e.g. on application of modern system engineering concepts to LLRF control
- accompanying topical mini-workshops, e.g. on costing of LLRF systems
- support attendance of, and contributions to, worldwide rf events, e.g. LLRF workshop in Japan 2009
- participation in laboratory tests and beam experiments
- support of visitors and of visitor exchanges between partner institutes
- training of summer students, support for technical students, PhD students and postdocs/fellows
- dissemination of network results by journal (or internet) publications and by seminars at partner institutes, conferences, and European universities, via web documentation, web databases, e.g. for LLRF and HPRF systems, and also via schools, e.g. on low-level RF design

Deliverables of tasks	Description/title	Nature[1]	Delivery month[2]
4.1.1	Continually updated AccNet web site	O	M2
4.1.2	AccNet Strategy for future proton & electron facilities in Europe	R	M48
4.2.1	Continually updated EUROLUMI web site	O	M2
4.2.2	EUROLUMI Strategy for LHC IR and beam-parameter upgrade path(s), with comment on longer-term prospects	R	M48
4.2.3	EUROLUMI Strategy and issues for LHC injector upgrade	R	M48
4.2.4	EUROLUMI Strategy and issues for FAIR	R	M48
4.3.1	Continually updated RFTECH web site	O	M2
4.3.2	RFTECH strategy/result for cavity design	R	M48
4.3.3	RFTECH strategy/result for LLRF & HPRF systems	R	M48
4.3.4	RFTECH strategy/result for LLRF&HPRF & cavity-design integration	R	M48
4.3.5	RFTECH RF costing tools	R	M48

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
4.1.1	4.1	Annual AccNet steering meeting, first year	O	M12	
4.1.2	4.1	Annual AccNet steering meeting, second year.	O	M24	
4.1.3	4.1	Annual AccNet steering meeting, third year.	O	M36	
4.1.4		Final AccNet steering meeting	O	M48	
4.2.1	4.2	Annual EUROLUMI workshop, first year	O	M12	
4.2.2	4.2	Annual EUROLUMI workshop, second year.	O	M24	
4.2.3	4.2	Annual EUROLUMI workshop, third year.	O	M36	
4.2.4		Final EUROLUMI workshop	O	M48	
4.3.1	4.3	Annual RFTECH workshop, first year	O	M12	
4.3.2	4.3	Annual RFTECH workshop, second year.	O	M24	
4.3.3	4.3	Annual RFTECH workshop, third year.	O	M36	
4.3.4		Final RFTECH workshop	O	M48	

1.3.5 Transnational access activities

Table 1.3 d5: Work package description WP5: TA-CERN: Open Accelerator Science Facilities

Description of WP5 task 1 – CryoMagNet
The CryoMagNet Transnational Access offers a complete set of facilities:

i) to measure the characteristic of conductors for superconducting magnets;
ii) to test the performance of accelerator type superconducting magnets in both horizontal and vertical cryostats;
iii) to measure with high accuracy the magnetic field and field imperfections of any accelerator magnets, normal or superconducting.

All test facilities are equipped with the relevant cryogenic infrastructure to work at both superfluid and pool boiling helium temperature.

Task number	5.1	**Start date or starting event:**					
Task title	CryoMagNet						
Activity type	SUPP						
Participant number	1						
Participant short name	**CERN**						
Person-months per participant	2						

Description of the infrastructure
Name of the infrastructure: CryoMagNet
Location (town, country): The "CryoMagNet" infrastructure is currently divided into three different buildings located on the CERN site and respectively holding: the superconducting strand and Cable Test facility, the plant to test superconducting magnets in general purpose vertical cryostats, the benches to test magnets in their own horizontal cryostats. These three activities correspond to three different phases of development or manufacturing of superconducting magnets: validation of the conductor, test of models and small length prototypes in vertical cryostat, validation of the final magnets mounted in their horizontal cryostats.
Web site address: http://CryoMagNet.Web.cern.ch
Legal name of organization operating the infrastructure: CERN
Location of organization (town, country): 1211 Geneve 23, Switzerland
Annual operating costs (excl. Investment costs) of the infrastructure (€): 4,125 k€ An estimate can be given for the cost of the various types of tests for a normal duration of a test : • One Cable Test : 20 k€, duration 1 week. • One test of up to 5 strands : 4 k€, duration 2 days • One test of a magnet in vertical cryostat. 5 k€ to 10 k€, assembly 1 week, test duration 1 week. • One test of magnet in its horizontal cryostat: mechanical adaptation: from 20 k€ to 50 k€, to be prepared before the test preparation lasting typically 1 to 2 weeks. Test: 20 k€ per week of test. The duration of the test is mainly linked to the complexity of the magnetic measurement to perform. • One day of magnetic measurement on an accelerator type magnet costs in average 500 €, depending of the size and complexity of the magnet. This must be added to the operation cost of the cryogenic equipment for the superconducting magnets.
Description of the infrastructure: o the superconducting strand and Cable Test facility holds : FRESCA: the "Cable Test Facility" for measurement of critical current of superconducting Rutherford cables : up to 17 mm section, in 10 T field, current up to 32 kA, Temperature from 1.8 K to 4.4 K. The capital investment for this infrastructure is ≈ 1 M€ , without the cryogenic plant.

7 small cryostats for strand samples tests (the capital investment for this infrastructure is ≈ 1 M€):
- 2 cryostats for critical current (Ic) on Nb-Ti strand : 1 kA, B = 11 T at 4.2 K, 13 T at 1.9 K
- 1 cryostat for Ic test on Nb_3Sn strand : 4 kA, B = 12.5 T at 4.2 K
- 1 cryostat for thermal transfer measurements on insulated cable,
- 1 cryostat for Rc test on cable samples at 4.2 K
- 1 cryostat for RRR test on Nb-Ti and Nb_3Sn strands
- 1 cryostat for Magnetisation test on Nb-Ti strands(to upgrade to Nb_3Sn)

- "BLOCK 4": the Vertical Test Plant holds 4 vertical cryostats allowing to test magnets up to 3.5 m long or 0.8 m diameter. Operating current: 20 kA max. Test are possible at both 1.9 K (superfluid helium) & 4.3 K (pool boiling helium). It is envisaged to add the capacity to test magnets working with forced flow supercritical helium by end 2008.
- The SM18 Test Plant is equipped with 12 benches for Cold masses (magnets in their horizontal cryostats) up to 15 m long, 15 kA, 1.9 K & 4.3 K.
  The capital investment for this infrastructure is ≈ 30 M€
- Various equipments allow to measure with high accuracy the magnetic field and field imperfections of accelerator magnets. These measurements are possible in both the vertical and horizontal test facilities mentioned (Block 4 and SM18) as well as in various smaller laboratories for normal conducting magnets.
  The capital investment for this infrastructure is ≈ 2 M€

Services currently offered by the infrastructure:
This test infrastructure has been used for the developments of all the superconducting magnets for the LHC project. Scientific achievements :
- Development of new conductors (Nb_3Sn, Nb-Ti. others) for High Field Magnets
- Validation of conductors (strands, cables, solid conductor) for magnet manufacturing : Ic measurement, magnetization, Rc (interstrand resistance) of cables
- Development of magnets : studies on training and stability, thermal and mechanical behaviour, protection,
- Magnetic Field quality measurement to unprecedented accuracy for accelerator magnets, both in static and dynamic conditions.
- Quality Control of magnets before installation

Description of work:
Modality of access under this proposal:
CERN will take care about the cost of the infrastructure running. Since tests could last several weeks, the user is expected to participate with CERN specialists at a scientific level to the definition of the goals of the tests and to the analysis of the results after the test completion.
The user is expected to finance the special equipment to build for the tests.
The expected availability for the 4 years covered by FP7 IA project is follows :
- Cable tests: 8 tests in total
- Superconducting strand tests: 100 tests in total
- Test in vertical cryostat (Block 4): 10 tests in total (1 week @ cold)
- Test in horizontal cryostat (SM18): 5 tests in total. (1 week @ cold)
  Note: the expected CERN program will need 6 benches out of the 12 available for the LHC exploitation and low beta upgrade. As the cryogenic power is limited, the test period must be agreed in advance with CERN.
- Magnetic measurements: 50 days in total

Support offered under this proposal:
CERN will offer infrastructure and expert support to carry out: qualification tests for superconductors ; tests of short superconducting magnets in vertical cryostats ; tests of magnets in their own horizontal cryostats ; magnetic measurements of all types of accelerator magnets.

The budget from FP7 would be used to support collaborators for travel expenses; for expenses related to the stay at CERN to prepare, carry out, and analyse the tests ; and for transport of material related to experiments at the facility

Outreach of new users:
The duration to manufacture a superconducting magnet to be tested generally extends well beyond 1 year. Several potential users, currently in the process of the design and manufacturing of magnets, have been contacted and have mentioned interest.

- GSI (Darmstadt, Germany): developing prototype magnets for their SIS100 and SIS300 projects for the FAIR accelerator complex
- INFN (Milan, Italy) developing a fast ramping superconducting magnet 4.5 T , 1 T/s
- CEA-DSM (Saclay, France) : developing a Nb_3Sn quadrupole
- Forschungszentrum Karlsruhe (Karlsruhe Research Center, Germany): development of a Nb_3Sn wiggler magnet to test on the ANKA Synchrotron Light Source
- Rutherford Appleton Laboratory (GB) manufacturing of a Nb_3Sn dipole prototype

These laboratories have also shown interest in using the Test facility for superconducting cable and strands in relation with the magnet development work quoted here above.

In addition several accelerators in construction or development (synchrotron light source, accelerators for hadron therapy) currently use or plan to use our magnetic measurement equipments, either at CERN or installed in their laboratories.

Review under this proposal:
The management of the CERN Accelerator Technology department is responsible to select proposals, in particular to verify that an equivalent support cannot be provided by European industry.

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**	**Estimated number of projects**
FRESCA	1 Test	20000	8	7	60	7
Strand Test	1 test of samples	4000	100	10	300	20
Block 4	1 week @ cold	10000	10	5	100	5
SM18	1 week @ cold	20000	5	2	100	2
Magnetic Measurement	1 day of measurement	500	50	10	150	5

Description of WP5 task 2 – HiRadMat

Accelerators with high beam power and high stored energy have become a topic of intense research in recent years. Momentum and the beam intensity at the CERN Large Hadron Collider (LHC) reach unprecedented values far above damage limits of any material. For the GSI FAIR accelerator the energy stored in the ion beam is much less, but still above damage limit due to different type of interactions of ions with material. Other examples for accelerators with beams above damage limit are high intensity proton accelerators and future linear colliders. The interaction of high power beams with materials and devices is of relevance for all those projects.

The CERN-SPS allows accelerating beams with some 10^{13} protons to a momentum of 450 GeV/c, to extract the beam and send it to a target within less than one turn (fast extraction). The facility to investigate the interaction of high power beams with materials and devices is the HiRadMat target zone to be constructed.

Materials and thermal shock waves, collimator prototyping and the experimental validation with high power hadron beams are included in WP9. The participants involved in WP9 are expected to become users of HiRadMat.

Task number	5.2		**Start date or starting event:**				
Task title	HiRadMat						
Activity type	SUPP						
Participant number	1						
Participant short name	**CERN**						
Person-months per participant	2						

Description of the infrastructure
Name of the infrastructure: HiRadMat at the CERN-SPS
Location (town, country): CERN, Geneve, Switzerland
Web site address: http://lhc-collimation-project.web.cern.ch/lhc-collimation-project/default.htm
Legal name of organization operating the infrastructure: CERN
Location of organization (town, country): 1211 Geneve 23, Switzerland
Annual operating costs (excl. Investment costs) of the infrastructure (€): 64'600 €
Description of the infrastructure: The existing high power, short duration beam from the SPS will be used for a test facility to study survival of materials, collimators and other devices under extreme thermal shock induced by beam. The facility will be installed in an existing extraction beam line of the SPS. The construction of the facility one is of the projects described in the CERN white paper. For protons, the beam energy will be 450 GeV, the energy in one pulse up to 2.4 MJ with a pulse length of ~7 μs and the beam spot size is variable around 1 mm^2. For heavy ions the beam energy is 177.4 GeV/nucleon (36.9 TeV per ion), the pulse energy up to 28 kJ, the pulse length about 12 μs and the variable spot size of ~1 mm^2. The facility is required to become operational in 2009/10 for tests of materials and collimators. Services currently offered by the infrastructure: The SPS is operating since many years with the beams that are required to perform tests of materials and collimation devices. A zone for the fast extraction of beams towards LHC exists and is operational. It is planned to use the extraction elements and to transfer the beam to a target station HiRadMat that needs to be constructed.

Description of work:
Modality of access under this proposal: The beam will be provided free of charge to the participating partners. During several periods of the SPS operational year windows for experiments with beam will be provided. The dates for these

windows will be defined in the framework of the yearly SPS scheduling. The presently established users include the institutes involved in FP7 program ColMat (WP9) for material research and advanced collimators/absorbers and associated institutes. Other institutes that will use the facility are SLAC, BNL and FNAL for material and collimator tests.

Support offered under this proposal:
CERN operates the accelerator complex including the SPS and HiRadMat facility. This includes the infrastructure for the experiments, installation of the experiments, preparation of the beams, and the beam operation during the experiments.
The budget from FP7 would be used to support collaborators for travel expenses, for expenses related to the stay at CERN and for transport of material related to experiments at the facility.

Outreach of new users:
Other institutes might also have an interest to use the facility:

- Research teams involved in high power target studies.
- Research teams involved in accelerators for neutrino production. There is some synergy since the underlying physics is the same, and similar tools are used.
- Research teams with activities in modelling and tests of shock waves.
- Research teams on High Energy Density Matter.

The results of this facility will be presented to the scientific community on a regular basis in workshops and conferences.

Review under this proposal:
There will be two stages for reviewing the experiments at the SPS. In workshops the experiments will be discussed and approved by the users and collaborators together with CERN. Then a document will be submitted to the relevant committees for approval of the tests and for distributing beam time.

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**	**Estimated number of projects**
SPS HiRadMat	hours	2693	96	50	800	6

Table 1.3 d6: Work package description WP6: TA-DESY: Open Accelerator Science Facilities

Work package number	WP6	**Start date or starting event:**					
Work package title	TA-DESY						
Activity type	SUPP						
Participant number	10						
Participant short name	**DESY**						
Person-months per participant	2						

Description of the infrastructure
Name of the infrastructure: FLASH-TTF
Location (town, country): DESY, Hamburg, Germany
Web site address: http://flash.desy.de
Legal name of organization operating the infrastructure: Deutsches Elektronen-Synchrotron DESY
Location of organization (town, country): Hamburg, Germany
Annual operating costs (excl. Investment costs) of the infrastructure (€): 12.8 M€

Description of the infrastructure:

FLASH-TTF is a superconducting linac installation to produce pulsed FEL SASE radiation (FEL - Free Electron Laser, SASE - Self amplified spontaneous emission). The electron bunches are produced in a laser-driven photoinjector and accelerated to 1 GeV by a superconducting linear accelerator. At intermediate energies of 125 MeV and 450 MeV the 1 nC electron bunches are longitudinally compressed, thereby increasing the peak current from initially 50 A - 80 A to approximately 1 kA - 2 kA as required for the FEL operation. Longitudinally, the electron bunches develop a sharp spike with a length of about 50 fs. The 27 m long undulator consists of NdFeB permanent magnets with a fixed gap of 12 mm, a period length of 27.3 mm and peak magnetic field of 0.47 T. Finally, a dipole magnet deflects the electron beam into a dump, while the FEL radiation propagates to the experimental hall. The length of the linac is about 250 m. The electron beam is produced in trains of a length of up to 800 µs with a repetition rate of 5 Hz or 10 Hz. The intra-train bunch spacing is to some extend adjustable to the needs of the experiments, from 10 kHz to 1 MHz. In providing this type of beam, FLASH-TTF is a unique facility worldwide.

Services currently offered by the infrastructure:

FLASH-TTF provides beamline sections for transverse and longitudinal electron beam diagnostics as well as a beamline bypassing the undulator section giving room for further experiments with the electron beam. Six superconducting accelerating modules built with TESLA technology powered by four 1.3 GHz RF-stations are installed and can be used for various experiments with and without beam.

FLASH-TTF offers machine studies such as:

- Photocathode studies
- Dark current measurements
- Optical and coherent transition, diffraction, and synchrotron radiation studies
- Emittance measurements
- Studies of higher order modes in superconducting cavities (HOM), HOM-BPMs, HOM absorbers
- Low level RF (LLRF) feed back and feed forward studies, beam loading compensation, automation
- Klystron nonlinearity studies

- Testing of novel beam position monitors (BPM)
- Beam based alignment
- Longitudinal bunch structure measurements
- Beam dynamics studies, effects of coherent radiation
- Long bunch trains with full beam loading
- Intra-train orbit feedback
- Phase and arrival time monitors, synchronization systems
- High gradient and cryo measurements
- Collimation tests, material tests
- Testing of devises to measure beam losses
- Testing of electronic equipment under radiation load

The installation is widely used for various studies with electron beam, superconducting accelerator modules, the low level RF system, and many others. Users from all over the world request beam time. In addition to this proposal, about half of the available annual beam time is reserved for photon science user experiments with the FEL SASE radiation. The other part of the beam time is mostly dedicated for machine related studies as described in this proposal.

As an example for trans national access to FLASH-TTF: a user group from FNAL (USA), SLAC (USA), CEA (France), KEK (Japan), and U Rostock (Germany) performing experiments related to HOMs; a user group from INFN-LNF (Frascati, Italy), INFN-TorVergata (Italy) used the bypass beamline for studies on optical diffraction radiation; a user group from CEA (France) work on re-entrant cavity BPMs and beam loss monitor system based on toroids; a user group including U Uppsala (Sweden), U Stockholm (Sweden), U Hamburg (Germany), BESSY (Germany) are currently commissioning the optical replica synthesizer experiment to measure the longitudinal electron bunch structure; a user group with MIT (USA), ELETTRA (Trieste, Italy), U Bilkent (Ankara, Turkey), U Hamburg (Germany) are developing and installing and testing a novel fs-synchronization system; users from PSI (Switzerland) develop beam position monitors suitable for fast intra train orbit feedback systems; user groups from U Warsaw (Poland), WUT-ISE (Warzaw, Poland), TUL-DMCS (Lodz, Poland), U Harburg (Germany), FNAL (USA) perform more than 10 different studies and experiments related to the low level RF system; a user group including INFN-LASA (Milano, Italy), BESSY (Germany), and FNAL (USA) do experiments with photocathodes for the RF gun based electron source; users from Frauenhofer Institut (Euskirchen, Germany) develop devices to measure low and high level of radiation induced by beam losses.

Description of work:

Modality of access under this proposal:

- During the allocated beam time for a user experiment, free access to the facility is given for installation and commissioning of equipment.
- Equipment involving large amount of work on the beam line or at other locations needs to be planned well ahead.
- Beam time is allocated to one experiment, so that their work can be pursued independent of other experiments. Experiments at FLASH-TTF are independent of experiments with the FLASH FEL beam.
- Experiments are grouped according to similar beam or machine conditions.
- A typical experiment has one units of 4 hours shift a day, 6 times a week. According to the users needs, larger blocks can be allocated.
- Users are present at DESY for equipment delivery and commissioning, data taking and analysis.
- The general infrastructure of DESY is open to the all users.

Support offered under this proposal:

- Subsistence while at DESY, including housing on-site or in the local vicinity.
- Installation of equipment is supported by DESY technical groups.

- Scientific support for the user experiments.
- Support is given for data taking, like ADCs and synchronisation signals, camera support, data acquisition support, however, special requirements in data taking need to be planned in advance or have to be supplied by the user.

Outreach of new users:

New users are attracted by e-mailing and advertising at web-page and specialised workshops and conferences such as the international biannual SRF Workshops and LINAC, PAC/EPAC/APAC and FEL conferences, and TESLA technology collaboration meetings.

Review under this proposal:

An international selection committee (BAC) reviews applications and selects projects at FLASH-TTF according to their scientific relevance. The committee members involve FLASH scientific and technical management and outside experts including representatives of users. The committee meets twice a year. Proposals are submitted through a web site to the review committee. The users need to describe their experiment/project underlining its scientific relevance, to state beam time and beam conditions required, including prerequisites. The users are asked to summarize their experiment in written form and to present the results in the weekly FLASH seminar.

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**	**Estimated number of projects**
FLASH-TTF	4 hours shift	1,753	140	117	1049	23

Table 1.3 d7: Work package description WP7: TA-STFC: Open Accelerator Science Facilities

Work package number	WP7		**Start date or starting event:**					
Work package title	TA-STFC							
Activity type	SUPP							
Participant number	27							
Participant short name	**STFC**							
Person-months per participant	2							

Description of the infrastructure
Name of the infrastructure: MICE
Location (town, country): STFC Rutherford Appleton Lab, Didcot, UK
Web site address: http://mice.iit.edu
Legal name of organization operating the infrastructure: Science and Technology Facilities Council
Location of organization (town, country): Didcot OX11 0QX
Annual operating costs (excl. Investment costs) of the infrastructure (€): 400K€
Description of the infrastructure: New Muon beam line at RAL and muon ionization cooling infrastructure Services currently offered by the infrastructure: • Muon beam of either sign, pulsed at 1 Hz, momentum from 120 MeV to 350 MeV/c. Also protons, pions and electrons from 100 MeV/c to 400 MeV/c. Precision beam line particle identification. Precision axial field spectrometers with scintillating fibres. Precision (70 ps) time measurement at three locations. Particle identification detectors (Cherenkov and calorimeter). All this commissioned first semester 2008. • Muon ionization equipment comprising solenoid optics, liquid hydrogen absorbers, RF cavities; Liquid hydrogen safe infrastructure; RF power station with 8 MW peak power at 200 MHz. All this will be commissioned in 2009.

Description of work:

Modality of access under this proposal:

- Presence at RAL of users and MICE experiment collaborators for equipment delivery and commissioning, data taking, analysis, in support of muon cooling experiments.
- Presence at RAL for users of the beam for tests of particle physics detectors in a low energy beam.
- Presence at RAL for proponents of new cooling experiments to undertake studies, installation and eventually data taking
- Proposals to be submitted to review committee that meets twice a year.

Support offered under this proposal:

In decreasing order of priority:

- subsistence while at RAL, including housing on-site or in the local vicinity;
- travel to / from RAL;
- possibility to provide some contribution to the running costs.

Outreach of new users:

Advertising in physics journals, web sites and e-mailing to the particle physics community.

Review under this proposal:

Selection committee involving MICE scientific and technical management and outside experts will review applications and select supported projects

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**	**Estimated number of projects**
MICE experiment	two weeks	8710	8	8	120	8

1.3.6 Joint Research activities

Table 1.3 d8: Work package description WP8: HFM: Superconducting High Field Magnets for higher luminosities and energies

Magnets with Nb_3Sn conductors are needed to upgrade existing accelerators in Europe such as the LHC on the medium long term and to prepare for new projects on a longer time scale. Their high current density properties in high fields and large temperature margin will be needed to meet the fields and gradient requirements and to withstand the heating due to the radiation in these new and upgraded machines. On the very long term (> 20 years), an LHC upgrade to 2-3 times the energy is an option to be considered. For such an energy level, dipole magnets with a field of around 20 T would be needed. These accelerator magnets are beyond the possibilities offered by using Nb-Ti or Nb_3Sn conductors alone. A possibility is to use a layered coil with an outer coil of 14 T in Nb_3Sn conductor and an inner coil of HTS conductor, delivering a field contribution of 6 T. High field capabilities are also the limiting parameter for wigglers and undulators when increasing the central field and reducing the period of the field. These limitations can be overcome using Nb_3Sn conductors also for these devices. The management of this WP has also the role to identify synergies between the various applications of Nb_3Sn.
The existing infrastructures which will directly benefit from the work in this WP are the LHC and ANKA.

Work package number	WP8		**Start date or starting event:**				M1	
Work Package title	HFM: Superconducting High Field Magnets for higher luminosities and energies							
Activity type	RTD							
Participant number	1	6	8	9	10	11	15	18
Participant short name	**CERN**	**CEA**	CNRS	COLUMBUS	DESY	EHTS	FZK	INFN
Person-months per participant	138	152	28	5	13	5	34	18
Participant number	23	26	27	30	35			
Participant short name	PWR	SOTON	STFC	TUT	UNIGE			
Person-months per participant	56	8	40	8	10			

Objectives:

Task1: Coordination and Communication.
- Coordination and scheduling of the WP tasks
- monitoring the work, informing the project management and participants within the JRA
- WP budget follow-up

Task 2: Support studies
- Certify radiation resistance of Nb_3Sn, radiation resistant coil insulation and impregnation
- Make a heat deposition and heat removal model for the dipole Nb_3Sn model with experimental validation and determine the thermal coil design parameters for the dipole model magnet.

Task 3 High field model
- Design, build and test a 1.5 m long, 100 mm aperture dipole model with a field of 13 T using Nb_3Sn high current Rutherford cables.

Task 4 Very high field dipole insert
- Design, build and test HTS solenoid insert coils for a solenoid background magnet aiming at a field increase up to 6 T to progress on the knowledge of HTS coils, their winding and behaviour. This as in intermediate step towards a dipole insert.
- Design, build and test an HTS dipole insert coil for a dipole background magnet aiming at a field increase of about 6 T.

Task 5 High Tc superconducting link

- Design of HTS bus: choice of HTS material definition of thermal conditions, requirements for stabilization and quench protection, modelling of quench propagation.
- Design. realization and test of electrical joints and electrical terminations.
- Mechanical design and assembly of a 20 m long superconducting link (26 pairs of 600 A).
- Design of a 20 m long superconducting link containing a 13000 A conductor.

Task 6 Superconducting wiggler for ANKA

- Build and test a full size racetrack coil wiggler magnet of 1.8 m active length with a period length less than 5 cm and a peak axis field of more than 2.5 T. Perform beam measurement results in ANKA.

Task 7 Short period helical superconducting undulator

- Design, build and test a prototype helical coil undulator magnet with 11.5 mm period, high peak magnetic field in Nb_3Sn technology.

Description of work:

Task 1. Coordination and Communication.

The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.
The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

Task 2 Support studies

Magnets with Nb_3Sn conductors will in accelerators like the LHC and neutrino factories be subjected to very high radiation doses. The superconductor itself (Nb_3Sn) and the electrical insulation employed on the coils need to be resistant to this radiation. A certification program for the radiation resistance is needed in parallel to the modelling efforts for such magnets. The same radiation is also depositing heat in the coils. The heat removal from the coils needs to be modelled. These models have to be supported with measurements. A thermal design of the dipole model coil can then be made.

- **Sub-task 1: Radiation resistance certification for Nb_3Sn, radiation resistant coil insulation and impregnation.**
  CERN will lead this activity and provide irradiation time at its accelerators. Other irradiation facilities from the partners might be envisaged. The exact work distribution between the 3 partners PWR, CEA-DSM and CERN still has to be determined.

- **Sub-task 2: Thermal models and design.**
  PWR will lead this activity. Thermal tests will be done in the various specialized cryogenic facilities at the 3 partners laboratories. All 3 partners will contribute to the modelling efforts aimed at producing a thermal model for the Nb_3Sn dipole model magnet.

Task 3 High field model

The technologies to be used for Nb_3Sn magnets, which are residing with the partners (e.g. high current density conductors, Nb_3Sn wind-and-react coil fabrication, insulation) are to be brought together and tested in short models. Several of these technologies (superconducting cable, insulation, coil design, support structures) were partly developed during the FP6-CARE-NED project.
The proposed dipole model will test these technologies for large accelerator magnets and the model will afterwards be used to upgrade the superconducting cable test facility FRESCA at CERN (which is part of a TA package in this proposal) from 10 T to 13 T. The issues are to reach high fields in large apertures with good temperature margins in the coil, beyond the possibilities of Nb-Ti conductors.
As a test bed for high field accelerator magnets a 1.5 m long dipole model will be build with an aperture of 100 mm and a field of 13 T. For this dipole model, CEA-DSM and CERN will design together the magnet. CERN will do the conductor characterization. PWR will do the thermal design

and thermal component tests. CEA-DSM will fabricate the coils and CERN will build the mechanical support structure. Combined teams will integrate the coils into the support structure. The cryogenic test of the model will be done in the CERN test station, which is part of a TA package in this proposal.

Task 4. Very high field dipole insert

Recent progress has shown outstanding performance on the intrinsic current transport properties of HTS Bi-2212 round wires, well adapted to magnets (J_e=450 MA/m^2 and J_c=1800 MA/m^2 at 4 K under 25 T). This should open the road to higher magnetic fields. This work package is a very first step to prospect for this possibility. The dipole model constructed in task 3 of this WP will serve the role of the outer layer. The development will pass in three steps. The first studies will deal with the specification of several HTS conductors. This will be completed by modelling work focused on stability and quench. The quench of HTS coils with their very often degradation is an identified issue. Due to the difficulty of making in one go a dipole insert coil of HTS conductor, several HTS solenoid insert coils will be made and tested in existing high field solenoid magnets at the partner's labs. The experience, which will be gained, will be used to construct a dipole insert coil. These subtasks are fully interdependent with strong interactions.

- **Sub-task 1: Specifications, characterizations and quench modelling.** The candidate conductors will be specified in this sub-task with as aim to select the best suitable product. The expertise of the partners CNRS, CEA-DSM, FZK, INFN, TUT and UNIGE will be needed for these specifications on electrical, mechanical and thermal behaviour and are of prime interest for our high field objective. Quench behaviour of these HTS magnets will be studied using quench modelling codes. The aim is to propose quench protection and detection strategies to avoid any degradation.

- **Sub-task 2: Design, construction and tests of solenoid insert coils**. This activity will be lead by CNRS-Grenoble with contributions of FZK and INFN for the design and the tests. The design issues for low temperature superconductors and HTS are different. Two major concerns, operating margins and quench protection, are very distinct. Several solenoids will be wound by CNRS-Grenoble with assistance of the partners. The coils will be instrumented to catch the maximum of information. They will be tested at CNRS-Grenoble or at FZK in very high field bores. In particular, the quench behaviour and protection strategies will be studied and analyzed.

- **Sub-task 3: Design construction and tests of a dipole insert coil.** Using the results of the solenoid insert coils, a dipole insert coil will be constructed. CEA-DSM will have the responsibility for this sub-task and will wind the insert coil. As for the solenoids, the partners will bring their know-how for design and manufacturing and the dipole-insert will be instrumented. The coil will be tested at a later stage in the upgraded FRESCA facility of CERN in the dipole model magnet from task 3.

Task 5 High Tc superconducting link

The use of HTS material in buses linking superconducting magnets is of great interest for accelerators such as the LHC. Existing buses use Nb-Ti superconductors, maintained at temperatures below 6 K. The use of HTS enables operation at higher temperatures and offers a convenient gain in temperature margin during operation. In the case of the LHC, the use of HTS links is of specific benefit to an upgrade, in that it provides long distance electrical connections between power converters and superconducting magnets. It links cold magnets electrically. In cases where space is limited and the radiation environment is harsh, it also provides more flexibility in the location of the cryostats supporting the current leads. HTS links of the type required for the accelerator technology do not exist yet, and significant work has to be done to develop a long-length multi-conductor operating in helium gas at about 20 K. Considerable R&D is being done on HTS cables for electrical utilities, and it might be thought that one could simply apply these technologies. However, at present this work is focused on using single or 3-phase AC conductors with high voltage insulation and liquid nitrogen cooling, and it should be noted that this is still development work yet to be concluded. Particle accelerators require high quasi-DC current carrying links with many cables (up to about 50) in parallel and cooled with liquid or gaseous helium. In the LHC there are over 50000 connecting cables with a total length of 1360 km. Thus the need specific to accelerator applications, is for a new type of link with multiple circuits, electrically isolated at around 1 kV - 2 kV, carrying quasi-DC currents. The design study has to cover the option to use MgB_2 at a temperature of 20 K as well as the electrical connections between HTS and LTS.

- **Sub-task 1: Studies on thermal, electrical and mechanical performance.** Performance tests on short samples of HTS material. CERN, COLUMBUS , EHTS and SOTON will study together the performance of HTS conductors at low temperatures. Existing test stations at CERN and in SOTON, which are used for measurements at 4.2 K, will have to be adapted to enable measurements of critical currents at 20 K. CERN, COLUMBUS and the SOTON will model the quench propagation in the HTS cables and define the requirements for stabilization and protection. CERN, COLUMBUS and EHTS will perform measurements of mechanical properties of short samples at liquid nitrogen temperature.

- **Sub-task 2: Design and test of electrical contacts HTS-HTS and HTS-Cu.** CERN, COLUMBUS and EHTS will prepare short samples and test their electrical resistance at cryogenic temperature. CERN and DESY will design together the electrical terminations of the HTS link.

- **Sub-task 3: Design and assembly of a 20 m long HTS multi-conductor 600 A link.** CERN, DESY, EHTS, COLUMBUS and SOTON will design together a 20 m long link containing 26 circuits operating at 600 A. The design includes both the superconducting bus and the mechanical envelope providing the vacuum insulation. The cryogenic test will be done at CERN. COLUMBUS and CERN will design and test the electrical insulation of the circuits. CERN, DESY, EHTS, COLUMBUS and SOTON will design together a 20 m long superconducting link operating at 13000 A.

Task 6 Superconducting wiggler for ANKA

This task aims to demonstrate the technical feasibility of planar short period wiggler magnets in Nb_3Sn technology with parameters beyond what has been achieved in Nb-Ti wigglers. Our goal is a wiggler magnet optimised to improve substantially the beam quality of electron storage rings by means of radiation damping rather than a device to produce specific type of radiation. We want to determine the technological limits of parameter space in terms of peak on axis field, period length, gap height, field quality, operating temperature and heat load. The magnetic and mechanical design of the wiggler will be done in collaboration between CERN and FZK. The construction of a 1.8 m long prototype wiggler will then be subcontracted to industry. After reception the magnetic performance of this prototype will be characterized in magnet test facilities at CERN and FZK and afterwards installed in the ANKA storage ring at FZK to test magnet performance and impact on the stored beam with realistic beam conditions and beam generated heat loads.

- **Sub-task 1.** Design of magnet structure , FZK and CERN (until December 2009).

- **Sub-task 2.** subcontracting of wiggler prototype to industry and follow-up of contracts until reception of all components, FZK (until December 2010).

- **Sub-task 3.** Completion of magnetic measurements of full magnet and related reports. CERN and FZK (ANKA) (until June 2011).

- **Sub-task 4.** Installation of Cryostat with wiggler in ANKA storage ring. FZK (until October 2011)

- **Sub-task 5.** Measurement of wiggler performance with beam in ANKA (total of 4 weeks of beamtime distributed in this period). FZK, BINP, CERN (until June 2012).

- **Sub-task 6.** Completion of measurement analysis and finalization of all reports. FZK, BINP, CERN (December 2012).

Task 7 Short period helical superconducting undulator

This task is focused on increasing the achievable magnetic field levels in short period magnets through the use of advanced materials (Nb_3Sn conductors) and innovative designs (helical coils). For example, single pass free electron lasers (e.g. X-FEL, FERMI@ELETTRA) could cover a wider wavelength range through field enhancement, or alternatively, operate at a significantly lower electron energy. Additionally, short period magnets could be used in the production of positrons for any future lepton collider and increased magnetic field levels will increase the positron yield and also allow for savings. The first part of this task will be a design study of the undulator using a Nb_3Sn conductor. A comparison will be made with existing Nb-Ti. Following this design stage a short prototype (~300mm) will be manufactured and tested magnetically. The results from this prototype will inform the study and the design will be iterated in order to provide the strongest possible field level. This second design will then be prototyped (~500mm) and characterised. The results will be analysed and a full description of the study will be given in a final report.

Deliverables of tasks	Description/title	Nature[1]	Delivery month[2]
8.1.1	HFM web-site linked to the technical and administrative databases	O	M48
8.2.1	Certification of the radiation resistance of coil material	R	M48
8.2.2	Thermal model for a dipole Nb_3Sn model magnet	R	M36
8.3.1	Dipole model test results analyzed	R	M45
8.4.1	A HTS dipole insert coil constructed	D	M48
8.5.1	HTS 20 m 600 A link assembled	P	M40
8.5.2	Design of HTS 20 m 13000 A link	R	M45
8.6.1	Final SC wiggler report	R	M48
8.7.1	Final prototype SC helical undulator fabricated and measured	R	M48

Mile-stone	task	Description/title	Nature[1]	Delivery month[2]	Comment
8.1.1	8.1	1st annual HFM review meeting	O	M12	
8.1.2	8.1	2nd annual HFM review meeting	O	M24	
8.1.3	8.1	3rd annual HFM review meeting	O	M36	
8.1.4	8.1	final HFM review meeting	O	M48	
8.2.1	8.2	Methodology for the certification of radiation resistance of coil material	R	M24	
8.2.2	8.2	Preliminary heat deposition model for a dipole Nb_3Sn model magnet	R	M12	publication on web
8.2.3	8.2	Engineering heat deposition model for a dipole Nb_3Sn model magnet	R	M24	publication on web
8.3.1	8.3	Dipole Nb_3Sn coils finished	D	M36	2 coils ready for mounting
8.3.2	8.3	Dipole Nb_3Sn model magnet finished	D	M42	Ready for cold test
8.4.1	8.4	HTS conductor specifications for insert coils	R	M12	
8.4.2	8.4	Two HTS solenoid insert coils	D	M24	
8.5.1	8.5	Final design report HTS link	R	M34	
8.5.2	8.5	20 meter HTS link ready for test	P	M40	
8.6.1	8.6	SC wiggler completed in industry	O	M24	
8.6.2	8.6	SC wiggler ready for beam in ANKA	O	M34	
8.6.3	8.6	Magnetic and beam measurements on SC wiggler completed	O	M42	
8.7.1	8.7	Short prototype SC helical undulator fabricated and tested	D	M36	

Table 1.3 d9: Work package description WP9: ColMat Collimators & materials for higher beam power beam

The unprecedented intensities of modern hadron accelerators impose special problems for materials that are placed close to or into the high intensity beams. The LHC machine and the FAIR project are examples where beam intensities are pushed into new regimes for exploring unknown territories in basic research with proton and ion beams. For example, the LHC advances the present state-of-the-art energy density for stored proton beams by three orders of magnitude: the energy stored in a single beam is equivalent to about 80 kg of TNT explosive, stored in a transverse beam area with a typical value of 0.2 × 0.2 mm^2. The safe handling of such beams is a forefront research topic in accelerator science with various challenges.
The beam intensities in the newest hadron accelerators are such that collimators and materials placed close to the beam are used at or even beyond their damage limits, while requirements on collimation efficiency are extraordinarily high. The operational efficiency of modern hadron accelerators, like LHC and FAIR, requires that collimation works reliably (minimum downtime) with excellent efficiency. Damage must be avoided or, if it cannot fully be excluded, handled in a safe manner (self-repairing devices). In addition, the vacuum quality for different modes of beam operation must remain good when beam power is absorbed. A high reliability and safety level of the collimators is mandatory.
It is difficult to predict collimator efficiency and robustness accurately. For example, beam-induced damage for high energy and high intensity occurs in a regime where practical experience does not exist. In addition, collimators are assembled from a variety of different materials which are located at different distances from the beam. Boundary conditions and material interfaces are difficult to model but play a crucial role for robustness and vacuum behaviour.

Work package number	WP9		**Start date or starting event:**		M1
Work Package title	ColMat Collimators & materials for higher beam power beam				
Activity type	RTD				
Participant number	1	2	12	16	17	18
Participant short name	**CERN**	ARC	EPFL	**GSI**	IFIC	INFN
Person-months per participant	86	5	19	95	18	24
Participant number	21	24	25	33	34	36
Participant short name	POLITO	RHUL	RRC KI	ULANC	UM	UNIMAN
Person-months per participant	14	18	30	offered	12	offered

Objectives:
- Coordination and scheduling of the WP tasks
- Monitoring the work, informing the project management and participants within the JRA
- WP budget follow-up
- Design collimation systems for high-intensity proton and ion beams, adequate for achieving the performance goals of LHC and FAIR.
- Predict energy deposition from different sources for LHC and FAIR.
- Identify and fully characterize in experiment and simulation materials that are adequate for usage in high power accelerators.
- Predict residual dose rates for irradiated materials and their life expectancy due to accumulated radiation damage.
- Design, construct and test two collimator prototypes for upgraded LHC collimation performance (one phase 2 secondary collimator, one primary collimator, possibly with a bent crystal).
- Design, construct and test one cryogenic collimator prototype.
- Develop crystal engineering solutions for collimation.

Description of work:

Task 1. Coordination and Communication.

The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.

The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

Task 2. Modelling, Materials, Tests for Hadron Beams.

The first challenge concerns safely intercepting and efficiently absorbing unavoidable losses from high intensity proton and ion beams. This includes protection of the accelerator against excessive energy deposition (leading to quenches of superconducting magnets and interruption of operation) and beam-induced damage, while maintaining an ultra-high vacuum. The study of innovative collimation systems is required, which place appropriate materials at optimized locations in the accelerator rings. This topic is addressed in sub-task 1. Connected to this is the energy deposition from particle losses and their associated particle cascades. This includes energy deposition in warm regions, in superconducting magnets and in experimental insertions (problem of background) for losses from different sources. This topic is addressed in sub-task 2. The third research theme is the study of appropriate materials for usage with high intensity beams. Issues include a review of suitable materials, characterization of standard and advanced materials, mechanical modelling of material behaviour and resistance to extreme thermal shock waves. This topic is addressed in sub-task 3. Finally, the fourth research topic treats the residual doses due to irradiation with lost particles (protons and ions) and the radiation-induced damage to materials. This topic is addressed in sub-task 4.

- **Sub-task1: Halo studies and beam modelling.**
  1. Nature, magnitude and location of beam losses in modern accelerators.
  2. Dynamics of the beam halo and proper diffusion models.
  3. Design and optimization of multi-stage collimation systems.
  4. Simulation of multi-turn collimation processes, including nuclear interactions of halo particles in the collimator materials.

  The following institutes contribute to this work: CERN,GSI, IFIC, INFN, ULANC and UNIMAN.

- **Sub-task2: Energy deposition calculations and tests.**
  1. Showering models with protons and ions in the relevant energy range.
  2. Modelling of the accelerator geometry and materials.
  3. Energy deposition calculations for various operational assumptions.
  4. Calculation of residual dose rates.
  5. Modelling of radiation-induced displacements per atom (dpa).

  The following institutes contribute to this work: CERN, GSI and RHUL.

- **Sub-task3. Materials and thermal shock waves.**
  1. Selection of candidate materials for usage in high intensity accelerators. This includes also special materials, like modern composite materials and crystals.
  2. Mechanical, electrical and vacuum characterization of materials.
  3. Simulations of thermal shock waves due to impacts of beam particles.
  4. Experimental tests on material resistance to beam-induced thermal shock waves.
  5. Modelling of beam shock-induced damage of accelerator materials.

  The following institutes contribute to this work: ARC, CERN, GSI, EPFL, RRC KI and POLITO.

- **Sub-task4: Radiation damage.**
  1. Experimental tests on material resistance to beam-induced radiation.

2. Modelling of radiation damage for accelerator materials.
3. Prediction of material life expectancy in accelerator environment.

The following institutes contribute to this work: CERN, GSI, RRC KI.

Task3. Collimator Prototyping & Testing for Hadron Beams

The robustness, efficiency and vacuum quality of the collimator solutions specified in Task 2 must be established with prototypes and realistic particle beams before installation into a sensitive accelerator environment. This task supports the construction of prototype collimators for LHC and FAIR and the subsequent tests. Required resources are centred at the big accelerator laboratories, as these have the knowledge to build such devices. It is, however, mentioned that LHC upgrade collimators are also prototyped in collaborating institutes in the United States through the DOE funded collimation work package in the LARP program (total value of 5M$).

This task foresees the prototyping and testing of both room-temperature (LHC baseline type) and cryogenic (FAIR baseline type) collimators:

- Two room temperature collimators will be designed for collimation close to the circulating beam. The designs should improve the cleaning efficiency, reduce collimator-induced impedance, optimize radiation impact, improve operational handling and provide ultra-high vacuum. One of the two designs can include a bent crystal for exploitation of crystal-enhanced collimation, an advanced R&D topic in the accelerator field.
- A cryogenic collimator will be designed to avoid uncontrolled beam losses and therefore the production of desorption gases. A comparatively warm 0.6 m long wedge (50 K - 70 K) will be situated in a chamber cooled by liquefied helium at a temperature below 10 K. Therefore the wedge will desorb only a small amount of gas when hit by the beam, while the cold surfaces act as cryo pumping system.

The two types of collimators complement each other and can be used also in the other accelerator, for example LHC collimation could be improved with cryogenic collimators originating from a FAIR design. This illustrates the highly beneficial impacts of European collaboration.

- **Sub-task1:** Prototyping, laboratory tests and beam tests of room-temperature collimators (LHC type). The following institutes contribute to this work: CERN, INFN. Collaboration with BNL, FNAL and SLAC in the United States.

- **Sub-task2:** Prototyping of cryogenic collimators (FAIR type). The following institutes contribute to this work: GSI, CERN

- **Sub-task3:** Crystal implementation and engineering. The following institutes contribute to this work: GSI, CERN. Collaboration with FNAL in the United States.

Deliverables of tasks	**Description/title**	**Nature**[1]	**Delivery month**[2]
9.1.1	ColMat web-site linked to the technical and administrative databases	O	M48
9.1.2	Collimator specification for LHC upgrade parameters	R	M24
9.1.3	Collimator specification for FAIR	R	M24
9.2.1	One ‘phase 2’ secondary collimator (P1), tested with beam	P	M30
9.2.2	One primary collimator with crystal feature (P2), tested with beam	P	M42
9.2.3	One cryogenic collimator (P3), tested with beam	P	M30
9.3.1	FAIR type collimator P2 tested	R	M42
9.3.2	Crystal type collimator P3 tested	R	M42

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
9.1.1	9.1	1st annual ColMat review meeting	O	M12	

9.1.2	9.1	2nd annual ColMat review meeting	O	M24	
9.1.3	9.1	3rd annual ColMat review meeting	O	M36	
9.1.4	9.1	Final ColMat review meeting	O	M48	
9.2.1	9.2	Functional specification LHC of beam loss and collimator design	R	M12	Simulations and design completed.
9.2.2	9.2	Upgrade LHC collimator specification	R, D	M24	Materials characterized and tested. Review of results and specification.
9.2.3	9.2	Functional specification FAIR of beam loss and collimator design	R	M12	Simulations and design completed.
9.3.1.1	9.3.1	LHC type collimator P1 designed	R	M20	'phase 2' secondary collimator P1
9.3.1.2	9.3.1	LHC type collimator P1 constructed	P	M26	
9.3.1.3	9.3.1	LHC type collimator P1 tested	R	M30	
9.3.2.1	9.3.2	FAIR type collimator P2 designed	R	M24	cryogenic collimator
9.3.2.2	9.3.2	FAIR type collimator P2 constructed	P	M36	
9.3.2.3	9.3.2	Crystal type collimator P3 designed	R	M10	crystal features
9.3.3.1	9.3.3	Crystal type collimator P3 constructed	P	M22	

Table 1.3 d10: Work package description WP10: NCLinac Technology for normal conducting higher energy linear accelerators

NCLinac concentrates on the identified issues in R&D to prepare for the future HEP Particle colliders that can reach beyond the LHC; it is generally agreed that a collider of this next generation will be a linear electron-positron collider. The issues to be addressed are primarily i) How to reach a high accelerating gradient reliably? and ii) How to stabilize the beams and the machine to allow collisions of nm-sized beams without loss of luminosity? For the first, NCLinac limits its scope to normal conducting accelerator structures, complementary to work on superconducting accelerator structures foreseen in the work package SRF. For the latter, synergy is actively sought and implemented between the superconducting (SC) and normal conducting (NC) linear collider approaches, where we have observed in the past that the communities of researchers had formed two separate camps. Searching their similarities rather than their differences, one goal of NCLinac is to bring these communities together again wherever possible. Issues concerning the damping rings (vacuum issues primarily for the positron damping ring) and the longitudinal phase-space (phase stabilisation) are included. Other topics are the need to measure beam positions, profiles and movements to the required level of precision and to elaborate and test algorithms for their active steering.
NCLinac is complementing a presently ongoing program of R&D; it uses and enforces readily established global research networks like the CLIC/CTF3 collaboration or the Global Design Effort for the ILC. The high-gradient research will be coordinated with the existing US High-Gradient Collaboration. NCLinac will improve and make available for a wider community of researchers purpose built and recognized world-class Research Infrastructures like the CLIC Test Facility CTF3 at CERN and the DAΦNE facility at Frascati, but also the world-wide only facility to address issues for extremely small emittances, ATF2 at KEK in Japan, is included.

Work package number	WP10	**Start date or starting event:**			M1
Work Package title	NCLinac					
Activity type	RTD					
Participant number	1	7	8	13	18	22
Participant short name	**CERN**	CIEMAT	CNRS	ESRF	INFN	PSI
Person-months per participant	126	36	56	24	57	18
Participant number	24	27	31	36	37	39
Participant short name	**RHUL**	STFC	UH	UNIMAN	UOXF-DL	UU
Person-months per participant	60	54	127	84	60	78

Objectives:
Task1: Coordination and Communication
- Coordination and scheduling of the WP tasks
- monitoring the work, informing the project management and participants within the WP
- WP budget follow-up

Task2: Normal Conducting High Gradient
- Investigate fundamental high-precision, high-power and higher order mode damping technical and scientific issues underlying the CLIC module
- Prepare hardware to test a CLIC module in the two-beam test stand of CTF3,

Task3: Linac & FF Stabilisation
- Design, build and test for stabilisation a CLIC quadrupole module in an accelerator environment
- Design, build and test for stabilisation a Final Focus test stand

Task4: Beam Delivery System
- Develop tuning strategies at ATF2

- Optimize the Linear Collider interaction region,
- Develop advanced beam instrumentation and test at ATF2 and PETRAIII

Task5: Phase Control

- Design, build and test a low impedance RF beam phase monitor with a resolution of 20 fs
- Design, build and test an electro-optical phase monitor with a resolution of 20 fs

Task6: Damping Ring Vacuum

- Identify and fully characterise thin films with low secondary emission and/or low activation temperature that can be applied in LC damping ring vacuum systems,
- Develop capability for simulating pressure distribution and dynamic effects in long vacuum chambers pumped by NEG coatings,
- Provide evidence of the electron cloud suppression effect for the selected coatings,
- Design and test a coating configuration for large scale production of the selected this films for the vacuum system of LC damping ring.

Description of work:

Task 1. Coordination and Communication

The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.
The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

Task 2: Normal Conducting High Gradient

The energy and luminosity design parameters for CLIC are 3 TeV and $6*10^{34}$ cm^{-2} s^{-1} respectively, and CLIC stands here synonymous for any future multi-TeV linear collider. These parameters result in extremely demanding requirements for the accelerating structures in terms of the accelerating gradient (100 MV/m or higher), high-power (of the order of 100 MW), tight mechanical tolerance (microns to tens of microns) and strong higher-order mode damping (complex geometries). A further level of difficulty is encountered when the challenges must be addressed simultaneously as is the case in the CLIC module.
The CLIC Test Facility 3 (CTF3) has been constructed to address the above issues to demonstrate feasibility of a multi-TeV linear collider based on CLIC technology. This project seeks to complement ongoing efforts, which are addressing the individual requirements, by concentrating primarily on questions of the integration, i.e. to simultaneously satisfy requirements of highest possible gradient, power handling, tight mechanical tolerances and heavy HOM damping. In addition this project will enhance the expansion of the CLIC study from its origins as a CERN project to a truly international collaboration. Existing collaborations with SLAC and KEK will be built upon and included in this project

- **Sub-task 1:** Design, manufacture, and validate experimentally a Power Extraction and Transfer Structure (PETS) prototype to improve CTF3.

- **Sub-task 2:** Explore influence of alignment errors on wake fields, elaborate and demonstrate appropriate High Order Mode (HOM) damping in the presence of alignment errors.

- **Sub-task 3:** Breakdown simulation: Develop and use atomistic simulations of atom migration enhanced by the electric field or by bombarding particles, understand what kind of roughening mechanisms lead to the onset of RF breakdown in high gradient accelerating structures.

- **Sub-task 4:** Design and build equipment to diagnose the electrons, ions and light emanating from the breakdown event both in the CTF3 Two-Beam Test-Stand at CERN and inside a scanning electron microscope in UU to analyze the surface science relevant to RF-breakdown.

- **Sub-task 5:** Precise assembly: Develop a strategy of assembly for the CLIC accelerating and power extraction structures satisfying the few to 10 micrometer precision requirement of positioning both radial and longitudinal taking into account dynamical effects present during accelerator operation.

Task 3: Linac & FF stabilisation
In the future linear colliders such as ILC and CLIC, beam sizes will be of the nanometre scale. In a real accelerator environment, many sources of noise such as ground motion, pumping devices, acoustic vibrations, cooling systems and others are present, sources which generate vibrations several orders of magnitude larger than the beam size. Stabilization of accelerator components such as the final focus (FF) is critical if the desired nanometre beam sizes are to be reached. It is particularly challenging for the CLIC project, where a stability of 1 nm above one Hertz is required even in the linac section, 0.1 nm above a few Hertz in the FF section. In a laboratory environment, these values could already be demonstrated. It is planned in this project to study the effectiveness of stabilisation equipment (such as seismic sensors, actuators, interferometers etc…) in a real accelerator environment. The equipment will be implemented at a CLIC quadrupole module inside the CTF3 facility, in the first stage with a quadrupole mock-up. In addition it is planned to use a CLIC standard module for comparing the vibration measurements with a laser interferometer (which can also serve as an alignment device) and the seismic sensors. The compatibility of these stabilisation devices with the alignment system that will be used in CLIC will be checked. A dedicated FF test stand will be built with a support and magnet prototype where the stabilisation will be developed. Furthermore, the stabilisation procedures will be simulated to ensure a better understanding of the beam-based feedback, stabilisation and the alignment. This will be tested on different accelerator facilities such as ATF2, CTF3 in preparation of ILC and CLIC.

- **Sub-task 1: CLIC quadrupole module.** CERN together with LAPP aims at demonstrating 1 nm quadrupole stability for the CLIC main linac quadrupole. Investigation of stabilisation feedback performance in different locations, e.g. an accelerator test tunnel will be performed. The aim is to demonstrate better than 1 nm stability of the main linac quadrupoles in an accelerator environment above frequencies of approximately 1 Hz. Inertial sensors will be tested and evaluated for accelerator environment (magnetic field, radiation, electrical and acoustic noise from accelerator components). The module needs a main beam linac support: study vibration isolation for the main beam quadrupole (principle, mock-up, feedback to be adapted to new boundary conditions) and build a test bench. The interferometric measurement system, developed in UOXF-DL, will be installed at the Final Focus Test stand and will be used to cross check results and extend the frequency range. CERN will also study the design and construction of main linac prototype magnet. The stabilisation of the main linac quadrupoles is one of the fundamental issues of CLIC. This activity aims to design and build a quadrupole mock-up that can serve as a model for the main linac quadrupole. New magnet manufacturing and assembly methods will be studied and implemented. The model will be used to investigate the performance of the stabilisation equipment that is also developed in this task.
  CERN aims at testing the compatibility (space, interferences, and complementarities) between the repositioning system (movers + associated sensors) and the stabilization system foreseen for the main beam quadrupole of CTF3/CLIC, in the real environment of the two beam test stand.

- **Sub-task 2: Final Focus Test stand.** LAPP together with CERN aims at exploring the potential to achieve 0.1nm stability scale for the final doublet quadrupoles above a few Hz by working on the design, simulation, construction and installation of the support (final doublet mock-up, eigenmode analysis) and on the feedback design depending strongly on the final doublet support chosen. LAPP will adapt feedback software to new configuration and boundary conditions and continue work to reduce costs.
  Oxford aims at studying the design, construction and deployment of an interferometric system to measure the motion between the proposed test magnet/girder and floor. This task includes the installation of interferometric system with the goal to push for maximum resolution and the possibility to correlate results with measurements done by inertial sensors. UOXF-DL will

contribute to the Development of optimized low-emittance beam transport and feedback for ILC and CLIC by completing an ILC prototype ATF2 intra-train and pulse-pulse Feedback and Final Focus system. In addition, they will study the simulation of the global luminosity performance of ILC and CLIC.

Task 4: Beam Delivery System

Key aspects and sub-systems of the ILC/CLIC beam delivery system will be developed and tested. The projects proposed here are new initiatives emerging from the results of the FP6 scheme (EUROTeV) with particular emphasis on developing and exploiting existing infrastructure at ATF2, CTF3, and PETRAIII. ATF2 will be the main international test facility for beam delivery studies over the period of FP7. Tuning procedures will be developed and tested at ATF2 and they will provide essential input into optimizing the CLIC IR region, which will also be performed in this context. Advanced BPMs will be employed and tested at the ATF2 and their integration with other systems optimized, including their use in bunch jitter subtraction for laser-wire measurements. Laser-wire measurements will also be made at PETRAIII, where a fast scanning system will be tested and the challenges of integrating a laser-wire as a reliable machine diagnostic tool will be met.

- **Sub-task 1.** The CI at Manchester (UNIMAN) (R. Appleby) and STFC at Daresbury (D. Angal-Kalinin) will test the tuning procedures at the ATF2 and use this knowledge to optimize the designs of the interaction region of both ILC and CLIC. Different tuning procedures and tuning knobs will be tested at ATF2 to achieve the vertical beam size down to 35nm; the proposed local chromaticity correction final focus system will be tested experimentally for the first time and various tuning procedures will also be applied to ILC and CLIC to optimize the interaction region (IR). The CLIC IR will be studied in detail, and the impact and mitigation of CLIC detector solenoid effects on the beam orbit, coupling and extraction will be considered. A further goal is to strengthen the computing infrastructure for tracking tools to be used at ATF2/ILC/CLIC and validate them experimentally.

- **Sub-task 2.** At RHUL (S. Boogert), high precision BPMs will be developed and tested at the ATF2 with particular emphasis on systems integration. The implications for ILC and CLIC beam diagnostics will be determined via full simulations using these experimental results.

- **Sub-task 3.** At RHUL (G. Blair), Laser-Wire systems will be developed and tested at the ATF2 and PETRAIII with particular emphasis on high-speed operation. The implications for ILC and CLIC beam diagnostics will be determined via full simulations using these experimental results.

Task 5: Phase Control

Very precise synchronization between main and drive beams is required in CLIC to avoid excessive luminosity loss due to energy variations. For this reason drive beam phase errors should be reduced by a phase feedback system within about 0.1 degrees (23 fs @ 12 GHz). The front end of this feedback system will consist of a monitor able to detect the longitudinal position of the bunches with a resolution of the order of 20 fs. The coupling impedance of the monitor has to be very low due to the high beam current. RF noise and wake fields in the beam pipe have to not affect the measurement and have to be rejected by proper designed filters. This device will find applications in other machines where precise high frequency beam phase detection is required. Two possible solutions will be investigated at the same time. A low impedance RF phase monitor with an integrated noise filter will be designed and built by CERN and INFN. It will be tested in CTF3 where it will also play an important diagnostic role in the optimization of the machine performances. An electro-optical monitor using periodic train of laser pulses to sample signal from wide bandwidth beam pickup will be developed and built by PSI and will be tested at the existing facilities at PSI.

- **Sub-task 1.** CERN will determine the specifications and will produce a conceptual design report of the RF monitor. CERN and INFN will attend together to the electromagnetic design and then they will produce a building design of the monitor. CERN will develop and realize the related electronics. INFN will build prototypes of the monitor that will be measured and tested in lab. A final version of the monitor will be built and the performances of the system will be tested in CTF3.

- **Sub-task 2.** The electro-optical monitor will be designed by PSI. PSI will implement prototypes of the system, which includes pick-up, laser, electro optical detector and electronics. The performances of the system will be tested in the existing facilities at PSI.

Task 6: Damping Ring Vacuum

Thin film coatings are needed to reduce secondary electron emission and to enhance pumping in limited conductance vacuum pipes of future LC damping rings. Although Ti-Zr-V non-evaporable getters (NEG) already fulfil these requirements, they need in-situ thermal activation at a temperature higher than 180°C. This essential feature is a major hindrance to the application of coating solutions to future accelerators. In these complex apparatus some vacuum pipes are not bakeable because of the tight mechanical tolerances. In other cases the vacuum chambers can withstand only mild heating because they are enclosed in magnets with severe constraints. As a consequence, the work proposed in this task aims at developing two different groups of thin films for particle accelerators vacuum systems: those with low secondary electron emission that do not need in-situ heating and those combining both low secondary electron emission and pumping capacity with lower activation temperature than Ti-Zr-V (less than 150°C). Although lacking in pumping efficiency, the materials of the first group will allow the suppression of electron cloud built-up, namely a foremost concern for future accelerators. In addition those of the second group will provide a pumping effect after heating at lower temperatures than Ti-Zr-V films; the lower thermal stress will allow a safer use of alternative structural alloys for vacuum pipes and simpler bakeout techniques, like high pressure hot water.

- **Sub-task 1.** A set of promising thin film materials will be selected and qualified by the four Institutes; this will include nitrides and carbides of transition metals, and carbon based coatings. The production will be initially carried out at CERN and STFC where vacuum properties will be also assessed; surface properties will be studied at STFC (composition and structure, Secondary Electron Yield (SEY), activation onset, ageing effects, poisoning, photoelectron yield, etc.); synchrotron radiation effects will measured at the ESRF (photon induced desorption and stability under radiation bombardment); efficiency in erasing electron cloud effect will be evaluated at INFN-LNF in a DAΦNE's dedicated facility.

- **Sub-task 2.** Four Institutes will develop conjointly the simulation of pressure distribution and dynamic effects in long coated vacuum chambers. Analytical methods, Monte Carlo techniques, and PSpice programming will be employed and their results compared. The physical parameters obtained in sub-task 1 together with vacuum chamber geometries will be the input of the calculation.

- **Sub-task 3.** The production strategies for large-scale applications of coated vacuum chambers will be discussed and tested. The critical phases of the fabrication and installation (materials procurement, assembling, surface treatments, coating configuration for the selected materials, storage, and commissioning) will be considered and their effect on the functional properties will be measured as indicated in sub-task 1. A prototype coating set-up will be installed at CERN.

Deliverables of tasks	**Description/title**	**Nature**[1]	**Delivery month**[2]
10.1.1	NCLinac web-site linked to the technical and administrative databases	O	M48
10.2.1	Simulation and experimental results with report on the theoretical and scientific aspects of the CLIC module	R	M48
10.2.2	Prototypes with descriptive report (technical, design and fabrication) of the hardware prepared for the test module.	P	M48
10.3.1	CLIC Module final report	R	M48
10.3.2	Final Focus final report	R	M48
10.4.1	Prototype Crab Cavity at CTF3	P	M36
10.4.2	ATF2 tests and CLIC IR study	R	M42

10.4.3	Laser Wire and Beam Position Monitor tests	R	M46
10.5.1	RF phase monitor final report	R	M45
10.5.2	Electro optical monitor final report	R	M48
10.6.1	Simulation of vacuum pressure distribution, final report	R	M30
10.6.2	Selected vacuum chamber coating properties and production final report	R	M30
10.6.3	Vacuum chamber coating system for large scale production	P	M36

Mile-stone	**task**	**Description/title**	**Nature**[1]	**Delivery month**[2]	**Comment**
10.1.1	10.1	Annual NCLinac review first year	O	M12	
10.1.2	10.1	Annual NCLinac review second year	O	M24	
10.1.3	10.1	Annual NCLinac review third year	O	M36	
10.1.4	10.1	Final NCLinac review	O	M48	
10.2.1	10.2	Modification of NCLinac computer codes and first round of simulations.	R	M24	
10.2.2	10.2	Design of NCLinac hardware for test module	R	M24	
10.2.3	10.2	Prototype components for CLIC module prepared	P	M36	
10.3.1	10.3	Commissioning of CLIC quadrupole module	D	M24	Complete module with girder and accelerating structure
10.3.2	10.3	Characterization of noise/ vibrations sources in an accelerator	O	M24	
10.3.3	10.3	Quadruple mock-up manufactured and ready for installation	D	M24	
10.3.4	10.3	Installation of interferometers at CTF3 Module	D	M24	
10.3.5	10.3	Installation of ATF2 final-focus alignment monitoring system	D	M6	
10.3.6	10.3	Installation of ILC prototype FB/FF at ATF2	O	M24	
10.4.1	10.4	Training at ATF3	O	M18	Commissioning at ATF2
10.4.2	10.4	LW and BPMs installed	D	M18	Hardware at ATF2 and PETRAIII
10.5.1	10.5	RF phase monitor prototype finished	P	M36	Prototype ready for test
10.5.2	10.5	Electro optical monitor prototype finished	P	M40	Prototype ready for test
10.6.1	10.6	Thin film materials selected	O	M6	
10.6.2	10.6	Selected materials fully characterized	R	M30	All parameters needed for vacuum design
10.6.3	10.6	Coating production strategy ready	O+P	M36	Coating system prototype

Table 1.3 d11: Work package description WP11: SRF: SC RF technology for higher intensity proton accelerators & higher energy electron linacs

The main activities in the SC RF Technology WP concentrate on three different areas: cavity improvements, beam experiments and upgrading test infrastructures. Improved methods for cavity treatment such as vertical electro-polishing or sputter coating will be investigated. Prototype work on superconducting (SC) crab cavities will be launched with the goal to increase the luminosity of colliders such as LHC, CLIC or ILC. However the most exciting and promising idea is to fabricate cavities from single crystal material. In this case grain boundaries are completely missing so that it will be possible to explore the intrinsic properties of the superconducting niobium material. The second research activity concentrates on further developing Low Level RF techniques and on new diagnostic tools based on the analysis of Higher Order Modes (HOM). These advanced and challenging concepts and ideas will be tested in the FLASH linac, and they are important for the extreme beam stability requirements and control problems in future projects. The main aim of the third research area of this WP is to form and to coordinate a powerful consortium of various test facilities, which is worldwide unique and which allows fundamental investigations in superconducting RF technology for a better understanding of this challenging field.

Work package number	WP11			**Start date or starting event:**			M1		
Work Package title	SRF								
Activity type	RTD								
Participant number	10	3	5	6	1	8	14	18	19
Participant short name	**DESY**	BESSY	BUW	**CEA**	CERN	CNRS	FZD	INFN	INP PAN
Person-months per participant	115	17	19	132	129	60	16	53	11
Participant number	20	22	27	28	29	33	36	38	40
Participant short name	IPJ	PSI	STFC	TUD	TUL	ULANC	UNIMAN	URostock	WUT
Person-months per participant	12	31	18	18	24	26	52	27	24

Objectives:

Task 1 – Coordination and communication
- Coordination and scheduling of the WP tasks
- Monitoring the work, informing the project management and participants within the JRA
- WP budget follow-up

Task 2 – Single crystal cavities
- Investigation of influence of crystallographic orientation on magnetic, thermal and mechanical properties of niobium single crystals.
- Development of fabrication procedure and fabrication of single cell and multi cell single crystal niobium cavities. Preparation and RF tests.

Task 3: Electro-polishing and surface investigations
- Test new recipes on niobium single-cell 1.3 GHz cavities and achievement of reproducible gradients.
- Develop a vertical electro-polishing set-up that could combine Electro Polishing (EP) and BCP treatments. Tests of cavities treated vertically.
- Characterise surface quality by FESM, SEM/AES and high resolution HRSEM/EDX.

Task 4: SC Cavities for proton linacs

- Design, fabrication and tests of beta=0.65 and beta=1.0 cavities with the goal to reach announced performances.
- Specification of the HOM damping for both cavity types and for the operation parameters of the proton driver.
- Definition of interfaces between cavities and cryomodules (cavity support, power coupler, …).

Task 5: LHC Crab cavities

- Design, build and test a single LHC and CLIC crab cavity module, including input coupler, mode couplers and tuners.
- Design, build and test a LLRF and synchronization system that meets the crab cavity phase and amplitude control specifications for LHC and CLIC.
- If the beam time and the necessary hardware become available, validate and test the assembled crab system solutions and LLRF control systems on LHC and CTF3 in 2011; otherwise make performance predictions based on the measured noise characteristics.

Task 6: Thin Films

- Improve the Nb sputtering technology for low beta cavities such as QWR to reach 6 MV/m at a Q-value of $5 \cdot 10^8$.
- Perform arc sputtering of photo cathodes (Pb) in a Nb cavity and test the performance of the developed systems
- Research on new technologies for thin film depositing of superconductors for SC cavity applications.

Task 7: HOM Distribution

- Development of HOM based beam position monitors (HOMBPM)
- Development of HOM based phase monitors (HOMPM)
- Development of HOM Cavity Diagnostics and ERLP (HOMCD)
- Measurement of HOM Distributions and Geometrical Dependences (HOMDG)

Task 8: LLRF at FLASH

- ATCA developments of carrier boards with FPGA and DSP, reference clock and timing distribution, cavity simulator, beam based longitudinal feedbacks and control for cavity & waveguide tuners
- Development of AMC modules with fast analogue IO and digital IO, ultra fast analogue IO (2 Gs, 10 bit) and with radiation sensors (gamma and neutron detector with customized ASICs)
- Development of AMC/RTM module for down-converters and up-converters
- Development of interfaces and communication protocols for ATCA/AMC

Task 9: SCRF gun at ELBE

- Installation of an energy spectrometer in the ELBE beam line for slice diagnostics and slice emittance measurements for different emittance compensation schemes.
- Design, built and test the set-up for preparation and application of GaAs photo cathodes in the SRF-Gun.
- Evaluation of critical R&D issues of SRF guns like photocathode compatibility, advanced emittance compensation and application as a high-brightness polarized electron source.

Task 10: SRF Test infrastructure

- Organization of a collaboration consisting of a general purpose central facility hosted at CERN and completed by complementary facilities providing specific equipment elsewhere;
- Operation in shared responsibility between the host laboratories for the (recurrent) non-project specific running costs and the user collaborations for the (ad-hoc) specific project costs;
- Providing an infrastructure for the maintenance and tests of SRF cavities of existing facilities and the development of SRF cavities for new facilities,
- Pushing the SRF technology performance limits,
- Training a new generation of accelerator experts in the field of SRF, and facilitating a

continuous technology transfer to industry.

Description of work:

Task 1. Coordination and Communication.
The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.
The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

Task 2. Single crystal cavities

- **Sub-task 1.** Investigation of the properties: magnetic properties (dependence on crystallographic orientation and treatment); thermal conductivity (phonon peak of the thermal conductivity of single crystal close to 2 K); mechanical properties (uniaxial tensile test, biaxial bulging test, considering the orientation dependence); investigation of the surface roughness after BCP (dependence on the crystallographic orientation).

- **Sub-task 2.** Development of fabrication procedure and fabrication of single cell single crystal niobium cavities. Find safe interval of strains, of annealing parameters to expand single crystals without altering their properties. Find safe interval of matching of single crystals for grow together by electron beam welding without altering their properties. Extension of the fabrication procedure to multi cell cavities. Preparation (BCP and compare to EP) and RF tests of the cavities from single crystal niobium.

Task 3. Electro-polishing and surface investigations
Studies carried out within the CARE SRF project concerning electro-polishing (EP) have shown that mixtures different from the standard recipe are promising in the view of the large scale cavity treatment. But these mixtures have only been tested at small samples. We propose to use these new mixtures with single cell superconducting cavities and thus explore the possible benefit in respect to enhanced and reproducible superconducting properties and / or simplifications in the fabrication procedures.
In the standard electro-polishing apparatus the cavity is treated with its axis being aligned horizontally. At Cornell University an EP apparatus with a vertical cavity axis was explored. We propose to investigate this option in more detail because it promises a more uniform flow of electrolyte. The COMSOL code will be used to look in details of the fluid distribution for the horizontal and vertical process as well as to find the optimum cathode geometry.
In addition surface investigations like field emission scanning microscope (FESM), in-situ SEM/AES and ex-situ high resolution HRSEM/EDX will be used to characterize the surface quality.

- **Sub-task1.** For each EP recipe, different cavities are treated several times in order to evaluate reproducibility of the treatment in terms of RF tests and surface consideration (roughness). EP treatments will take place at CEA-DSM Saclay, and cavity will be tested at DESY and CEA-DSM Saclay.

- **Sub-task 2.** Design, commissioning and operation of the vertical EP set-up. Fluid modelling via COMSOL software will permit to evaluate the best configurations.

- **Sub-task 3.** Systematic FESM, HRSEM and EDX measurements on electro-polished Nb samples to detect and characterise field emitting sides.

- **Sub-task 4.** Detailed data analysis of all emitters identified on bulk and thin film Nb samples to derive correlations between their morphology, composition and EFE strength.

Task 4. SC Cavities for proton linacs

Since a few last years, different options for the upgrade of the Large Hadron Collider were investigated. A very promising option is based on a superconducting proton linac (SPL), which can advantageously replace the injector of the CERN complex. It also offers new possibilities, since such an accelerator could be used as a proton driver for EURISOL or/and a neutrino factory.
All these applications require acceleration up to 5 GeV of a high intensity proton beam. The beam is delivered by the LINAC4 injector at the energy of 180 MeV and at a frequency of 352.2 MHz. The optimized design of the SPL accelerator is based on two families of sc cavities (beta=0.65 and beta=1.0) operating at 704.4 MHz at gradients of 19 MV/m and 25 MV/m, respectively. For the high beta cavity family of the SPL, the RF peak power transferred to the beam is in excess of 1 MW. Moreover, the mean power is in the range of 100 kW considering the operating duty cycle. Such power levels need to develop power couplers at the best level of the state of the art.

- **Sub-task 1:** Design and fabrication of beta=0.65 704 MHz elliptical cavity equipped with a Titanium helium reservoir. Preparation (BCP, HPR) and assembly in clean room. Modification of the vertical cryostat and adaptation to the cavity size. Test of the cavity in vertical cryostat. This sub-task is under responsibility of IPN-Orsay. The cavity preparation recipe will be defined with CEA-DSM-Saclay, and the cavity interfaces with a cryomodule studied with CERN.

- **Sub-task 2:** Study and fabrication of beta=1 704 MHz elliptical cavities. Optimization and fabrication of 2 couplers sustaining 1MW of RF power with safety margin. Conditioning and long-run test of couplers. Fabrication of a tuning system with piezo elements. Many handling tools and preparation/tuning set-ups have to be upgraded because of the size and weight of the cavity. Preparation of the cavities and assembly without power couplers respectively for cold tests in horizontal/ vertical cryostat. This sub-task is under responsibility of CEA-DSM-Saclay. The cavity preparation recipe will be defined with IPN-Orsay, and the cavity interfaces with a cryomodule studied with CERN.
- **Sub-task 3:** Beam dynamics simulation with the real High Order Modes spectrum and with the operation parameters of the proton driver; specification of HOM damping for the most dangerous longitudinal modes accordingly. This sub-task is under the responsibility of CERN with participation of CE-Saclay.

- **Sub-task 4:** Study of interfaces between the cavity (with power coupler, cold tuning system, magnetic shielding, supports and alignment tools) and the cryomodule. This sub-task is under the responsibility of CERN. CEA-DSM-Saclay and IPN-Orsay will participate in order to fix the design in accordance with components specification and to adapt the prototypes to make it fit to the cryomodule

Task 5. LHC Crab cavities

- **Sub-task 1**: STFC, ULANC and CERN will determine the full LHC system requirements for the crab cavity system and then STFC and CERN will develop a suitable crab cavity design which meets these requirements; ULANC will develop suitable input and mode couplers to allow for damping of the dangerous trapped modes. A suitable frequency tuner will be developed by ULANC and CERN. Validation of expected cavity performance will be completed by fabrication of a model test cavity and collectively STFC, ULANC and CERN will perform mode characterization measurements.

- **Sub-task 2**: ULANC, UNIMAN and CERN will determine the full CLIC system requirements for the crab cavity system and then UNIMAN and CERN will develop a suitable crab cavity design which meets these requirements; UNIMAN and ULANC will develop suitable input and mode couplers to allow for damping of the dangerous trapped modes. A suitable frequency tuner will be developed by ULANC and CERN. Validation of expected cavity performance will be completed by fabrication of a model test cavity and collectively STFC, ULANC, UNIMAN and CERN will perform mode characterization measurements. A complete X-band crab cavity will be fabricated by STFC and its performance verified by ULANC and UNIMAN and CERN.

- **Sub-task 3:** ULANC will develop suitable LLRF systems that can control the amplitude and phase of the crab cavities required for both LHC and CLIC. Low power phase and amplitude qualification measurements will be performed with their respective model cavities.

<u>Task 6. Thin Films</u>

Thin films depositing techniques has made major progress since the last large scale use of sputtering deposition techniques for Nb coated Cu SC cavities in the 1990's in the LEP-II and ALPI projects. The classical sputtering technique has been improved with e.g. new processes for: surface preparation, surface cleaning, cavity shaping and biased sputtering. For the longer term, new thin film depositing techniques such as plasma based Atomic Layer Deposition will through experimental studies and theoretical studies using measured input data improve our understanding of thin film properties. This work should eventually permit the production of a new generation of high performance thin film SC cavities made with new methods and maybe with new superconducting materials.

- **Sub-task 1.** New and improved techniques for the production of Nb sputtered Quarter Wave (QW) cavities. QW cavities are highly suitable for heavy ion SC linacs which today are used (or widely proposed to be used) for applications such as accelerators for radioactive ions beams, for low energy injectors and other ion beam applications. The work, led by CERN in collaboration with INFN-LNL, will focus on magnetron sputtering, high peak power magnetron sputtering and better shaping (techniques) of the cavities. The target value is to reach accelerating field of 6 MV/m with a Q-value of at least $5*10^8$.

- **Sub-task 2.** Arc coating of cavities and photo-cathodes. The arc coating technique is especially suitable for elliptical cavities such as TESLA and ILC type cavities and for LHC type cavities. The development of microfilters to avoid the formation of micro particles on the surface is already in progress. The work will focus on i) coating and testing of elliptical cavities, ii) the development of the technique for other geometries, iii) the characterization of RF properties of the films which will be performed with a TE011 cylindrical bulk niobium cavity using the thermometric/calorimetric method and iv) coating the SC photocathode with a highly emission efficient lead layer. Roma2-INFN, IPJ-Swierk and DESY will drive the development on the planar and cylindrical arc coating, IPNO-IN2P3 will provide test cavity and infrastructure to measure the quality of the films samples and the common test facilities at CERN will serve for the testing of the elliptical cavities.

- **Sub-task 3.** The development in thin film techniques is making steady progress and there are new techniques such as plasma based atomic layer deposition (ALD) techniques which appear versatile enough to be applied for the manufacturing of SC cavities. The work, led by CI in collaboration with CEA-DSM, INFN-LNL, CERN, and IPNO-IN2P3 will cover experimental studies of new methods for thin film deposition, characterization of surface properties with analyses equipment such a Atomic Force Microscopy and electron microscopy and RF tests of new types of SC thin films tested in either "button" type test facilities or in bulk niobium cavity using the thermometric/calorimetric method.

<u>Task 7. HOM Distribution</u>

The wake-field excited by multi-bunch particle beams has the beneficial quality that it is, in essence, its own built-in diagnostic and this is the area of research for the proposed work package. An attenuated portion of the field radiated to the attached HOM (Higher Order Mode) damping ports provides information as to the location of the beam with respect to the electrical axis of the accelerating cavities and this provides a BPM (Beam Position Monitor). A suitable combination of the cavity eigenmodes provides essential information on the cavity to cavity and indeed on cell-to-cell alignment. Research in this area on the FLASH-TTF linac has allowed the emittance of the beam to be improved significantly. Use of the unique experimental facility, FLASH-TTF at DESY and the recently developed ERLP at Daresbury will allow these HOMs to be probed and their capability of improving the emittance of future colliders and light sources assessed. This research has particular relevance to the ILC, XFEL, and

4GLS. Furthermore, the new 3.9 GHz cavities to be installed at FLASH have an increased wake-field as the iris is more than a factor of 2 smaller than the TESLA cavity and the associated modes will require careful monitoring to ensure that they do not appreciably dilute the emittance of the beam.
We expect this research to have a significant experimental component associated with it, together with theoretical and experimental modelling. The former will be conducted at FLASH-TTF, DESY labs and ERLP, STFC Daresbury labs and the latter at the UNIMAN, URostock and CEA-DSM (Saclay). Considerable success on using these signals as a BMP has been achieved with room temperature copper structures and we will exploit these techniques in the superconducting accelerating cavities.

This project aims at developing HOM based monitors and analyzing the modal distribution within the cavities:

- **Sub-task 1:** HOM based beam position monitors (HOMBPM). Improve the speed of existing HOMBPM installations, measure each bunch of every bunch train, and compare the resolution with various modes in order to verify the accuracy of the technique.

- **Sub-task 2**: HOM based phase monitors (HOMPM). The purpose of this monitor is to measure the phase of the RF injected into the cavities with respect to the phase of the beam. The work on these monitors will proceed together with the additional LLRF development at FLASH.

- **Sub-task 3**: Cavity Diagnostics and ERLP (HOMCD). From the HOM spectrum one can ascertain the cavity alignment and cell geometry. In particular we will investigate: mechanical deviations of individual cells from the ideal geometry, cell-to-cell misalignment, deformation of fields by couplers.

- **Sub-task 4**:HOM Distributions and Geometrical Dependences (HOMGD). Combining finite element and S-matrix cascading techniques allows the eigenmodes in multiple accelerating cells and cavities to efficiently modelled. This will allow an investigation of the implication of typical fabrication errors, on the mode distribution –in particular the splitting of the mode degeneracy and the influence of the couplers on the mode frequencies will be investigated.

Task 8. LLRF at FLASH

The present LLRF control system at FLASH will satisfy user needs for the next 1-2 years but does not fulfil the long term (3-10 years) requirements in several areas: field regulation, availability, maintenance and operability. The demand for high availability (HA), modularity, standardization and long time support favours the choice of the ATCA and uTCA standards with carrier boards and AMC modules. This technology comes from telecommunication industry and therefore lacks instrumentation needed for High-Energy Physics experiments. However the ATCA architecture for instrumentation in HEP experiments is already being developed (AGATA project) or is considered as strong candidate (XFEL, ILC instrumentation). The LLRF control system will be build using modular approach basing on ATCA architecture.
The input signals will be processed by AMC plug-in modules hosted by carrier board providing communication for the system components and supporting signal processing by embedded FPGAs and DSPs. Presently none of the required AMC boards for ADCs, DACs, down-converters, clock synthesizers etc. are available. Therefore a development of these boards using state-of-the-art technology is necessary in a way that optimizes the total costs while keeping high commercial standards on reliability, availability, maintainability and others. Several components of the LLRF system (controller, distribution of reference frequency, radiation monitoring) and control software were developed partly in the frame of FP6-CARE-JRASRF. They will be extended and implemented in the ATCA based LLRF system installed in FLASH accelerator.

- **Sub-task 1.** The LLRF control system will be build using modular approach basing on ATCA. The ATCA carrier board equipped with AMC sockets and huge processing power (FPGA and DSP) will be developed. Particular focus will be paid for transmission of analogue signals with low crosstalk from digital section.

- **Sub-task 2.** The main goal of this subtask is a development of AMC and RTM modules required IO functionality. For RF signals processing of direct and downconverted signals will be investigated and compared. For radiation monitoring the AMC with integrated radiation level sensor will be developed. For synchronization of digital signal processing with RF field the special AMC with timing signals (clocks and event triggers) will be developed. Inter-module communication will be crucial for machine operation. To achieve High Availability (HA), High Maintainability (HM) and High Operability (HO), protocols for remote diagnostics are needed.

- **Sub-task 3.** The actuators (step motors, piezos) of the tuning system require power signals that cannot be supplied directly from LLRF system. Therefore special power drivers must be developed together with AMC modules interfacing between drivers and LLRF system and software performing tuning algorithms must be implemented in firmware.

- **Sub-task 4.** The goal of this task is to explore the possibility to build up beam based feedbacks and test a prototype at FLASH. The diagnostic devices (measuring longitudinal beam parameters like beam energy, bunch arrival etc.) will be connected by developed interfaces to ATCA based LLRF system and fast low level algorithms to extract relevant correction parameters will be implemented. The corrections will be then fed back to the LLRF system within a bunch train.

Task 9. SCRF gun at ELBE

- **Sub-task 1.** For the slice diagnostics system, beam dynamic simulations will be carried out. Commissioning of the diagnostics at ELBE, measurement of slice emittance and energy spread of the SRF-Gun beam, in particular for high bunch charges around 1 nC will be performed by BESSY and FZD.

- **Sub-task 2.** Improvement of the GaAs photo-cathodes preparation chamber which is now used for Cs2Te photo-cathodes. Lenses and mirrors in the laser beam line will be replaced since green laser light will be used for the operation of the gun. For this work FZD is responsible.

- **Subtask 3.** The measurements in this subtask concerns the i) properties of photo-cathodes like quantum efficiency, live time, thermal emittance, ii) the long term behaviour of the RF cavity, i.e. unloaded quality factor, maximum gradient, field emission, iii) later measurements with GaAs photo-cathodes.

Task 10. SRF Test infrastructure

Central facility (CERN): The proposed work consists of the

- management and coordination of the task
- extension and upgrade of assembly, cleaning and RF testing equipment in bld. SM18 and bld. 252, both at room temperature and low temperature, such as extension of bunkers, acquisition of low and high power equipment at various frequencies, re-cabling of cryostats regarding RF controls, including temperature mapping, test resonators for the RF characterization of samples (AB-RF);
- refurbishment of the cryogenic installation, re-cabling of cryostats regarding the cryogenics , and other upgrade activities, in particular the extension of the infrastructure to continuous operation at 2 K in bld. SM18 (AT-CRG);
- refurbishment of the surface polishing and cleaning activities (bld. 118) as well as the coating activities (bld. 252) and the characterization of samples by DC methods (TS-MME).

Specialized facilities: The proposed work consists of the

- design, acquisition, installation and operation of an electro-polishing bench for multi-cell cavities of various provenience (CEA-DSM-Saclay);
- design, acquisition, installation and operation of the upgrades (diagnostics) associated with the coupler conditioning and window coating stations at 1.3 GHz (CNRS-LAL-Orsay);
- design, acquisition, installation and operation of a large size intermediate temperature (900°C) UHV furnace for superconducting cavity annealing (CNRS-IPN-Orsay);
- upgrade and operation of a medium size high temperature (1800°C) UHV furnace for annealing samples and 3 GHz cavities (TUD); upgrade and operation of a complete 2nd 1.3 GHz RF station (about 15 kW) for the HoBiCaT test facility (including low-level RF system) to be able to power two cavity units in HoBiCaT simultaneously (BESSY).

Other (non-beneficiary) collaboration partners are BUW for field emission scanning of samples, DESY for TTF test facility, INFN Roma for coating techniques of niobium on copper alternative to sputtering, IPJ for experimental facilities for UHV arc deposition of pure Nb and Pb layers, and UErlangen for microwave imaging laser scanning of samples.

Deliverables of tasks	Description/title	Nature[1]	Delivery month[2]
11.1.1	SRF web-site linked to the technical and administrative databases	O	M48
11.2.1	Summary of single crystal niobium properties	R	M36
11.2.2	Summary report on single crystal niobium cavities	R	M48
11.3.1	Reproducibility of the process as a Function of the EP-Mixture	R	M36
11.3.2	Summary of test results with vertical EP	R	M42
11.3.3	Evaluation of enhanced field emission in Nb samples	R	M48
11.4.1	Results of SC proton cavity tests (beta=1 and 0.65)	R	M33
11.4.2	Tests results in horizontal cryostat with power coupler	R	M42
11.5.1	LHC crab cavity design complete	R	M36
11.5.2	CLIC crab cavity design complete	R	M36
11.5.3	LHC and CLIC LLRF design complete	R	M36
11.6.1	QE data for Pb/Nb deposited photo cathode samples	R	M12
11.6.2	RF measurements on thin film deposited QRW prototype	R	M36
11.6.3	Cold test results for the test cavities w/out the deposited lead photo cathode	R	M36
11.6.4	New thin film techniques for SC cavities	D	M48
11.7.1	HOM electronics and code to probe beam centring on 3.9 GHz cavities	R	M48
11.7.2	Report on HOM experimental methods and code	R	M48
11.8.1	Report on system test and performance	R	M48
11.9.1	Results of slice measurements	R	M24
11.9.2	Results for GaAs photocathodes	R	M33
11.10.1	A European Infrastructure for R&D and Test of SRF cavities and cryo-modules (summary report)	R	M48
11.10.2	A Central Infrastructure at CERN for R&D and Test of Superconducting Radio-Frequency Cavities and Cryo-modules	R	M48
11.10.3	RF tests of nine-cell cavities processed in new processing stations at Saclay	R	M36
11.10.4	Test and operation of the upgraded coupler coating bench and coupler processing stations at LAL-Orsay	R	M36
11.10.5	New results on annealing niobium samples and RF cavities at IPN-Orsay	R	M36
11.10.6	Operation of a 1800°C UHV furnace for heat treatment of niobium cavities at 3 GHz	R	M30
11.10.7	Operation of 2nd IOT-based RF station operational at HoBiCaT as demonstrated by cavity test	R	M30

Mile-stone	task	Description/title	Nature[1]	Delivery month[2]	Comment
11.1.1	11.1	Annual review SRF first year	O	M12	
11.1.2	11.1	Annual review SRF second year	O	M24	
11.1.3	11.1	Annual review SRF third year	O	M36	
11.1.4	11.1	Final SRF review	O	M48	
11.2.1	11.2	Investigation properties finished	R	M36	

11.2.2	11.2	Development fabrication procedure finished	P	M42	
11.3.1	11.3	Tests achieved for 1st recipe	O	M24	
11.3.2	11.3	Tests achieved for 2nd recipe	O	M36	
11.4.1	11.4	Cavity fabrication (proton linac)	P	M30	
11.4.2	11.4	Proton beam Instabilities studies	R	M36	
11.4.3	11.4	Definition of cryomodule interface	R	M42	
11.5.1	11.5	LHC crab cavity specifications completed	R	M6	LHC beam dynamics studies complete and impedance specifications defined
11.5.2	11.5	LHC model crab cavity completed	P	M18	Prototype cavity fabricated and tested
11.5.3	11.5	LHC input and mode coupler design development finished	P/R	M33	Prototype mode couplers designed, fabricated and tested with the prototype cavity model
11.5.4	11.5	CLIC crab cavity specifications completed	R	M6	CLIC beam dynamics studies complete and impedance specifications defined
11.5.5	11.5	CLIC model crab cavity completed	R	M18	Prototype cavity fabricated and tested
11.5.6	11.5	CLIC input and mode coupler design development finished	P/R	M33	Prototype mode couplers designed, fabricated and tested with the prototype cavity model
11.5.7	11.5	Development of LHC LLRF system	P	M23	LHC LLRF system prototype available for tests with prototype cavity
11.5.8	11.5	Development of CLIC LLRF system	P	M33	CLIC LLRF system prototype available for tests with prototype cavity
11.6.1	11.6	Lead deposition on samples for photocathode development	O	M12	Report and samples
11.6.2	11.6	Lead deposition on half cells and 1.5 cell cavities	O	M18	Report and samples
11.6.3	11.6	QWR sputtering with Nb using the magnetron technique	P	M30	
11.6.4	11.6	Report on new thin film coating techniques for SC cavities	R	M36	
11.6.5	11.6	Improved RF-design of 1.5 cell	R	M36	
11.7.1	11.7	HOM alignment for 3.9 GHz cavity electronics verification	D	M36	
11.8.1.	11.8	Design and manufacturing of the carrier board prototypes.	P	M18	
11.8.2	11.8	Design and manufacturing of the AMC and RTM IO modules	P	M24	
11.8.3	11.8	Design and manufacturing of the AMC IO modules	P	M24	
11.8.4	11.8	Design and fabrication of AMC modules for controling step motors, piezo and waveguide tuners	P	M24	
11.8.5	11.8	Report on longitudinal beam parameter studies and their	R	M36	

		controllability by fast feedback systems in conjunction with the LLRF system			
11.9.1	11.9	Preparation system for GaAs finished	O	M12	
11.9.2	11.9	Installation spectrometer dipole	O	M18	
11.9.3	11.9	GaAs photocathodes produced	D	M24	
11.10.1	11.10	Processing, assembly and RF test of cavities (LHC type, 1500 MHz), cryo-modules and samples (RF and DC)	R	M24	Assessment of present status of facilities (SM18, quadrupole resonator, cryo-line and cryostat, high power magnetron sputtering)
11.10.2	11.10	Design of the electro-polishing station for multi-cell cavities at CEA-Saclay	R	M22	
11.10.3	11.10	Upgrade of the coupler coating bench and coupler processing stations finished	D	M24	
11.10.4	11.10	900°C UHV furnace installed at IPN Orsay	D	M24	
11.10.5	11.10	First 3 GHz cavity treated	D	M18	
11.10.6	11.10	Test completed of loaned IOT tubes at low power with existing power supply	R	M16	To evaluate available systems

Table 1.3 d12: Work package description WP12: ANAC Assessment of Novel Accelerator Concepts

This WP merges three very important topics regarding novel accelerator concepts in three different fields: high luminosity colliders (Task 2), technologies required by neutrino facilities (Task 3) and plasma wave accelerator techniques (Task 4).
Task 2: the feasibility study of a new collision scheme for storage-ring colliders will be performed, characterized by "large Piwinski angle, low β* and Crab Waist". This scheme holds the promise of increasing the luminosity by more than two orders of magnitude beyond the current state-of-the-art, without any significant increase in beam current and without reducing the bunch length. First exploratory tests of one of its ingredients, namely the "Crab Waist", are presently in progress at the INFN National Frascati Laboratory's Φ-Factory DAΦNE. The feasibility of the scheme will be studied for both an upgrade of the DAΦNE collider for the KLOE2 experiment and a possible application to the upgrade of LHC luminosity.
Task 3: the Electron Model of Many Applications (EMMA) ring, the world's first so-called non-scaling FFAG, is being constructed at the STFC Daresbury Laboratory to prove the principle of this type of accelerator and its successful operation could have far reaching consequences. In particular, non-scaling FFAGs are currently being studied for applications in Particle Physics (in particular, for the generation of intense neutrino beams for long baseline neutrino oscillation measurements using a Neutrino Factory), the treatment of cancer with carbon and proton beams, for the generation of neutrons and muons for investigating the structure of matter and for energy generation using sub-critical nuclear reactors. The knowledge gained from the operation of EMMA will be vitally important for the work in all these areas.
Task 4: the development of ultra short X ray beams is of major importance for fundamental studies, namely related to ultra fast phenomena in domains such as material science and life science. Such X ray beams are produced by coupling high quality ultra short electron beams with undulator magnets. For this purpose, the development of ultra short electron beams with low emittance is in progress in different places in Europe using RF or laser based accelerators. Importantly, the development of these short electron bunches is crucial for the development of a two stage laser plasma accelerator which should permit to reduce notably the relative energy spread of the electron beam.
Existing infrastructures used in the three Tasks:

- DAΦNE e+e- storage ring, INFN Frascati National Laboratories
- LHC collider, CERN
- EMMA FFAG Ring, Daresbury Laboratories
- SPARC LAB, INFN-Frascati National Laboratories
- LOA, CNRS

Work package number	WP12		**Start date or starting event:**		M1		
Work Package title	ANAC						
Activity type	RTD						
Participant number	18	4	1	8	27			
Participant short name	**INFN**	BINP	CERN	CNRS	**STFC**			
Person-months per participant	125	21	35	67	56			

Objectives:
Task 1. Coordination and Communication.

- Coordination and scheduling of the WP tasks
- Monitoring the work, informing the project management and participants within the JRA
- WP budget follow-up

Task 2. Design of Interaction Regions for high luminosity colliders.

- Feasibility study of a new IR based on the Crab Waist concept for the upgraded KLOE experiment at DAΦNE.
- Study the possible integration of the Crab-Waist collision scheme into the LHC collider upgrade

Task 3. Upgrade of the EMMA FFAG Ring.

- Design, build and test the external diagnostics systems for EMMA.
- Commission EMMA using the diagnostics and perform the necessary experiments to evaluate non-scaling optics for a variety of applications.

Task 4. Instrumentations for novel accelerators.

- Development of high quality ultra short electron beams with laser plasma accelerators
- Design, build and test of detectors for emittance measurements

Description of work:

Three RTD Tasks will provide unique research and technology studies in three different fields:

- Task 2: feasibility study and implementation of a new collision scheme for colliders, based on "large Piwinski angle" and "Crab Waist" concepts, which will be tested for the first time at the DAΦNE Φ-Factory at LNF (Frascati) in 2008. Study of a new DAΦNE IR for the KLOE 2 detector, as well as the application of the same principle to an IR for the LHC Upgrade will be performed.
- Task 3: design, prototype, test, construct, install and commission external diagnostics devices for measurements such as emittance, longitudinal profile and momentum for beams accelerated in the EMMA ring. In addition, an emittance measurement system will be constructed for the injection line to allow a study of emittance growth.
- Task 4: study of different approaches for measuring emittance of electron beams delivered by laser plasmas accelerators. Diagnostic satisfying the best criteria will be developed and tested using ultra short electron beams from EU accelerator facilities or Laser based accelerators. Development of a high energy resolution electron spectrometer at 3 GeV.

<u>Task 1. Coordination and Communication.</u>

The activities of this task are to oversee and co-ordinate the work of all the other tasks of the work-package concerned, to ensure the consistency of the WP work according to the project plan and to coordinate the WP technical and scientific tasks with the tasks carried out by the other work-packages when it is relevant. The coordination duties also include the organization of WP internal steering meetings, the setting up of proper reviewing, the reporting to the project management and the distribution of the information within the WP as well as to the other work-packages running in parallel.
The task also covers the organization of and support to the annual meetings dedicated to the WP activity review and possible activity workshops or specialized working sessions, implying the attendance of invited participants from inside and outside the consortium.

<u>Task 2. Design of Interaction Regions for high luminosity colliders.</u>

The main purpose is to prove the compatibility of large detectors with a novel Interaction Region (IR) design relaying on large Piwinsky angle, low–β and crab waist, a configuration capable to provide for the DAΦNE electron/positron collider a significantly larger luminosity than in the original configuration and a collision scheme which can be applied to other existing and future lepton colliders in order to reach unprecedented luminosities. Compatibility between the conflicting requirements of high luminosity IRs and experimental detectors is also an issue in terms of IR mechanical structure design, collider optics, beam dynamics and background rejection. The KLOE detector at DAΦNE will be upgraded in order to cope with the higher luminosity rates expected from the improved collision scheme. The study proposed is aimed at designing a new IR fitting inside the KLOE detector and implementing the new collision configuration, which will be tested at DAΦNE in 2008 with the SIDDHARTA detector. The experience gathered on the DAΦNE collider will be crucial to address possible issues in view of successful runs with more demanding detectors as KLOE, FINUDA or other possible future experiments. This activity will be of interest also the most advanced non-EU Laboratories, such as the Japanese KEK and the Chinese IHEP, as well as for the hadron collider LHC coming into operation at CERN, for which several approaches are under study in order to increase the collider luminosity beyond Phase-I.

- **Sub-task 2.1.** DAΦNE IR design for the upgraded KLOE detector. INFN will provide the infrastructure and perform beam parameter optimization, bb simulations, Touschek lifetime calculations, background remediation studies. BINP will contribute with dynamic aperture optimization, beam-beam (bb) simulations and intra-beam scattering (IBS) and Touschek computation. CNRS will take part to the design of the luminosity monitor and to the beam measurements.

- **Sub-task 2.2.** Study of an IR design with large Piwinski angle and crab waist collision scheme for the LHC upgrade. CERN will take care of beam parameter optimization, IR design and bb simulations.

Task 3. Upgrade of the EMMA FFAG Ring.

The Electron Model of Many Applications (EMMA) ring will be the world's first so-called non-scaling FFAG. It is being constructed at the STFC Daresbury Laboratory to prove the principle of this type of accelerator and its successful operation could have far reaching consequences. Construction of the EMMA ring is due for completion in early to mid-2009. As EMMA is a proof-of-principle accelerator, diagnostic devices to measure all aspects of the machine operation are very important. The EMMA ring will be instrumented with devices to measure the beam position, transverse profile, time of flight and beam intensity. However, certain measurements can only be made in an external beamline, for example emittance, longitudinal profile and momentum. In this project, we plan to design, prototype, test, construct, install and commission the diagnostics devices for these measurements. In addition, an emittance measurement system will be constructed for the injection line to allow a study of emittance growth in the ring.

- **Sub-task 3.1.** External diagnostics design, construction and testing. The requirements for the diagnostics will come from tracking studies performed by CNRS-Grenoble and STFC at the Daresbury Laboratory. The design, construction and testing of the devices will be undertaken by staff in STFC. The installation in the beam-lines will also be done by STFC staff.

- **Sub-task 3.2.** Commissioning and experimental running. Commissioning of EMMA using diagnostics will be undertaken by staff from STFC and CNRS. The experimental measurements with these devices required to determine the applicability of non-scaling optics for the applications being studied will also be made by staff at STFC and CNRS.

Task 4. Instrumentations for novel accelerators.

The need of new instrumentation to diagnose parameters of electron beam produced by laser plasma accelerator is extremely important. An experimental methodology in needed to investigate their parameters, such as emittance or relative energy spread, since they are not today produced with a very high shot to shot reproducibility than the one currently produced using RF cavities based accelerators. We propose to study the different approaches for measuring emittance of these electron beam delivered by laser plasmas accelerators. The emittances are expected to be in the mm.mrad range. The diagnostic which satisfies the best criteria will be then developed and tested using ultra short electron beams produced in European accelerator facilities or Laser based accelerators.

- **Sub-task 4.1.** Different approaches for measuring the beam emittance have also been suggested or tested in the past. To avoid errors induced shot to shot fluctuation in the emittance measurement LLR and INFN will develop a single shot emittance measurement or a specific technique to reduce those errors. This diagnostics will be tested at the SPARC Lab in Frascati, where a low emittance RF gun is available. The selected technique will be then tested and used at LOA where a laser plasma accelerator will be developed for this purpose.
- **Sub-task 4.2.** Since we plan to produce during the contract a 3 GeV electron beam at LOA, we propose to design, to develop and to test a high energy resolution electron spectrometer that will be used with the future laser plasma accelerator.

Deliverables of tasks	Description/title	Nature[1]	Delivery month[2]
12.1.1	ANAC web-site linked to the technical and administrative databases	O	M48

12.2.1	DAΦNE IR design for the upgraded KLOE detector	R	M36
12.2.2	Study of an IR design for LHC upgrade	R	M36
12.3.1	Results from the operation of EMMA using the new diagnostics	R	M40
12.4.1	Electron beam emittance measurement report	R	M48
12.4.2	Prototype of 3 GeV, high energy resolution electron spectrometer	P	M36

Mile-stone	task	Description/title	Nature[1]	Delivery month[2]	Comment
12.1.1	12.1	1st annual ANAC review meeting	O	M12	
12.1.2	12.1	2nd annual ANAC review meeting	O	M24	
12.1.3	12.1	3rd annual ANAC review meeting	O	M36	
12.1.4	12.1	Final ANAC review meeting	O	M48	
12.2.1	12.2	DAΦNE beam parameters definition for KLOE	O	M18	Preparatory for IR study
12.2.2	12.2	Compatibility of new IR scheme and LHC	O	M18	Preparatory for IR study
12.2.3	12.3	Requirements for electron beam diagnostics	R	M2	
12.3.1	12.3	Construction of the electron beam diagnostics completed	R	M10	
12.3.2	12.3	Commissioning of EMMA completed	R	M18	
12.4.1	12.4	Electron beam emittance meter finished	P	M36	Alignment and pre test

Table 1.3 e Summary of staff effort

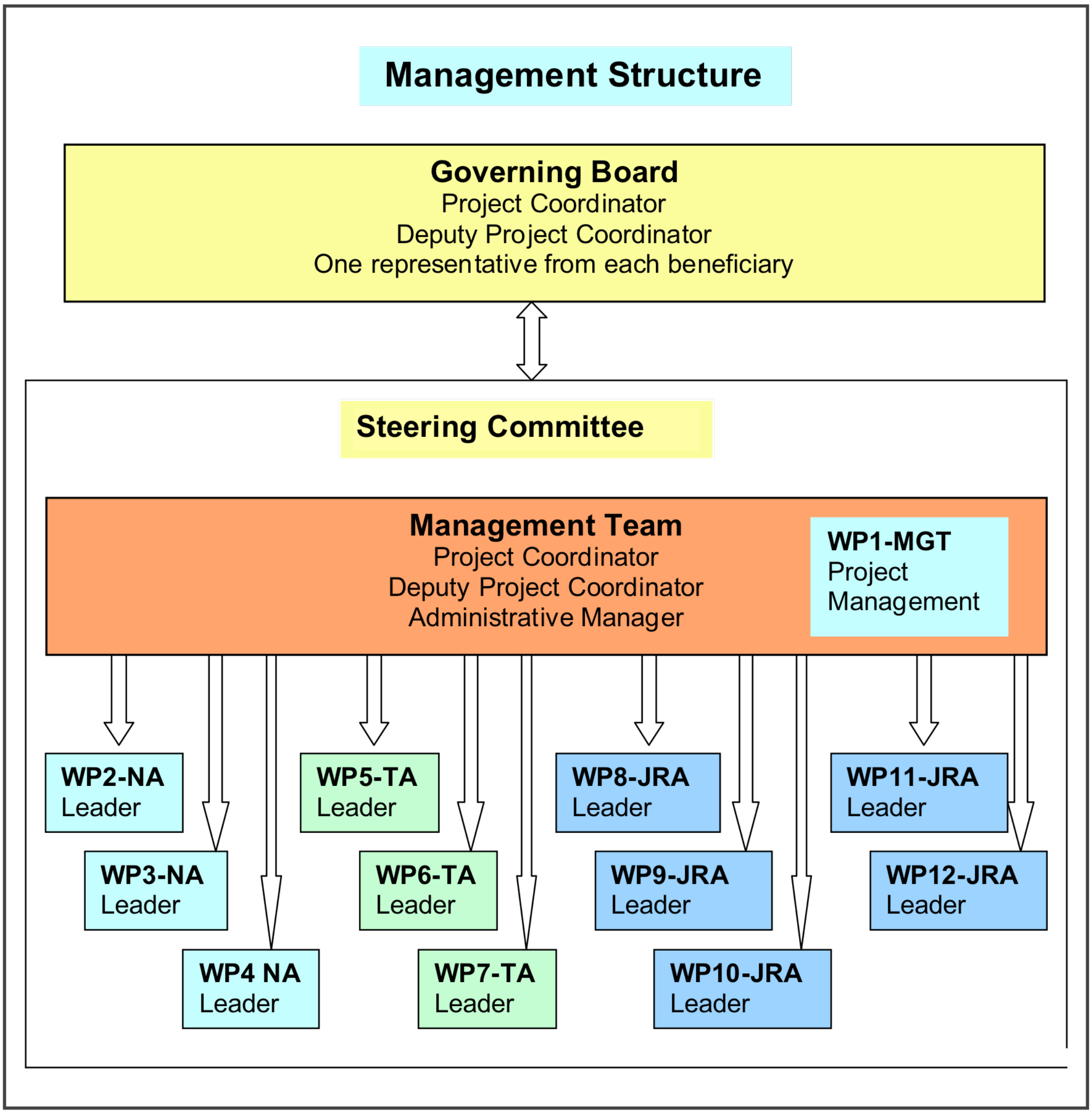
Participant no./Short name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	Total person months
1 CERN	91	14	16	12	4			138	86	126	129	35	650
2 ARC									5				5
3 BESSY											17		17
4 BINP												21	21
5 BUW											19		19
6 CEA								152			132		284
7 CIEMAT										36			36
8 CNRS				4				28		56	60	67	215
9 COLUMBUS								5					5
10 DESY				4		2		13			115		134
11 EHTS								5					5
12 EPFL									19				19
13 ESRF										24			24
14 FZD											16		16
15 FZK								34					34
16 GSI									95				95
17 IFIC									18				18
18 INFN			4					18	24	57	53	125	282
19 INP PAN											11		11
20 IPJ											12		12
21 POLITO									14				14
22 PSI										18	31		49
23 PWR								56					56
24 RHUL									18	60			78
25 RRC KI									30				30
26 SOTON								8					8
27 STFC							2	40		54	18	56	170
28 TUD											18		18
29 TUL											24		24
30 TUT								8					8
31 UH										127			127
32 UJF				4									4
33 ULANC									0		26		26
34 UM									12				12
35 UNIGE			4					10					14
36 UNIMAN									0	84	52		136
37 UOXF-DL										60			60
38 URostock											27		27
39 UU										78			78
40 WUT		12									24		36
Grand Total	91	26	24	24	4	2	2	515	321	781	783	304	2876

2. IMPLEMENTATION

2.1 Management structure and procedures

The project management and WP coordination will be implemented through the management structure, shown in Figure 3.

Figure 3 Management structure



- **Governing Board (GB)**

The EuCARD Consortium is composed of 40 legal entities. The Governing Board (GB) is the top-level decision making and arbitration body. It has one representative from each beneficiary in the project and includes the Project Coordinator and the Deputy Project Coordinator. Each member has one vote and decisions will be taken by a majority of the votes. The GB has the power to decide, upon Steering Committee proposals, on strategic issues, such as modifications of the project programme (if necessary) and admission of new beneficiaries. The GB will be convened for the first time one month before the start of the project. The Governing Board will review the progress of the project at the annual EuCARD meetings, and, where necessary, decides on changes in the work plan and budget allocation for the next reporting period. Outside the annual meetings, the GB may call for extraordinary meetings. The chair of the GB will be elected by its members.

- **Steering Committee (SC)**

The SC is composed of 14 members: the Project Coordinator and Deputy Project Coordinator, the Administrative Manager, and the eleven Work Package Leaders of WP2 to WP12. It is the executive body of the Consortium in charge of the coordination and management of all activities in the project. It shall monitor the work progress and will take executive decisions on scientific and administrative issues that may arise during the implementation of the project. The SC will have regular meetings, typically four times a year.

- **Project Coordinator (PC)**

The PC will be responsible for the daily scientific management of the EuCARD project, including the overall supervision and regular follow-up of the progress in all Work Packages. Within these activities, he will have the responsibility of the coordination of Work Package 1. The PC will also chair and organize the Steering Committee meetings, and will be in charge of the preparation of the Periodic Reports and the Final Report.

- **Deputy Project Coordinator (DPC)**

The DPC will assist the Coordinator in the daily scientific management tasks, will replace the Coordinator in case of absence.

- **Administrative Manager (AM)**

The AM will be responsible for the administrative and contractual follow-up of the project, including budget control and cost reporting. The AM will monitor the contractual deadlines for deliverables and milestones, and will assist in organising the Annual Review and Final Review meetings. The AM will be in charge of financial issues, such as payments and redistribution of EU funding received, collection of certificates on financial statements, of periodic reports and justification of costs, as well as of legal issues, such as the implementation of the Consortium Agreement and Intellectual Property Rights agreed by the beneficiaries. In addition, the AM will ensure the proper application of ethical and gender equality practices in conformity with the European Charter for Researchers.

- **Management Team**

The Project Coordinator, Deputy Project Coordinator, and Administrative Manager will form the Management Team. The Management Team will be supported in their various activities by CERN administrative, legal and financial services.

- **Work package Leaders**

The WP Leaders will manage the Network-, Transnational-Access- and Joint-Research-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 task progress, and for producing the milestone and deliverable reports within their WPs. They will contribute to the preparation of all other reports regarding the activities of their WPs, which are requested by the Management Team.

- **Management Procedures**

Modern project management tools and methods, which have proved their efficiency in other projects, will also be used for EuCARD. An efficient tool has been developed in the Information Technology Department of CERN for Progress Project Tracking, and a special version is available for management of EU projects. This tool is in use in major CERN/EU co-funded projects, such as EGEE and Ethics. It aims at making available a common system of reporting and at centrally collecting the financial and administrative information requested. A customization for the EuCARD project has to be evaluated. A template will be provided on the web for reporting on milestones under a standardized format as a means of monitoring and verification by the coordinator.

2.2 Individual participants

Full name of Participant: European Organization for Nuclear Research

Short name of Participant: CERN

Description of Participant:
CERN is the European Organization for Nuclear Research, the world's largest particle physics centre. With some 2500 staff members and 6500 visitors CERN is involved in a large number of particle physics activities and is presently completing the world most powerful particle accelerator, the LHC.
CERN has experience in managing the largest world accelerator infrastructures and by its very nature of International Organization the expertise in leading large scale collaborations involving a large number of institutes from all over the world. The CERN administrative, legal and financial services are competent to process all issues the consortium may have to face, including at the highest political level if required.

Tasks in EuCARD:
IA coordination, coordination of: WP4 (ACCNET), WP6 (HFM), WP7 (ColMat), co-coordination of WP7 (NCLinac), TA's CryoMagNet and HighRadMat, and participation in:
WP1, WP2, WP3, WP4, WP5, WP8, WP9, WP10, WP11 and WP12

Short CV for key contributors:
Dr. P. Lebrun will be the EuCARD coordinator if the project is approved. He mainly worked on applied magnetism, superconductivity and cryogenics. He has been during nine years the leader of the Accelerator Technology Department with more than 300 staff and has experience in managing RTD, large projects and international collaborations.
Dr. R. Aßmann, physicist. After research at the Max-Planck-Institute in Germany and the Stanford Linear Accelerator Center in the US, he is presently responsible at CERN for collimation and control of beam halo at the LHC.
Dr. A. Ballarino has been in charge of the design and procurement of the leads powering the LHC superconducting magnets, using HTS technology.
Dr. A Bertarelli works for CERN Design Office, in particular as leading engineer for the design of the LHC collimators.
Dr. Hans-H. Braun, accelerator physicist, leads the CLIC and CTF3 beam dynamic studies.
Dr. P. Chiggiato has 20 years of experience in ultrahigh vacuum. He is in charge of a section devoted to surface treatments, coatings and physicochemical analysis.
Dr. E. Jensen is deputy RF group leader, expert in microwave tubes, cavity design and RF field computation. He responsible for the high power RF systems of CERN's synchrotrons and member of the CLIC study.
Dr. J.-P. Koutchouk: Senior accelerator physicist, led several teams of scientists, among them the LHC conceptual design for layout, parameters and performance, the specification of the LHC beam instrumentation and the super-conducting magnet field quality control. He is coordinator for the EuCARD proposal until 31/06/2008.
Dr. M. Lindroos is a graduate of Nuclear Physics. He works in the AB department with special responsibility for new projects in radioactive ion beam physics, in particular the SC linac upgrade of the REX-ISOLDE radioactive ion beam accelerator.
Dr. J. Miles: spent years in the SPS and LEP operation group and then moved to the machine physics group to work on LHC optics. More recently he managed industrial contracts for the production of LHC main dipoles, cryogenic supply line (QRL) service modules and cryogenic electrical feed boxes (DFB).
Dr. G. de Rijk, Senior physicist, CERN coordinator for the development of the Nb_3Sn magnet technology, has over the last 20 years acquired a wide experience in magnet design and construction and accelerator operation.
Dr. W. Scandale: Senior physicist at CERN, who worked on accelerator designs , in particular on the initial LHC concept. He is engaged in the studies of the upgrade of the LHC and coordinates the activities of the HHH network of CARE on the evaluation of technologies applicable to the upgrade.
Dr. R. Schmidt: Senior physicist at CERN, born 1952, PhD Hamburg University 1982, Main activities: accelerator physics and technology, working on LHC.
Dr. E. Todesco: Ph. D. physicist, has been working on transverse motion in beam dynamics, and on

superconducting magnets design and analysis. Dr. M. Vretenar: accelerator physicist, responsible for the RF systems of the CERN Hadron Linacs, now in charge of the construction of the new CERN linear accelerator, Linac4. Coordinator of the HIPPI tasks in CARE, related to pulsed proton linac development. Dr. L. Walckiers made key developments in the field of accelerators magnets both to measure with the requested accuracy their field quality and to protect and qualify the performance of superconducting magnets. He is currently leader of the group "Magnet Electrical systems and Instruments" Dr. W. Weingarten is a senior physicist trained in accelerator physics and superconductivity. He joined CERN for the LEP energy upgrade programme based on superconducting cavities. Later he held senior management posts in CERN's Safety Division (Division Leader). Dr. W. Wuensch: received his PhD in physics from the University of Rochester. He is now leading the RF structure development program of the CLIC study. Dr. F. Zimmermann: senior accelerator physicist; CERN since 1999; SLAC 93-98; DESY 90-93; experience at HERA, SLC, PEP-II, KEKB, Tevatron, etc.; LHC beam commissioner; LHC upgrade studies; CARE-HHH co-coordinator; EPS-IGA Prize; APS Fellow; PRST-AB Editor.

Full name of Participant: Austrian Research Centers Gmbh - ARC
Short name of Participant: ARC
Description of Participant: The Austrian Research Centers GmbH- ARC is Austria's largest contract research enterprise. Founded in 1956, the ARC understand their role as innovation partners of industry and of public organisations. They act as a service provider in the field of application-oriented research and technology development combining a broad interdisciplinary catalogue of skills with specialised know-how. In addition they have a strategic look on topics which will be of importance for the future. The Powder Technology Center at ARC is equipped with different facilities for the research and manufacturing on diamond based composites using a powder metallurgical approach. Facilities for pressing, sintering, hot pressing, rapid hot pressing or gas pressure sintering as well as the complete process chain of the powder injection moulding process is available. The available testing facilities cover a laser flash system for the measurement of the thermal diffusivity, a differential scanning calorimeter for specific heat measurement, different dilatometer for the measurement of the coefficient of thermal expansion and a system for thermal cycling. Of course the equipment for testing the mechanical properties is available as well. The different properties can be measured as a function of the temperature.
Tasks in EuCARD: Task 9.2.3 Materials and thermal shock waves
Short CV for key contributors: Dr. E. Neubauer: Diplome Engineer, Researcher at ARC and involved in fundamental and applied research projects, with a strong focus on composite materials and new powder metallurgical processing techniques.

Full name of Participant: Berliner Elektronenspeicherring - Gesellschaft für Synchrotronstrahlung mbH, Berlin
Short name of Participant: BESSY
Description of Participant: BESSY operates the largest 3rd generation SR facility in the XUV range in Europe (BESSY II) with over 1200 users per year. BESSY carries out and supports technological development in fields ranging from fundamental sciences, such as surface physics, magnetism, and structural biology, to new technologies and applications exploiting synchrotron radiation. BESSY is also the European radiation standard and services European radiometric laboratories and legal certification institutions. BESSY now plans to build a new free electron-laser facility (BESSY-FEL). It will employ a 2.3 GeV superconducting driver linac based on accelerator technology developed at DESY for the TESLA project. As a precursor, BESSY will build the HGHG-FEL demonstrator STARS, a 325 MeV linac-based FEL. To enable the development of CW linac technology, BESSY has been operating the

HoBiCaT superconducting RF test facility since 2004. As part of the FP6 EUROFEL Design Study, and in close collaboration with DESY, HoBiCaT has become the leading European centre for CW SRF TESLA cavity development.
Tasks in EuCARD: Task 11.9.1 SRF-Gun beam measurements. Task 11.10 Upgrade and operation of an RF station
Short CV for key contributors: Dr. J. Knobloch, Senior Scientist, Project Leader STARS & BESSY FEL, Group Leader Superconducting Technology, in charge of superconducting RF cavity development and cryogenics. Dr. W. Anders, Senior Scientist, Head of the Technical Division and RF-Group Leader, in charge of developing the RF transmitter system for the BESSY FEL & STARS. Dr. T. Kamps: Senior Scientist, Group Member Accelerator Physics and BESSY Project Leader for the Superconducting RF Gun Project at FZ-Dresden, in charge of developing the diagnostics for the SRF injector.

Full name of Participant: Budker Institute of Nuclear Physics
Short name of Participant: BINP
Description of Participant: BINP (Novosibirsk) was established in 1958 with the main research directions included HEP, accelerator physics (e+e- colliders mainly), thermonuclear physics, SR generation and utilization, etc. Nowadays the following facilities are in operation at BINP: e+e- colliders VEPP-4M (energy up to 6 GeV) and VEPP-2000 (round beams, energy 1 GeV), FEL with the world record power in the THz radiation region, SR source VEPP-3, two open traps for plasma researches. The total staff of BINP now is around 3’000.
Tasks in EuCARD: Task 12.2.1 Beam simulations.
Short CV for key contributors: Dr. E. Levitchev is the BINP Deputy Director responsible for the accelerator research direction. He’s an expert in the field of accelerator development and operation, beam optics and dynamics study.

Full name of Participant: Bergische Universität Wuppertal
Short name of Participant: BUW
Description of Participant: At the Physics Department of BUW basic research on superconducting niobium cavities and surface properties of low and high Tc superconductors has a very long tradition. Major contributions towards high accelerating gradients in multicell RF structures were made, e.g. multipacting-free cavity shapes, thermometry for in-situ localisation of defects and high purity Nb for quench suppression. A unique dc field emission scanning microscope has been developed for the identification of emitters on samples and correlated optimization of surface preparation techniques.
Tasks in EuCARD: Task 11.3 Electro-polishing and surface investigations
Short CV for key contributors: Dr. G. Mueller is a senior researcher and since 1999 apl. Professor for experimental physics at BUW. He is the leader of the field emission microscopy group at the physics department.

Full name of Participant: Commissariat à l'Énergie Atomique
Short name of Participant: CEA
Description of Participant: DSM is the ‘Directorat’ (about 1700 permanent staff) of CEA, involved in various kinds of physics and associated technologies. Within CEA-DSM, SACM (Accelerator, cryogenic and magnetism department, about 120 permanent staff) will be the main contributor to the EUCARD program, with the contribution of SIS (Structure engineering department).

Tasks in EuCARD:
WP4, Networking activities in EuroLumi and RFTECH.
WP8, WP Co-coordination, task leader for models task, coil construction, thermal measurements and modelling, HTS insert dipole coil construction
WP11, WP Co-coordination, important contributions in nearly all tasks.

Short CV for key contributors:
Dr. C. Antoine: Physicist, expert in SRF R&D: superconducting material properties, surface treatment, surface analysis.
Dr. B. Baudouy: Specialist in heat exchange in helium
Dr. S. Chel: CEA engineer in technology for particle accelerators, head of SACM/LESAR
Dr. R. Duperrier: senior scientist
Dr. F. Eozénou: Engineer specialized in electro-chemistry. Responsible for electro-polishing R&D activities at SACM.
Dr. F. Kircher: CEA expert, senior engineer in superconducting magnets, deputy head of SACM
Dr. Olivier Napoly: CEA Expert, senior engineer in accelerator physics, coordinator of the European program CARE.
Dr. J.-M. Rey: Specialist in HTS superconductors and coil fabrication
Dr. J.-M. Rifflet: CEA expert, senior engineer in superconducting magnets. Member of the steering committee of CARE/NED jra.

Full name of Participant: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Short name of Participant: CIEMAT

Description of Participant:
CIEMAT is a research Institute mainly focused on Energy and Technology topics. The contribution to this Project will be performed by means of the Superconductivity Group. This group was born 20 years ago, when the first magnet prototypes for LHC project were starting. We have designed and fabricated superconducting magnets and current leads for LHC, TESLA500, XFEL and GSI. In 2004, we started the collaboration with the experimental facility CTF3 at CERN. In that framework, we have also developed other non-superconducting devices, as precision movers for quadrupoles, kickers, septa and a special device so-called PETS to extract RF power from an electron beam.
Our group keeps a close and fruitful relationship with Spanish companies devoted to the fabrication of electromechanical devices, especially with those able to manufacture electromagnets and cryostats. Those companies have been actively participating in the LHC construction. In the same way, they are interested in R+D activities for future facilities like CLIC and ILC.

Tasks in EuCARD:
WP10

Short CV for key contributors:
Dr. L. Garcia-Tabares: PhD Naval Architect. Head of the Applied Superconductivity Group at CIEMAT. Main researcher in more than 20 projects concerning Applied Electromagnetism and Superconductivity.
Dr. F. Toral: PhD Electric Engineering. Main researcher for the development of MQTL quadrupole for LHC, linac magnets for TESLA500 and XFEL, and CIEMAT contribution to CTF3.
Dr. D. Carrillo: Electronic Engineer. Expertise on rf calculations. Main researcher for the development of a resonant cavity for a racetrack microtron.

Full name of Participant: Centre National de la Recherche Scientifique

Short name of Participant: CNRS

Description of Participant:
The Centre National de la Recherche Scientifique (National Centre for Scientific Research) is a government-funded research organization, under the administrative authority of France's Ministry of Research. The CNRS operates thanks to a structure of 1’260 research unities, more than 30’000 employees (~ 90 % are fixed term researchers, engineers, technicians and administrative staff) and a global 2007 budget of 3.080 billion euros. As the largest fundamental research organization in Europe,

CNRS carried out research in many fields of knowledge, through its six research departments: • Mathematics, Physics, Earth Sciences and Astronomy (MPPU) • Chemistry • Life Sciences • Humanities and Social Sciences • Environmental Sciences and Sustainable Development (EDD) • Information and Engineering Sciences and Technologies (ST2I) and two national institutes: • The National Institute of Nuclear and Particle Physics (IN2P3) • The National Institute of Earth Sciences and Astronomy(INSU)
Tasks in EuCARD: WP4, WP8 on high-field dipole insert, WP10, WP11 on proton superconducting cavities, WP12 on luminosity monitoring and beam measurements.
Short CV for key contributors: Dr. A. Variola is the accelerator group leader in LAL-Orsay. He has a PhD thesis on accelerator physics and he has previously worked in CERN for 7 years participating to the discovery of cold anti-hydrogen (ATHENA experiment) Dr. M. Baylac is the accelerator group leader in LPSC-Grenoble. For her PhD, she performed the first non-invasive measurements of the CEBAF electron beam polarization. Then she worked for 4 years at CEBAF on highly polarized photoguns. Prof. P. Tixador is professor at Grenoble INP. His current interests are superconducting power applications from design to model construction and simulation activities. He has successfully developed a large HTS magnet. He carries out these activities at G2Elab and at Institut Néel - Grenoble, which offer means for characterizations, coil fabrication, system testing and integrating. Dr. D. Gardès is the accelerator division leader in IPN-Orsay. Nuclear physicist, director of research at CNRS. PhD thesis in nuclear physics. Main activities were in the beam-plasma interaction physics and inertial confinement fusion. Dr. A. Jeremie is a senior scientist at LAPP Annecy. Dr. V. Malka is the SPL group leader at LOA-ENSTA. He is research director at CNRS and lecturer at Ecole polytechnique. He works actively on laser plasma accelerators developments.

Full name of Participant: Columbus Superconductors SpA
Short name of Participant: COLUMBUS
Description of Participant: COLUMBUS is an small company founded in 2003, with the aim of developing and commercializing superconducting wires based on innovative superconducting materials, as MgB_2. The company activities currently involve 30 people, and has a new manufacturing plant covering an area of 3’400 m^2 with capability to produce up to 2’000 Km/year. COLUMBUS is now developing MgB_2 based conductors for a variety of applications, going from medical to the electro-technical field.
Tasks in EuCARD: Task 8.5.1 Studies on thermal, electrical and mechanical performance Task 8.5.2 Design and test of electrical contacts HTS-HTS and HTS-Cu Task 8.5.3 Design and assembly of a 20 m long HTS multi-conductor 600 A link
Short CV for key contributors: Dr. G. Grasso got his PhD in 1997 at the University of Geneva on Materials Science. From 1998 to 2006 he was a Senior Research Scientist at the Italian National Research Council. Since April 2006, he is Managing Director and R&D Responsible for COLUMBUS

Full name of Participant: Deutsches Elektronen-Synchrotron
Short name of Participant: DESY
Description of Participant: DESY is a German research centre for High Energy physics, synchrotron light and FEL physics. DESY has a long lasting experience in accelerator design and operation such as HERA, PETRA, DORIS and

FLASH. Superconducting magnets and cavities were developed for the storage ring HERA, FLASH and XFEL. FLASH is the most advanced SASE FEL infrastructure and serves also as unique test bed for superconducting RF technology. The approved XFEL project with its 800 superconducting 1.3 GHz cavities will be the largest superconducting RF accelerator for the near future. DESY is the most advanced centre of superconducting RF components with respect to design, preparation, fabrication, and industrialization. DESY plays a leading role in the TTC (TESLA Technology Collaboration) which is a scientific consortium of 49 international laboratories the mission of which is to advance SCRF technology R & D and related accelerator studies across the broad diversity of scientific applications, and to keep open and provide a bridge for communication and sharing of ideas, developments, and testing across associated projects.
Tasks in EuCARD: Coordination of WP11, TA WP6 FLASH-TTF, Participation inWP4, WP8 on HTS link, WP11 on electropolishing HOM and LLRF.
Short CV for key contributors: Dr. D. Proch, PhD in physics, fellow at Cornell University, Fellow at CERN, head of SRF section DESY (FLASH-TTF), CARE JRASRF coordinator, Guest professor at Peking University and Tsinghua University. Dr. S. Schreiber, PhD in particle physics from U Bonn in 1992, Fellow at CERN 1992-94 (laser system for CTF1), joined DESY in 1995 (photo-injectors for TTF1 and FLASH), since 11/2005 head of FLASH operation. Dr. N. Baboi, PhD in physics, specialist in cavity and HOM physics Dr. H. Mais, PhD in theoretical Physics, specialist in beam dynamics Dr. M. Grecki, PhD in Physics, specialist in Low Level RF control Dr. D. Reschke, PhD in Physics, specialist in R&D of SC cavities Dr. S. Simrock, PhD in Physics, group leader of beam controls group Dr. W. Singer, PhD in material science, Head of material science group at DESY Dr. X.Singer, PhD in material science, specialist in material science Dr. J. Sekutowicz, PhD, specialist in SC cavity design Dr. W. Zeuner, PhD in High energy physics, deputy coordinator of CMS

Full name of Participant: European High Temperature Superconductors GmbH & Co. KG, Hanau
Short name of Participant: EHTS
Description of Participant: EHTS is a member of the BRUKER group and is active in research and production of high temperature superconductivity. The company's research and development team includes 30 people who work on BiSCCO and YBCO-based high temperature superconducting technologies. EHTS provides industrial superconductors and application solutions to a wide range of customers, and performs also own development of HTS devices for power applications. One example is the delivery of Bi-2223 HTS wire for the CERN LHC HTS current leads. EHTS is and was involved in different German national and EU projects like the EU-projects Acropolis, SLIM Former or Super3C. The expertise of EHTS covers the development, production and characterization of HTS.
Tasks in EuCARD: Task 8.5.1 Studies on thermal, electrical and mechanical performance Task 8.5.2 Design and test of electrical contacts HTS-HTS and HTS-Cu Task 8.5.3 Design and assembly of a 20 m long HTS multi-conductor 600 A link
Short CV for key contributors: Dr A. Aubele, 35 years old, material scientist, graduated university Stuttgart, joined EHTS in 2001, R&D Bi-2223.

Full name of Participant: Ecole Polytechnique Fédérale de Lausanne
Short name of Participant: EPFL
Description of Participant:

The Laboratory for Mechanical Metallurgy has a long standing record of processing, characterizing and modelling of advanced metal based composite materials, both regarding their structural and thermo-physical properties.
Tasks in EuCARD: Task 9.2.3 Materials and thermal shock waves
Short CV for key contributors: Dr. L. Weber holds a Ph.D. in Materials Science from ETH Zürich. He has 5+ years experience in designing, characterizing, modelling and manufacturing of composites for thermal management. Dr. R. Tavangar holds a Ph.D. from Sharif University, Teheran, Iran, and has been working for the last 3 years at EPFL on composites for thermal management.

Full name of Participant: European Synchroton Radiation Facility, Grenoble
Short name of Participant: ESRF
ESRF is the materialization of an important European cooperation in science. Eighteen nations work together to use the extremely bright beams of light produced by the ESRF's high-performance storage ring to study a remarkably wide range of materials, from bio-molecules to nano-magnets, and ancient Egyptian cosmetics to metallic foams. The centre has a large experience in designing, running and maintaining an electron linac, a synchrotron and a large storage ring in which the vacuum quality is critical.
Tasks in EuCARD: Task 10.6.1 Vacuum effect measurements with beams.
Short CV for key contributors: Dr. R. Kersevan, senior scientist and engineer.

Full name of Participant: Forschungszentrum Dresden-Rossendorf e.V.
Short name of Participant: FZD
Description of Participant: FZD operates the radiation source ELBE, a user facility with a medium energy, high current, CW SRF linac (1.3 GHz TESLA) and two free electron lasers. In 2007 a superconducting RF photo injector was put into operation and is in use as an injector test facility now. Fields of excellence are design and construction of SRF accelerator modules and SRF photo injectors, beam dynamics and diagnostics, photocathode development, CW RF techniques, high-power lasers and laser plasma acceleration.
Tasks in EuCARD: WP 4, Task 3, Task 11.9.1 SCRF gun at ELBE
Short CV for key contributors: Dr. J. Teichert: senior scientist at FZD and group leader for SRFC photo injector development in the Radiation Source ELBE department. Born in 1952, received his Ph.D. in physics from the Technical University of Dresden in 1984. He joined FZD in 1987 working on ion beam and semiconductor physics. Since 2001 scientist in ELBE. Main interests: SC RF technology, photo injectors, and free electron lasers. He was responsible for the design, development and commissioning of a SCRF photo injector at the ELBE facility in CARE.

Full name of Participant: Forschungszentrum Karlsruhe GmbH
Short name of Participant: FZK
Description of Participant: Activity fields of the Institute for Technical Physics (ITP) are superconductivity and cryogenics and their applications. The activities span over nuclear fusion, electric power equipment and high field magnets. Essential are developments of superconductors, mainly high temperature superconductors, cryogenic components and the characterisation of structure materials at low temperature. ITP operates a high field laboratory with superconducting magnets up to 20 T in a 185 mm bore. The "Institut für Synchrotron Strahlung" (Institute for Synchrotron Radiation) ISS at FZK operates the

synchrotron light source ANKA, a 2.5 GeV storage ring (http://ankaweb.fzk.de/). ANKA provides light from hard X-rays to the far-infrared for research and technology. ANKA is operated as a user facility for the national and international scientific community, for the Helmholtz Society research programs and for industrial customers. Collaborations exist with MAXLAB (Sweden), ELETTRA (Italy) and ESRF (France) within FP6. ISS works closely with the Institute for Solid State Physics and the Institute for Technical Physics at the FZK, with the Laboratory for Application of Synchrotron Radiation of the University of Karlsruhe, and with the University of Erlangen-Nürnberg.

Tasks in EuCARD:
Task 8.4 Very high field dipole insert, Task 8.6 SC wiggler: contract, acceptance tests and beam tests

Short CV for key contributors:
Prof. Dr. M. Noe, M.S. in Power Engineering in 1991 and Ph.D. in 1998, from the University of Hanover in Germany. After a Postdoc position at the Ecole Polytechnique Federale de Lausanne in Switzerland, he joined FZK in 1998 and became group leader for high temperature superconducting power devices at the Institute for Technical Physics. Since 2006, director of the Institute for Technical Physics at FZK and professor for technical applications of high temperature superconductivity at the Faculty of electrical engineering and information technology of the University Karlsruhe.
Dr. R. Rossmanith is head of the Insertion Device Group at ANKA. This Group develops devices to be inserted at ANKA and other facilities. The group pioneered the development of superconductive undulators and was the first worldwide to test them with beam.

Full name of Participant: Gesellschaft für Schwerionenforschung mbH, Darmstadt

Short name of Participant: GSI

Description of Participant:
The laboratory operates the heavy ion linear accelerator UNILAC, the synchrotron SIS and the cooler storage ring ESR. GSI is presently concentrating on the design work for the international Facility for Antiproton and Ion Research FAIR that will be build on the laboratory site during the next years. GSI will contribute its broad experience in accelerator design for high intensity ion beams, in RF cavity design and in space charge and other collective effects to the project.

Tasks in EuCARD:
WP4 contributions to EUROLUMI and RFTECH. WP 9 contributions to all aspects of the WP.

Short CV for key contributors:
Dr. O. Boine-Frankenheim: Deputy department head FAIR accelerator theory. Field of research: Beam dynamics simulations and experiments. Contributions to the theory of space charge and impedance effects in synchrotrons. Further contributions to electron cooling and IBS in storage rings.
Dr. P. Huelsmann: Deputy department head synchrotron RF group. Research and development of magnetic alloy RF systems for acceleration, bunch compression and barrier buckets, of fast solid state gap switches to short circuit ceramic gaps of RF cavities, and of measurement cavities or measurement systems respectively to observe single β-decay events in the existing ESR.
Dr. J. Stadlmann: Deputy department head FAIR synchrotrons. Main research topic: Design of the two main synchrotrons of the FAIR project. Other research involvements: machine coordination of the existing GSI synchrotron and accelerator design study of the Beta Beam Factory within EURISOL.

Full name of Participant: Instituto de Fisica Corpuscular (Consejo Superior de Investigaciones Cientificas – Universitat de València)

Short name of Participant: IFIC

Description of Participant:
The IFIC is a Spanish laboratory having a long-standing reputation in theoretical and experimental physics. From the experimental point of view, it has expertise in the design and construction of detectors and beam instrumentation for nuclear, medical and particle physics.

Tasks in EuCARD:
Task 9.2.1 Halo studies and beam modelling

Short CV for key contributors:
Dr. A. Faus-Golfe: domains of activities

- design optics for experimental insertions for circular colliders and their implications for detector design and luminosity performance
- beam dynamics simulations
- non linear collimation system for circular and linear colliders
- beam instrumentation design, prototyping and construction (BPM)

Currently, in charge of the Future Linear Collider beam dynamics and providing a link to the Machine Detector Interface physics group as project leader in the IFIC.

Full name of Participant: Istituto Nazionale di Fisica Nucleare

Short name of Participant: INFN

Description of Participant:
The INFN - the National Institute of Nuclear Physics - is the major Italian research organization dedicated to the study of the fundamental constituents of matter, and conducts theoretical and experimental research in the fields of subnuclear, nuclear, and astroparticle physics. Fundamental research in these areas requires the use of cutting-edge technologies and instrumentation, which the INFN develops both in its own laboratories and in collaboration with the world of industry. These activities are conducted in close collaboration with the academic world. The INFN workforce includes about 2,000 of its own employees, almost 2,000 university employees involved in research conducted by the Institute, and 1,300 young researchers, including undergraduate and graduate students and research fellows.
Fields of excellence: High Energy and Nuclear Physics Accelerators and Experiments, operation of Particle Accelerators and Colliders, Accelerator Controls, Computing, Synchrotron Radiation Sources and Experiments, Astroparticle physics, Free Electron Lasers.

Tasks in EuCARD:
WP3, WP4, WP8 on high-field dipole insert, WP9 on halo studies and cillimation tests, WP10, WP11 on Nb coating, WP12 on design of Interaction Region design for high luminosity, with tests in DAΦNE.

Short CV for key contributors:
Dr. S. Guiducci: staff physicist in the Accelerator Division of LNF since 1977, INFN coordinator of EuCARD, has been INFN coordinator of the work on Damping Ring for the EUROTeV and CARE in FP6. She was one of the Damping Ring Area team leaders for the GDE (Global Design Effort for the ILC). Member of the ESGARD Committee.
Prof. V. Palladino is BENE general coordinator. He has been a member in charge of the WA neutrino facility for CHARM II and CHORUS, INFN principal investigator for HARP and MICE.
Dr. G. Volpini: is senior researcher at INFN Milano, LASA lab, where he leads the group for superconductivity applied to accelerator and detector magnets.
Prof. Dr. E. Palmieri: INFN Research Director at Legnaro National Laboratories form 2006 where he has been staff researcher since 1986. Appointed Professor at Padua University, Material Science Department, since 1999 with lectures on "Superconductivity" and "Thin film deposition techniques". Director of the Padua University – INFN Master on "Surface Treatments for Industrial Applications", since 2002. Expert of Italian Ministry of University and Research since 2003.
Dr. F. Marcellini: staff physicist in the LNF Accelerator Division since 1996. His field of interest is Rf structures design and construction.
Dr. M. E. Biagini: staff physicist in the Accelerator Division of LNF since 1977. Her fields of expertise are the design and operation of storage ring colliders, including DAΦNE at LNF and PEP-II at SLAC.
Dr. C. Milardi: staff physicist since 1988 in the Accelerator Division and responsible since 2006 for the operation of the DAΦNE at LNF.
Dr. A. Ghigo: staff member of accelerator division at INFN-LNF since 1988. He coordinates the INFN participation in the CLIC Test Facility project at CERN, in the SPARX FEL project and in the JRA on photo-injector (PHIN) in CARE.

Full name of Participant: The Henryk Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences, Krakow

Short name of Participant: INP PAN

Description of Participant: The Institute carries out basic and applied research in physics, with emphasis on nuclear physics. This research is aimed at explaining the structure of matter from microscopic to cosmic scales, through experiments and/or application of theoretical methods. Its activity extends into interdisciplinary research in a range of related fields and also stimulates technology transfer to the industry and to spin-off companies.
Tasks in EuCARD: WP11
Short CV for key contributors: Assoc. Prof. L. Zawiejski: Head of the Linear Accelerators Division at INP PAN, specialized in physical science, physics, experimental nuclear high energy physics. Dr. W. Wierba, Senior Design Engineer, specialized in design of detectors for high energy particles, fast front end and readout electronics. More than 25 years of experience in high energy physics experiments at JINR Dubna, CERN and DESY.

Full name of Participant: The Andrzej Soltan Institute for nuclear studies in Swierk
Short name of Participant: IPJ
Description of Participant: IPJ is a National Laboratory carrying out fundamental and applied research on subatomic physics, It also produces specialized equipment for various applications (e.g. medicine and environmental protection). Main Activities: nuclear physics, elementary particle, astro-particle, cosmic ray, neutrino, plasma. Technologies: plasma, detectors, electronics, accelerators, materials science, informatics. Applications: research, medicine, environment, energetics, safety, archaeology and arts. IPJ has six Research Departments in addition to a Training and Consulting Department, a Division of Information Technology, and a Department for Nuclear Equipment “HITEC”. IPJ closely cooperates with the Institute of Atomic Energy (IEA), located in the same area. This area has a technical infrastructure matching nuclear reactor requirements. Technical Services of IPJ serve the research nuclear reactor MARIA, the Department of Radioactive Waste Neutralization and other research facilities within Swierk’s boundary. IPJ participates in leading international research projects, like FAIR, LHC, FLASH and XFEL The Institute constructs radiation detectors and electronics for experiments. The main IPJ Research Infrastructures and laboratories of interest in the context of accelerator physics are: an isochronous cyclotron (30 MeV proton energy), a laboratory for modifying surfaces, a laboratory for detectors, a muon telescope and a laboratory for thin superconducting films deposition.
Tasks in EuCARD: Task 11.6.2 Arc coating of cavities and photo-cathodes.
Short CV for key contributors: Dr. R. Nietubyc: Education: Faculty of Physics, Warsaw University. 1992: Diploma Thesis. 1992-1996 PhD studies Institute of Physics PAS. 1996-2006 adjoint at Institute of Physics PAS.1998 Dissertation..1999 and 2001-2003 Postdoc at Hamburg University/DESY. 2006 Consultant at Comef - Scientific And Research Equipment (Trade Company) and adjoint at The Andrzej Soltan Institute for Nuclear Studies (IPJ), Swierk. Fields of Activity: x-ray physics, x-ray spectroscopy, accelerator technology Practical Experience: x-ray absorption

Full name of Participant: Politecnico di Torino
Short name of Participant: POLITO
Description of Participant: Politecnico di Torino participates into the project through the Mechanics Department. The research team has a specialised laboratory for material characterisation in case of dynamic and impact loading and has widely recognised experience in modelling the behaviour of the materials of interest for the particular application considered in the present research project, taking into account the results of the

experimental tests. The research team has also a good expertise in the development of new material test methodology and of the correlated experimental test apparatus.

Tasks in EuCARD:
Task 9.2.3 Materials and thermal shock waves

Short CV for key contributors:
Prof. G. Belingardi: professor of mechanical design from 1995; author of about 150 papers; he has been the coordinator of the local research unit for six projects funded by the EU in the 4th 5th and 6th framework program; these projects dealt with material characterisation and numerical modelling with particular focus to mechanical structure behaviour and vehicle safety.
Prof. M. Avalle: associate professor of mechanical design from 2003; author of about 50 papers; important contribution to the development of the specialised laboratory of the Mechanics Dept. and to the material research work performed.
Dr. L. Peroni: assistant professor of mechanical design from 2003; author of about 25 papers; he has a particular skill in developing new test devices to be used for material characterisation under unusual environmental and loading conditions.

Full name of Participant: Paul Scherrer Institut, Villigen

Short name of Participant: PSI

Description of Participant:
The Paul Scherrer Institute (PSI) is a multi-disciplinary research centre for natural sciences and technology. In national and international collaboration with universities, other research institutes and industry, PSI is active in solid state physics, materials sciences, elementary particle physics, life sciences, nuclear and non-nuclear energy research, and energy-related ecology.
PSI's priorities lie in areas of basic and applied research, particularly in fields which are relevant for sustainable development, as well as of major importance for teaching and training, but which are beyond the possibilities of a single university department.
PSI develops and operates complex research installations which call for especially high standards of know-how, experience and professionalism, and is one of the world's leading user laboratories for the national and international scientific community. Through its research, PSI acquires new basic knowledge and actively pursues its application in industry.

Tasks in EuCARD:
WP4, WP10 on phase control systems, WP11

Short CV for key contributors:
Dr. M. Dehler: Senior Scientist beam diagnostics. Since 1998 at PSI: beam diagnostics for the Swiss Light Source SLS, bunch by bunch feedback systems; development of microwave structures as pick-ups and correctors, numerical simulation of electron sources. 1995-1997, Fellow at CERN: Theoretical analysis and design of RF electron guns, accelerator structures for the CLIC project. 1989-1994, PhD at TU Darmstadt.
Dr. T. Weiland: Development of numerical electromagnetics codes, eigenmode and wake field calculations, S-band linear collider project.
Dr. T. Schilcher: Senior Scientist beam diagnostics. Since 1998 at PSI: computing, control and beam diagnostics for the Swiss Light Source (SLS), digital Beam Position Monitoring system, fast global orbit feedback system, digital low level RF systems. 1995-1998, PhD at DESY, Hamburg: Control of Pulsed Accelerating Fields in Lorentz Force Detuned Superconducting Cavities of TESLA.

Full name of Participant: Politechnika Wroclawska

Short name of Participant: PWR

Description of Participant:
Wroclaw University of Technology, Faculty of Mechanical and Power Engineering employs about 100 staff members and educates over 1000 students including 50 doctoral students. The Faculty is specialized in thermal processes including combustion, thermodynamics, fluid mechanics, heat transfer studies, refrigeration and cryogenics and power generation technologies. There is a long time experience in design, commissioning and operation of complex thermal and cryogenic test stands as

well as modelling of thermo-mechanical objects and devices. The Faculty collaborates with the laboratories and organizations active in the field of cryogenics and thermal processes, like: CERN in Geneva, ITER in Cadarache, CEA Saclay, Forschungszentrum Karlsruhe, Interuniversity Accelerator Centre in New Delhi, EDF R&D in Chatou.
Tasks in EuCARD: Task 8.2 task coordination thermal modelling and measurements, Task 8.3 Thermal design.
Short CV for key contributors: Prof. M. Chorowski, professor and dean of the Faculty of Mechanical and Power Engineering, professional experience in cryogenics, Joule-Thomson refrigerators, applicability of gas mixtures in cryo-coolers, involvement in R&D tasks concerning LHC cryogenic system, thermo-hydraulics of magnet resistive transition and risk analysis of complex cryogenic installations. Good experience in working in multinational teams and collaboration with industry. Dr. J. Fydrych, PWR assistant professor at the Faculty of Mechanical and Power Engineering, main professional interests: cryogenics and fluid mechanics, helium cryostats design commissioning and operation, cryogenic distribution lines and safety relieve systems of cryogenic installations; two-year work experience in dealing with the reception and thermal tests of the cryogenic distribution lines for the LHC at CERN, good experience in working in multinational environment. Dr. S. Pietrowicz, PWR assistant professor at the Faculty of Mechanical and Power Engineering, experienced in modelling of heat transfer and fluid flow phenomena, thermodynamic analysis of thermo-mechanical systems, training experience at KEK in the field of heat transfer in stack of Rutherford cables at saturated and supercritical helium conditions. Dr. J. Polinski, postdoc, professional experience in cryogenic engineering, heat and mass transfer modeling, thermal insulation system analysis and design, low temperature measurement techniques including heat transfer phenomena in He II , cryogenic system risk analysis. Good skill in cooperation in multidiscipline and multinational teams, presently at CEA Saclay on leave from PWR.

Full name of Participant: Royal Holloway University of London
Short name of Participant: RHUL
Description of Participant: RHUL is a research-led multi-faculty higher education institute within the federal University of London; its performance in the latest UK wide Research Assessment Exercise placed it 9th nationally, with its physics department scoring a grade 5 for research. RHUL is part of the John Adams Institute for Accelerator Science (JAI), which was established in 2005 as a partnership between RHUL, Oxford University and the UK Science and Technology Facilities Council. The key strategic aim of the JAI is to develop a Centre of Excellence in the UK for advanced and novel accelerator technology providing expertise, research, development and training in accelerator techniques, and promoting advanced accelerator applications in science and society. RHUL are leaders in advanced beam diagnostics, including laser-based systems and cavity BPMs; they are also leaders in advanced simulation techniques and radiative processes.
Tasks in EuCARD: Task 9.2.2 Energy deposition calculations and tests, Task 10.1 Work package co-coordination, Task 10.4.3 BPMs development and test, Task 10.4.4 Laser wire system development
Short CV for key contributors: Prof. G. Blair. Professor of particle physics and Deputy Director of the JAI, PI of the laser-wire projects at ATF and PETRA and developer of advanced full-simulation techniques for accelerators, including collimation studies. Dr. S. Boogert. Lecturer in accelerator physics and PI of the nano-BPM project at ATF. Technical coordinator of the laser-wire projects at ATF and PETRA.

Full name of Participant: Russian Research Center “Kurchatov Institute”
Short name of Participant: RRC KI
Description of Participant: The Russian Research Center “Kurchatov Institute” is renowned internationally, well beyond the

borders of Russia. Its main scientific directions are related to fundamental research in nuclear physics, plasma physics and solid state physics. RRC KI is the leading in the development of new types of atomic and fusion reactors, including ITER. RRC KI has is deeply involved in the research of radiation resistant materials for fission and fusion reactors.
Tasks in EuCARD: Task 9.2.3 Materials and thermal shock waves
Short CV for key contributors: Prof. A. Ryazanov is the head of laboratory of basic research of an effect of irradiation (fast neutrons, heavy and light ions, electrons) on materials including fundamental investigations of radiation resistance of structural materials for fission and fusion reactors.

Full name of Participant: University of Southampton
Short name of Participant: SOTON
Description of Participant: The Institute of Cryogenics at University of Southampton has been for more than 15 years an active player in HTS applications with a cumulated funding of more than 5 M€ from governments and industry. It has worked closely with CERN on the successful HTS current leads project for LHC, involving in the design/manufacture of prototypes and the full cryogenic tests for all of the 600 A assemblies.
Tasks in EuCARD: Task 8.5.1 Studies on thermal, electrical and mechanical performance Task 8.5.3 Design and assembly of a 20 m long HTS multi-conductor 600 A link
Short CV for key contributors: Prof. Yifeng Yang is the director of the Institute of Cryogenics and has an established track record in applied superconductivity research, including device design/test, ac losses and cryogenic stabilisation.

Full name of Participant: Science and Technology Facilities Council
Short name of Participant: STFC
Description of Participant: The Science and Technology Facilities Council is one of Europe's largest multidisciplinary research organisations supporting scientists and engineers world-wide. The Council operates world-class, large scale research facilities and provides strategic advice to the UK government on their development. It also manages international research projects in support of a broad cross-section of the UK research community. The Council also directs, coordinates and funds research, education and training.
Tasks in EuCARD: WP7, WP8 on SC undulator, WP10, WP11 on crab cavity and HOM, WP12 on EMMA ring.
Short CV for key contributors: Dr. R. Apsimon, Project Manager for MICE and also involved in ATLAS at CERN. Was ATLAS SCT Barrel integration coordinator and project manager for the 4-barrel assembly. Has worked on the development of particle detectors at Rutherford Appleton Laboratory for 35 years. Prof. J. Clarke: Head of the Magnetics and Radiation Sources group within the Accelerator Science and Technology Centre. Has over 18 years of direct experience in the field of high energy particle accelerator design and is a particular expert in the field of periodic magnet systems. Dr. R. Edgecock: project leader for the EMMA FFAG and coordinator of the UK Neutrino Factory Target and Design Study work packages. Working on R&D for a future neutrino oscillation facility since 1999. He is the coordinator of the FP7 EUROnu Design Study. Dr. O. B. Malyshev, Senior Vacuum Scientist, expert in vacuum gas dynamics, vacuum system design and modelling, experimental work with desorbing and outgassing surfaces, surface preparation and analysis (including NEG coatings). Dr. D. Angal-Kalinin: senior scientist, with interests in accelerator design, beam-optics and -focusing at collision point, halo collimation, diagnostic, feedbacks and crab-crossing systems. She is coordinating the work package on beam delivery system in EUROTeV.

Full name of Participant: Technische Universität Darmstadt
Short name of Participant: TUD
Description of Participant: The University of Darmstadt pioneered two decades ago in building a superconducting electron accelerator at 130 MeV. The institute operates and upgrades this “recyclotron” continuously to provide excellent beam for nuclear physics experiments. This machine was also a driver for the first European CW - FEL.
Tasks in EuCARD: Task 11.10 UHV furnace for annealing samples.
Short CV for key contributors: Dr. R. Eichhorn: 1994 Diploma Physics, 1994 Postgraduate TUD, 1999 PhD Physics, Postdoc GSI Darmstadt, 2002 Task Leader FZ Juelich, 2006 Senior Scientist TUD, Head of the Accelerator S-DALINAC

Full name of Participant: Polytechnic Lodz
Short name of Participant: TUL
Description of Participant: The Technical University of Lodz provides teaching courses in over 20 different disciplines with 60 specialisations. TUL offers a possibility of obtaining the following degrees: Bachelor of Art, Bachelor of Science, Master of Science and Doctorate of Philosophy. There are 21’000 students (including 800 PhD students) and approximately 3’000 staff members at the University. The Technical University of Lodz has nine faculties and six and other organisational units included International Faculty of Engineering. The Electrical, Electronic, Computer and Control Engineering covers a wide spectrum of knowledge, including microelectronics, computer science and power electronics. In this project, the Department of Microelectronics and Computer Science headed by Prof. Andrzej Napieralski will contribute in work package 4.3 RFTech to the development of Advanced Telecommunication Carrier Architecture (ATCA)-based Low Level RF control system. Electrical Engineering branches. The Department has modern educational laboratories created during 7 TEMPUS projects: JEP 2031 and 4343, JEN 02031-93, CME-01059-95, SJEP-09159, SJEP 12204-97 and SJEP 12216-97. As an effect of the latter, the ASIC Design Centre (ADEC) has been created, with the purpose of technology transfer for small and medium enterprises. The international co-operation of the Department involves participation in many international scientific projects, e.g. “Coordinated Accelerator Research in Europe” CARE 2003-2007 RII3-CT-2003-506395, “Pervasive computing framework for modelling complex virtually-unbounded systems” PERPLEXUS 2006-2009 FP6-34632. In addition, currently the Department takes part in over twenty research projects with grants from Ministry of Science and Higher Education.
Tasks in EuCARD: WP 4 RFTech to the development of ATCA-based Low Level RF control system with Advanced Mezzanine Card (AMC) modules, gamma and neutron radiation sensors and piezo and waveguide control subsystem. Design of neutron sensor as custom Application Specific Integrated Circuit (ASIC).
Short CV for key contributors: Prof. Dr. A. Napieralski, M.Sc. and Ph.D. from the Technical University of Lodz in 1973 and 1977, D.Sc. degree in electronics from the Warsaw University of Technology (Poland) in 1989 and in microelectronics from the Université de Paul Sabatié (France) in 1989. Director of the Department of Microelectronics and Computer Science. Domains of interest: modeling of power and semiconductor devices,electro thermal simulation of VLSI circuits, modeling of transient thermal states in electronic circuits, thermal modeling of hybrid circuits and multi-domain simulations. Dr. D. Makowski: born in Pabianice, Poland, on April 7, 1976.Assistant Professor at the Department of Microelectronics and Computer Science. Lecturer on Real Time Microprocessor Systems, Computer Architecture and Programmable Devices. Working on radiation influence on electronic devices. Research interests: radiation hardening and designing radiation tolerant devices and digital systems. Participation in the design of ATCA-based hardware for Low Level RF (LLRF) system for FLASH and

XFEL accelerators.
Dr. P. Sekalski: born in Lodz, Poland, on August 17, 1978. His thesis work is directly linked with the fast tuners used for superconducting TESLA-type cavities. Since 2002 he has been collaborating with DESY - Hamburg, Germany, INFN-Milan, Italy, CEA-Saclay and IN2P3-Orsay, France. He coordinated activities on "Tuners" in CARE and develops the control system for fast tuners. He is Assistant Professor at the Department of Microelectronics and Computer Science.

Full name of Participant: Tampere University of Technology

Short name of Participant: TUT

Description of Participant:
The Institute has been involved with superconductivity nearly 25 years. The electromagnetic properties of both low temperature (LTS) and high temperature superconductors (HTS) have been modelled which describes well the flux dynamics and transport current behaviour of these materials. Calculation models for ac and thermal losses and thermal stability have been created which support the work of magnet designer. The research work has been demonstrated within numerous, mainly energy applications (SMES, motors, cables).

Tasks in EuCARD:
Task 8.4.2 HTC conductor characterization, specification and quench modelling.

Short CV for key contributors:
Dr. R. Mikkonen: Lecturer, about 100 international and 40 domestic publications about superconductivity. Research areas: LTS and HTS magnet design, stability considerations, superconductivity energy applications. Finnish member in the OECD/IEA Expert Committee within sc, member of the International Organizing Committee of MT conference.

Full name of Participant: Helsingin Yliopisto (University of Helsinki)

Short name of Participant: UH

Description of Participant:
The University of Helsinki (http://www.helsinki.fi/university/), established in 1640, is the largest and most diversified university in Finland with eleven faculties. The university has around 38000 students working on degrees and 7700 employees. High-level research is carried out at the departments of the faculties as well as at independent research institutes like the Helsinki Institute of Physics (HIP, http://www.hip.fi). HIP carries out physics research and technology development at international accelerator laboratories and is responsible for Finnish research collaboration with CERN. HIP have a longstanding record of internationally recognized involvement in experimentation at high energy physics colliders as well as basic research in theoretical physics.

Tasks in EuCARD:
WP10

Short CV for key contributors:
Dr. K. Österberg, University lecturer in Experimental High Energy Physics and leader of HIP project “Linear Collider Research”, has coordinated several high energy physics related experimental projects.
Prof. K. Nordlund, Professor of Computational Materials Physics and project leader of “Radiation Damage in Particle Accelerator Materials”, has lead more than 10 projects on non-equilibrium effects in solids.
Dr. F. Djurabekova, co-leader of HIP project “Radiation Damage in Particle Accelerator Materials” and Senior scientist, has more than 10 years of experience of defect simulation in solids and at surfaces.

Full name of Participant: Université Joseph Fourier Grenoble

Short name of Participant: UJF

Description of Participant:
UJF is the Scientific and Medical University in Grenoble, France. It has a large contribution to Physics, Mathematics (pure and applied), Computing, Chemistry, Biology, Mechanics, Medicine and Pharmacy, as well as new domains like nano-sciences and nanotechnologies, biotechnologies and environmental

sciences. In parallel, UJF is open to the socio-economical world, via technological platforms and valorisation.
Tasks in EuCARD: Task 4.3 Coordination of the RFTECH network.
Short CV for key contributors: Prof. J.-M. De Conto: Professor at the Joseph Fourier University since december 2005 – Institut Universitaire de Technologie, Département Mesures Physiques. Research activities at Laboratoire de Physique Subatomique et de Cosmologie (UJF – CNRS/IN2P3 – Institut National Polytechnique de Grenoble). Project leader of the ETOILE project (synchrotron for hadron therapy, to be build in Lyon) from 2000 to 2003. Member of the LPSC Scientific Committee (1995-2003) and from 2007 coordinator of the workpackage 4 in the CARE/HIPPI JRA. R&D for particle accelerators (beam dynamics, radiofrequency). Contribution to the ELFE, ETOILE, SPIRAL2, GENEPI projects.

Full name of Participant: University of Lancaster-Cockcroft Institute
Short name of Participant: ULANC
Description of Participant: Part of the larger Cockcroft Institute, a consortium of three universities of Liverpool, Manchester and Lancaster, Science and technology Facilities Council (STFC) and the Northwest Development Agency (NWDA). The mission to do advanced R&D in accelerators, be the central point for national deliverables to large international projects, education and training of next generation scientists and technologists, critical core competencies in niche areas and transfer/exchange of knowledge to industry. There are about 100 FTEs in CI, with Univ. of Lancaster-CI having two senior professors, a dozen of various post-docs in various stages, many Ph. D. students, in-house RF tube and cavity design capability as well as RF testing and advanced electromagnetic codes.
Tasks in EuCARD: Task 9.2 Modelling, Materials, Tests for Hadron Beams. Task 10.4 Beam delivery systems for electron beams, Task 11.5 Crab cavities, Task 11.6.3 New methods for thin films.
Short CV for key contributors: Prof. A. Dexter: Professor, Department of Engineering, Lancaster university. Special expertise in RF cavities, transversely deflecting ‘Crab’ or other cavities, power RF and control, high power RF tubes, and beam dynamics. More than two decades experience in charged particle beams and accelerators. Senior faculty with three post-doctoral fellows and many Ph. D. students.

Full name of Participant: University of Malta
Short name of Participant: UM
Description of Participant: Department of Micro- and Nano-electronics, Faculty of Information and Communications Technology.
Tasks in EuCARD: WP9 collimation studies.
Short CV for key contributors: Dr. N. Sammut; Representative of Malta at CERN. Developer of the feed-forward control system (FIDEL) of the LHC. Developer of instrumentation for fast magnetic measurement systems.

Full name of Participant: Université de Geneve
Short name of Participant: UNIGE
Description of Participant: Department of Nuclear and Particle Physics. Long experience in particle physics experiments and strong neutrino physics group. Has played leading roles in the HARP, K2K, T2K and MICE experiments, and in the studies of neutrino factory and muon collider facilities. Connected to other neutrino groups in Switzerland. Solid State Physics Department and Institute of Applied Physics. Strong experience in low

temperature /high field measurements. Several facilities for testing prototype superconducting wires and tapes at 4.2 K – 77 K, up to a magnetic field of 21 T, under the effect of various mechanical loads.

Tasks in EuCARD:
WP3 Co-coordination of the NEU2012 network, Task 8.4.1 HTC conductor characterization and specification

Short CV for key contributors:
Prof A. Blondel: University of Geneva since 2000, after 24 years at CNRS and Ecole Polytechnique Paris. PhD on the Gargamelle experiment at CERN; Analysis coordinator in ALEPH at LEP/CERN measuring the number of light neutrino species. Beam polarization experiments at LEP for MeV precision measurements of Z and W mass and Z width. Since 2000 involved in neutrino oscillation physics and search for leptonic CP violation. Spokesperson of the MICE experiment at RAL (UK).
Prof. R. Flükiger: University of Geneva since 1990, after 2 years at MIT, High Field Magnet Laboratory (USA) and 10 years at Forschungszentrum in Karlsruhe (D). Affiliated to the Dept. Phys. Cond. Matter (DPMC) and to the Federal NCCR project MANEP (Materials w. Novel Electronic Properties). Solid state physicist, specialized in the development of superconducting materials for high field magnets. Extended studies on the effect of mechanical load on the critical current of superconducting Nb_3Sn wires and Y-123 tapes (coated conductors) up to 21 T (simulating effects of Lorentz forces in large high field magnets).

Full name of Participant: University of Manchester-Cockcroft Institute

Short name of Participant: UNIMAN

Description of Participant:
Part of the larger Cockcroft Institute, a consortium of three universities of Liverpool, Manchester and Lancaster, Science and technology Facilities Council (STFC) and the Northwest Development Agency (NWDA). The mission to do advanced R&D in accelerators, be the central point for national deliverables to large international projects, education and training of next generation scientists and technologists, critical core competencies in niche areas and transfer/exchange of knowledge to industry. There are about 100 FTEs in CI, with Univ. of Manchester-CI having three professors, eight post-doctoral fellows and many Ph. D. students. In-house microwave laboratory and electromagnetic codes.

Tasks in EuCARD:
Task 9.2 Modelling, Materials, Tests for Hadron Beams. Task 10.4 Beam delivery systems for electron beams, Task 11.5 Crab cavities, Task 11.6.3 New methods for thin films.

Short CV for key contributors:
Prof. Dr. S. Chattopadhyay: Director, Cockcroft Institute and Sir John Cockcroft Chair of Physics at Universities of Liverpool, Manchester and Lancaster. Associate of Harvard University Physics Department. Associate Director of Thomas Jefferson national Accelerator Facility in USA from 2001 till 2007, Director of Centre for Beam Physics, Senior Scientist and Professor in the Graduate School of Lawrence Berkeley Laboratory and University of California at Berkeley, 1984-2001. Experience in the conception, design, construction and operation of particle accelerators, colliders, synchrotron radiation sources and free electron lasers. Expertise in beam cooling, control of coherent beam instabilities and optical manipulation of beams.
Dr. P. McIntosh: Senior Scientist and Group Leader, RF Group, Accelerator Science and Technology Centre (ASTeC), STFC, 2005-now. More than seven years experience at Stanford Linear Accelerator Centre (SLAC) and Berkeley prior to joining ASTeC, many years experience at industry. Specialist in normal conducting and superconducting high power and low level RF cavities.
Dr. R. Jones: Faculty of University of Manchester, School of Physics and Astronomy, 2006-now. Over a decade's experience at Stanford Linear Accelerator Centre (SLAC) in NLC linacs and cavity development. Ph. D. from University College London. Currently working on many international projects with unique expertise in high gradient RF cavities, wake fields and associated beam dynamics.

Full name of Participant: The Chancellor, Masters and Scholars of the University of Oxford

Short name of Participant: UOXF-DL

Description of Participant: The University of Oxford is globally renowned for the quality and diversity of its research, with over 3000 academic staff and 3000 postgraduate students working on research. 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. All European research projects are supported by administrative staff and experienced personnel drawn from across the University of Oxford, in particular from Research Services for management, contractual and legal issues, Research Accounts for financial reporting, Departmental Administrators for the day-to-day project management and ISIS Innovation Ltd., the University of Oxford's knowledge and technology transfer company, for the protection and exploitation of knowledge-related issues.
Tasks in EuCARD: Task 10.3 Linac & FF stabilisation
Short CV for key contributors: Prof. P. Burrows: Professor of Accelerator Physics, John Adams Institute for Accelerator Science, Oxford University. UK Linear Collider Project Manager. Convenor, ILC Beam Delivery Instrumentation. Dr. D. Urner: Departmental Lecturer, John Adams Institute for Accelerator Science, Oxford University. Project leader, MonaLisa alignment monitoring system for Linear Colliders. Dr. A. Reichold: University Lecturer, John Adam Institute for Accelerator Science, Oxford University. Project leader, LiCAS Rapid Tunnel Reference Survey system for linear accelerators.

Full name of Participant: Universität Rostock
Short name of Participant: URostock
Description of Participant: • Founded in 1419. Oldest university in Northern Europe. • Nine faculties are located at the university. More than 55 course offerings. • There are around 13,500 students including approximately 1,000 students from abroad. • Faculty of Computer Science and Electrical Engineering: 32 full professors, 1 junior professor. • Cooperation with DESY, Hamburg, since 1998.
Tasks in EuCARD: Task 11.7 Experimental modelling HOM distribution.
Short CV for key contributors: Dr. U. van Rienen, 1983: Diploma in Mathematics, Univ. Bonn; 1989: Ph.D., Techn. Univ. Darmstadt (TUD); 1997: Habilitation, TUD; since 1997: Full Professor, Univ. Rostock (Theory of EM Fields)

Full name of Participant: Uppsala University
Short name of Participant: UU
Description of Participant: Uppsala University was founded in 1477 and is the oldest university in Scandinavia. Presently it has a staff of 6000, about 40000 undergraduate students enrolled in courses offered by nine faculties.
Tasks in EuCARD: Task 10.2.4 Scanning electron microscope analysis.
Short CV for key contributors: Dr. V. Ziemann: After positions at SLAC, CERN and TSL, Uppsala he joined the Physics department at Uppsala University where he coordinated accelerator physics activities at DESY and CERN. Recently, he was appointed director for the "Center for Accelerator and Instrumentation" development. Dr. R. Ruber: Coordinated the construction of the detector solenoids for WASA at TSL, Uppsala and for ATLAS at CERN and is presently managing the construction of the Two-beam Test-stand for CTF3 at CERN.

Full name of Participant: Politechnika Warszawska

Short name of Participant: WUT

Description of Participant:
Warsaw University of Technology (WUT), Institute of Electronic Systems (ISE); web: www.pw.edu.pl for WUT and www.ise.pw.edu.pl for ISE; 19 Faculties, 35000 students, 1200 Ph.D. students, ISE is located inside the Faculty of Electronics and Information Technologies (FE&IT), of around 5000 students and 200 Ph.D. students; Major Faculties: FE&IT, El.Eng., Mechatronics, Physics, Chemistry, Civil Engineering, Material Engineering, Environmental Engineering, Mechanics Energy and Aviation, Mathematics and Information Sciences, Manufacturing Eng., Transport Eng,. etc.
FE&IT celebrated in 2007 the 50th anniversary; Research and didactic specialization of ISE: theory of electronic circuits and systems; DSP algorithms, radar technology, RF technology, FPGA algorithms, novel electronics applications; optical fibre measurement data networks.

Tasks in EuCARD:
WP2 leader and main actor, Task 11.8.1 support, Task 11.8.2 main executer, Task 11.8.5 support, Task 11.8.6 support.

Short CV for key contributors:
Prof. R. Romaniuk, professor at WUT, research director of WUT-ISE (Institute of Electronic Systems), research specialty – photonics and electronic systems for high energy physics experiments and accelerator technology, tutor of several Ph.D. students, authored more than 200 papers on the subject and several books.
Dr. K. Pozniak, Since over 20 years working on design, fabrication, testing, commissioning and maintenance of large electronic and photonic systems for HEP experiments and accelerators.
Dr. W. Zabolotny, Member of the designers team of CMS Muon Trigger in the LHC. Specialist in GPP, DSP, FPGA, VHDL programming.
Dr. M. Ramotowski, Departmental Lecturer, Institute of Electronic Systems WUT. Research programs manager.
Dr. M. Linczuk, Ph.D. in electronics and information technologies. Works on DSP-FPGA systems for FLASH, XFEL and POLFEL.
Dr. T. Czarski, Senior researcher. Active in modelling of superconductive cavities for LLRF control systems.

2.3 Consortium as a whole

The consortium partners include most European laboratories operating large and medium size accelerators for research. Altogether, they represent the leading world competence in the field with the largest and often most innovative research instruments. This puts this consortium as a whole in a privileged position to achieve the scientific and technical project objectives with a maximum chance of success and minimum risks.

As coordinator of the project, CERN, one of the central partners of the consortium, regroups the efforts of 20 member States of which 18 are from the European Union. In addition, many participants in the project are major organisations at national level or parts of larger national research infrastructures (among the latter CEA, CIEMAT, CNRS, DESY, GSI, INFN. STFC). These large laboratories have a wide competency domain oriented towards partly complementary and partly common infrastructures,
Besides these large organisations, the consortium includes a number of smaller more specialized institutes with specific competencies and test infrastructures (e.g. BESSY, FZD, CNRS-LOA) and of universities (e.g. UNIGE, TUD, UM, WUT) with relevant expertise in innovative domains. The consortium includes two high-tech industries motivated by one of the themes.

In the main area of the project research activities, the consortium has the top-of-the–art competency, as illustrated hereafter:
HERA (DESY) till recently was and LHC (CERN) is a world leading accelerator using superconducting technologies, the LHC becoming the unique 27 km long machine operated at 1.9 K, cooled by superfluid helium. The LHC beam is orders of magnitude more powerful than any other accelerated beam and has required the study and development of very high efficiency collimation, of interest for pulsed superconducting synchrotrons considered at GSI. With the TESLA studies (DESY), the superconducting RF acceleration has reached world records in gradients and has already found several applications in a new generation of (X)FEL light sources like FLASH (DESY). The two-beam acceleration principle investigated at CLIC-CTF3 (CERN) appears as the most promising candidate for electron and positron beam acceleration beyond one TeV in the next decade. The trans-national accesses, networks and other joint activities are all at a world level and carried out in collaborations including at least one recognized world leader.

The proposed activities are in line with the European priorities defined by independent European bodies and with the R&D programmes of individual national or European laboratories that provide the matching funds. This guaranties a major individual and collective interest from all laboratories and institutes to meet the goals and produce the announced deliverables.

The work packages involve typically from 4 to 18 partners; tasks or even subtasks involve several of them. The deliverables relying largely on collaborative efforts, care was given to preparing a solid framework for the consortium, using the experience gained in the FP6 CARE I3.

Given the significant matching funds required from the partners, commitment to the deliverables and indicative budgets was requested and obtained. This phase included detailed discussions on the division of EU funding, taking into account if necessary specific financial situations. A positive early confrontation to financial constraints will guaranty solid foundations for a reliable collaboration. The participation of the large funding agencies at the national and international levels recalled above secures the procurement of the funds necessary to reach the objectives.

Most partners and their staff have a long practice of collaborations as detailed in the next section. Taking advantage of this experience and mutual knowledge, the distribution of responsibilities (coordination of work packages and tasks) is made according to leading competence in the topics and collaboration requirements. As most fields enter in the competence domain of several institutes, work packages are co-coordinated by two coordinators from two different leading laboratories in the domain (Table 2.4.b). This large but focused distribution of responsibilities aims at forming a consortium both efficient and motivating for the partners.

The consortium as a whole will interact with a significant number of external European and international organizations who have expressed their interest like the accelerator laboratories and programs in the USA (e.g. US-LARP) and Japan, funded by their own agencies. On invitation in the networks activities, their presence and contribution will enrich the investigations on the most performing upgrades and innovative solutions.

Table 2.3 a Institutes associated[1] to the EuCARD project

Associate institute short name	Associate institutes full name	Country	Work package involvement
ANL	Argonne National laboratories	USA	WP11
ANU	The Australian National University	Australia	WP11
BNL	Brookhaven National Laboratory	USA	WP4
BUT	Bialystok University of Technology	Poland	WP11
CHIPP	Swiss Institute for Particle Physics	Switzerland	WP3
CIAE	China Institute of Atomic Energy	China	WP11
CIHEP	Institute of High Energy Physics (Beijing)	China	WP12
Cracow-U	University of Cracow	Poland	WP3
ELETTRA	Sincrotrone Trieste	Italy	WP6
FNAL	Fermi National Accelerator Laboratory	USA	WP4, 8
FRAUH	Frauenhofer Institut (Euskirchen)	Germany	WP6
GANIL	Grand Accelerateur National d'Ions Lourd	France	WP11
IHEP	Institute for High Energy Physics, Protvino	Russia	WP4
Imperial	Imperial College London	United Kingdom	WP3
INR RAS	Russian Academy of Sciences, Institute for Nuclear Research, Moscow	Russia	WP9
IPCP	Institute for Problems of Chemical Physics, Chernogolovka	Russia	WP9
ITEP	Institute for Theoretical and Experimental Physics, Moscow	Russia	WP9
JINR	Joint Institute for Nuclear Research, Dubna	Russia	WP4
KEK	High Energy Accelerator Research Organization, Tanashi	Japan	WP4, 8, 10
LBNL	Lawrence Berkeley National Laboratory	USA	WP8
LUT	Lublin University of Technology	Poland	WP11
MIT	Massachusetts Institute of Technology	USA	WP4
MPG-MPIK	Max Planck Inst. für Kernphysik, Heidelberg	Germany	WP3
MSU	Michigan State University	USA	WP11
Osaka U	Osaka University	Japan	WP3
SLAC	Stanford Linear Accelerator Center	USA	WP10, 11
Texas A&M	Texas A & M University	USA	WP4
THALES	Thales Group	France	WP4
TIFR	Tata Institute for Fundamental Research	India	WP3
TJNAF	Thomas Jefferson National Accelerator Facility	USA	WP11
TRIUMF	Tri-University Meson Facility	Canada	WP11
TUBERLIN	Technische Universität Berlin	Germany	WP4
UErlangen	University of Erlangen	Germany	WP11
CINVESTAV	Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional	Mexico	WP4

UAM	Universitad Autonoma Madrid	Spain	WP3
UANK	University of Ankara	Turkey	WP6
UBOL	University of Bologna	Italy	WP4
UCLM	University of Castilla La Mancha, Ciudad Real	Spain	WP9
UCLN	Université Catholique Louvain-la Neuve	Belgium	WP3
UHAM	University of Hamburg	Germany	WP4
UHAR	University of Harburg	Germany	WP6
UniSofia	Sofia University St Kliment Ohridski	Bulgaria	WP3
USAN	University of Sannio	Italy	WP4
USTOCK	University of Stockholm	Sweden	WP4
UT	Technical University Twente	The Netherlands	WP8

[1]An associate Institute is an organisation external to the EuCARD consortium and participating into specific activities

Complementarity and collaboration between partners.
For the very high field dipole magnets, all the partners have some experience in superconducting magnet design and construction as well as in sc cable developments. CERN has the obvious experience gained on the construction of the LHC dipole and on the liquid helium superfluid system and DESY acquired experience with the construction of the HERA magnets. CNRS, CEA-DSM, FZK, INFN, TUT and UNIGE have expertise on electrical, mechanical and thermal behavior of sc magnets. CNRS has an additional experience in cryostat design and in working with superfluid liquid helium. CEA, INFN, STFC and PWR contributed to the NED (Next European Dipole) activities within CARE aiming at developing a high performance Nb_3Sn wire in collaboration with industry, development which will serve as a starting point for WP8 activities.

Concerning collimator and material tasks, CERN and GSI have worked on collimation issues for LHC and FAIR respectively. They are developing experience on energy deposition, associated material properties, radiation damage and thermal shock waves. IFIC, INFN, ULANC AND UNIMAN will contribute to halo studies and beam modelling. While ARC, EPFL, RRC KI AND POLITO will participate in material characterization and experimental tests.

For the normal conducting (nc) linac technology, a large number of the interested partners, CEA-DSM, CIEMAT, CNRS, IFIC, INFN, PSI, STFC, UH and UU, are also members of the multi-lateral collaboration built around the test facility CLIC-CTF3 at CERN, working on various aspects of this evolving facility testing the two-beam acceleration scheme and the high-gradient nc cavities. They all developed specific expertise directly applicable to the tasks pursued in WP10. ULANC and STFC will use their experience on beam delivery systems in linear colliders and special cavity development. Institutes like CEA, INFN, PSI and RHUL bring their know-how on diagnostics and monitoring.

For the superconducting (sc) RF technology, beneficiaries bring their expertise in various techniques of preparation, construction and testing of sc cavities. DESY has the obvious experience of building high-field cavities for the XFEL project, in particular on surface preparation and cryo-modules. CERN has expertise in cryogenics techniques and development of different types of cavities for proton beams. Both laboratories and CNRS have complementary infrastructures for testing sc cavities, which can be used and developed within the EuCARD activities. CEA, CERN, DESY, INFN and Polish Universities have knowledge on Nb coating techniques.

In the assessment of novel accelerator, there is a particularly welcome complementarity between the accelerator expertise of INFN and the knowledge recently developed by CNRS-LOA (Laboratoire d'Optique Appliquée) on plasma accelerating technique, which bring together two communities which had first contacts through the CARE initiative. INFN, CERN and CNRS will put in common their experience in designing interaction regions of colliders and associated monitoring. STFC will also add its expertise in diagnostics and running accelerator facilities.

All the institutes mentioned above have collaborated together in the past. In particular, 14 of the EuCARD beneficiaries are participating in the still going-on CARE project, so that both the complementarity and the continuity are ensured. Many of the participating institutes have in addition the experience of networking activities, successfully and strongly developed since several years within projects like CARE and EURONS, as well as in transnational access activities, as EURONS is a good example.

2.4 Resources to be committed

2.4.1 Strategy for allocation of EU funding

The strategy for EU funding stems from the priorities assigned to EUCARD:

- **IA Management:** The laboratory directors convened by the ESGARD chairman agreed that CERN, as a European Organisation, has specific responsibility and shall support the management cost, so as to allow maximum distribution of the EU funding to the consortium participants.
- **Networks:** the networks being the backbone of the IA, a modest contribution is allocated to the coordinators to maximise the capability of organising mini-workshops or exchange of experts. Networks costs are requested to be funded at 100 % by EU.
- **Trans-national accesses:** The policy for financing the trans-national accesses follows a long-standing tradition of mutual help and support in the field of particle physics. A 100 % EU funding is requested for the support of the access users and a small budget is allocated to the access management by the access operators (WP budget line 1). The operating costs of the infrastructures are not charged at CERN (WP5), and charged at a symbolic level of 5 % of their actual cost at DESY (WP6). The anticipated users of MICE (WP7) are in large number and the EU funding of the operating cost is requested to be 20 % of the annual operating cost.
- **Joint Research Activities:** On average, the EU funding requested for JRA's is about 30 % of the total cost. This policy of mainly covering the total costs by the matching funds was successfully experimented in CARE and demonstrated a significant leverage effect.

2.4.2 Mobilization of resources and guaranty of deliverables

The budget evaluation of each task was carried out by experienced senior staff of the various partners. Prior to sending this proposal, each beneficiary was requested to formally agree through its laboratory management to provide the requested matching funds and deliver the planned deliverables. If the proposal is accepted, this engagement will be confirmed formally in the Grant Agreement.

2.4.3 Financial dashboard

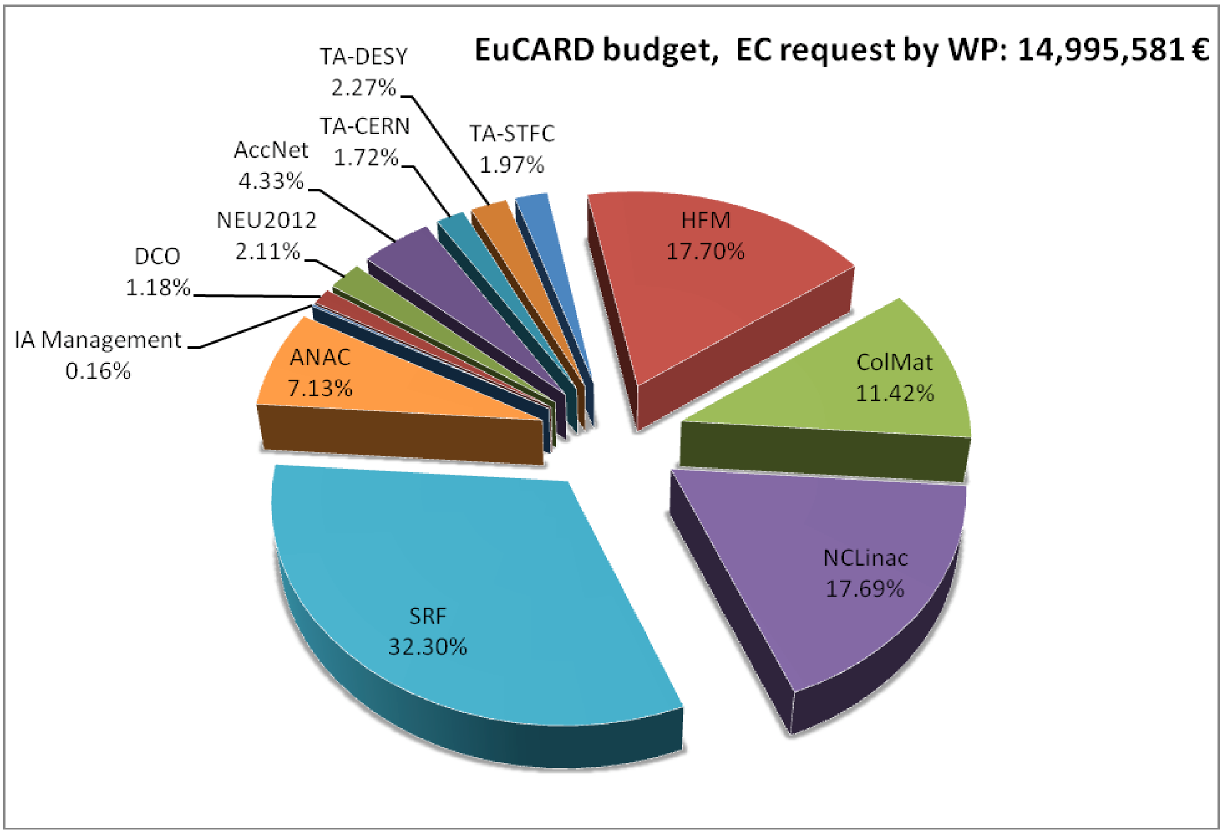


Figure 3: EC funding per Work Package

Figure 3 shows the distribution of EC funding per WP. Most of the resources are mobilised for the JRA's. This is explained by the complexity and cost of the equipment necessary to upgrade very large accelerators and test facilities. As already presented, the cost of NA's and TA's are kept low by a deliberate policy of providing resources (human for NA's, facilities for TA's) at no or low cost, as has been a long-standing tradition in particle physics for such activities.

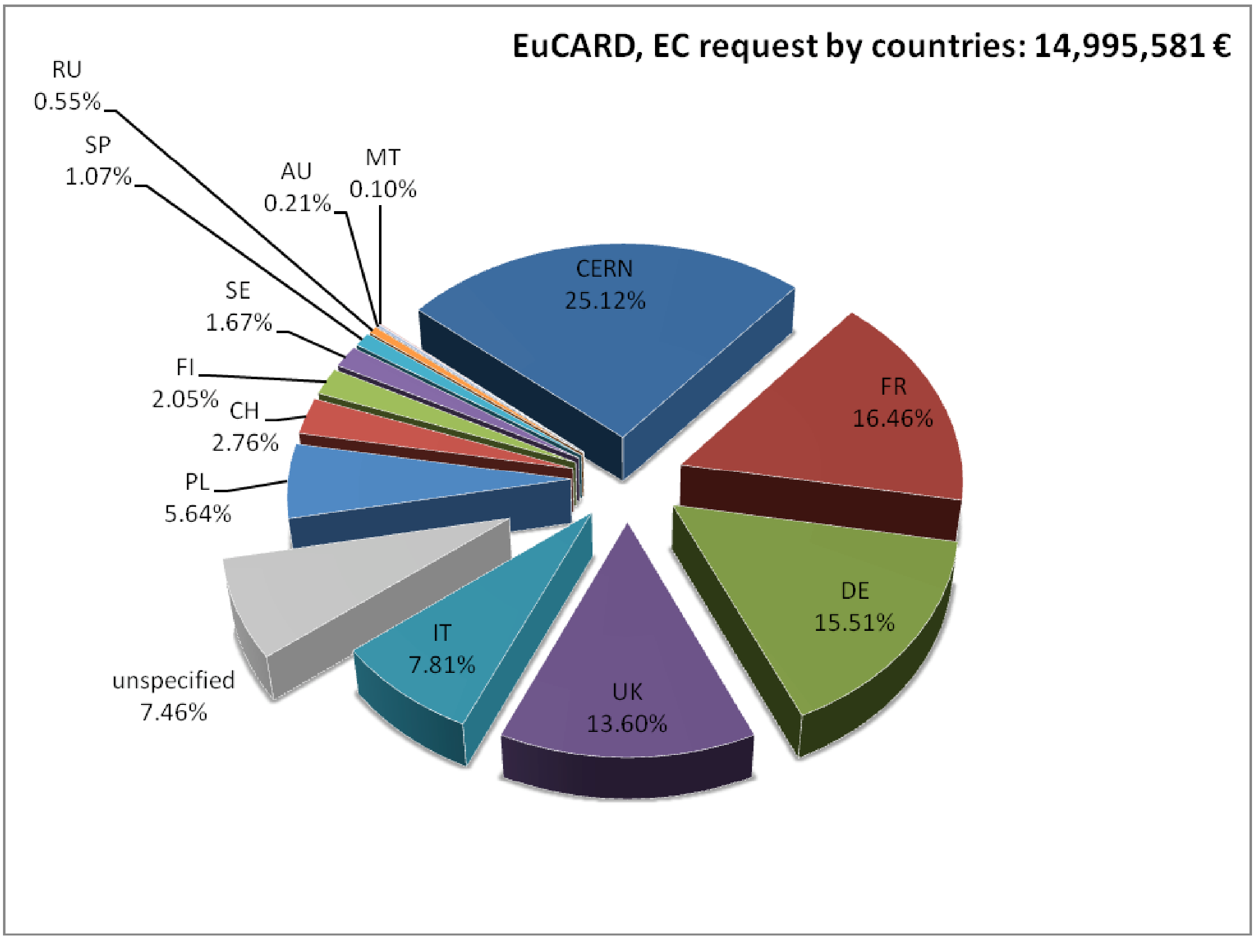


Figure 4: EC funding per country; "unspecified" stands for users of NA's and TA's

Figure 4 displays the balance of EC funding among countries. The equilibrium reached testifies the dynamism around accelerator R&D throughout Europe. It is further a guaranty of financial robustness against possible changes of national scientific policies. CERN has the largest commitment of matching funds. They will be secured from the R&D budget already voted in 2007 by the Member States for a period of 4 years.

Table 2.4 a gives the total cost breakdown and the requested EC funding per WP. The sharing of the total costs gives 53 % for Personnel and 47% for Material. This equilibrated balance results from research work targeting design and fabrication of equipments to be included in accelerator infrastructures. Subcontracting only appears in one WP for a small global share.

Table 2.4 a Budget breakdown

WP	PM	PM direct costs	Consumable & prototype direct costs	Travel direct costs	Sub-contracting costs	Total direct costs	Total cost	EU requested funding
1: IA Management	91	536,900	0	15,000	0	551,900	883,040	24,000
2: DCO	26	122,760	33,300	9,000	0	165,060	264,096	177,696
3: NEU2012	24	145,870	0	90,300	0	236,170	355,576	316,600
4: AccNet	24	148,800	0	364,600	0	513,400	821,441	649,600
5: TA-CERN	4	24,800	698,125	116,500	0	839,425	1,343,080	258,080
6: TA-DESY	2	12,400	1,885,000	96,500	0	1,993,900	3,190,240	340,240
7: TA-RAL	2	12,400	312,000	741,250	0	1,065,650	1,517,420	296,040
8: HFM	515	2,938,150	1,911,975	188,251	600,000	5,638,376	8,394,706	2,654,035
9: ColMat	321	1,762,650	1,519,000	346,500	0	3,628,150	5,249,240	1,712,820
10: NCLinac	781	4,529,550	1,026,650	137,300	0	5,693,500	9,016,752	2,652,630
11: SRF	783	4,807,205	4,903,185	604,810	0	10,315,200	15,667,236	4,843,914
12: ANAC	304	1,651,080	505,000	136,000	0	2,292,080	3,572,818	1,069,926
Grand Total	2,876	16,692,565	12,794,235	2,846,011	600,000	32,932,811	50,275,645	14,995,581

Table 2.4.b gives a more detailed breakdown of the total cost and EC funding per work package and per task. Some additional explanations are given below:

- **management (WP1):** Based on the experience of FP6-CARE, the management is estimated at 67 person-month (pm) for the coordinator, his deputy, the manager and financial officer. In addition 24 pm are foreseen for the administrative assistant and information technology (IT) support. For EuCARD, CERN will not request EU funding for this task, except for travel expenses and miscellaneous expenses related to this function. Each other work package includes a coordination task as budget line 1. The purpose is to gather all costs incurred by the work package and task coordinators in running their work packages and reporting to the Coordinator. This budget line includes as well allowances for participation to the consortium events: annual meetings, steering committee and governing board meetings for the participating institutes. Altogether the management and coordination budget amounts to 6.0 % of the total cost.
- **Dissemination (WP2):** 2 pm for EU reporting and 10 pm are planned for the coordinator, in addition to the information technology support mentioned above. Some 100 k€ are set apart for dissemination in networks or other European initiatives, for the organization of prospective meetings with industry, for publication of books and support of publications in Open Access Publishing.
- **Networks (WP3 and 4):** Financing two 3-day workshops per network or network task and per year is planned, each supporting 17 persons. Judging from CARE experience, significant un-supported attendance is expected as well. Provision is made for inviting 8 experts each for 2 weeks per year for each network
- **Trans-National Accesses (WP 5, 6 and 7):** The total costs incurred by the access operators has been evaluated and committed.
- **Joint Research Activities (WP 8 to 12):** The joint research activities mobilise 86 % of the EU funding. The personnel and material budgets are about equal. In one task (11.10), the material budget dominates, as the goal is largely a hardware upgrade of a network of complementary SRF test stations. The details of the estimated manpower and the goals and investments justifying these costs are to be found in the Work Package descriptions in section 1.3. The detailed cost break-down per beneficiary is to be found in the A3 forms.

Table 2.4 b Budget distribution over WP and tasks

	WP type		Task	Coordination	total task	total WP	EC task	EC WP
WP1	NA	IA Management		J.-P. Koutchouk/CERN, from 7/2008: P. Lebrun/CERN		883,040 €		24,000 €
WP2	NA	**DCO**: Dissemination, Communication & Outreach		R. Romaniuk/WUT, dep. J. Miles/CERN		264,096 €		177,696 €
WP3	NA	**NEU2012**: Structuring the accelerator neutrino community		V. Palladino/INFN (NAPOLI)		355,576 €		316,600 €
			3.1 Coordination and communication		120,680 €		81,704 €	
			3.2 Use of existing nu facilities		106,480 €		106,480 €	
			3.3 Roadmap to the Future		128,416 €		128,416 €	
WP4	NA	**AccNet**: Accelerator Science Networks				821,441 €		649,600 €
			4.1 Coordination and communication	W. Scandale/CERN (until 5/11/2009), F. Zimmermann/CERN (from 6/11/2009), A. Variola/IN2P3-LAL	326,561 €		177,600 €	
			4.2 **EuroLumi** Beam physics, magnets & collimation	F. Zimmermann/CERN, E. Todesco/CERN	268,880 €		246,000 €	
			4.3 **RFTech** RF design & technologies	JM de Conto/LPSC, dep. Mariusz Grecki/TUL	226,000 €		226,000 €	
WP5	TA	**TA-CERN** Open Accelerator Science Facilities				1,343,080 €		258,080 €
			5.1 Access management		93,280 €		93,280 €	
			5.2 CryoMagNet	L. Walckiers/CERN	906,800 €		121,800 €	
			5.3 HiRadMat	R. Schmidt/CERN	343,000 €		43,000 €	
WP6	TA	**TA-DESY** Open Accelerator Science Facilities				3,190,240 €		340,240 €
			6.1 Access management		47,040 €		47,040 €	
			6.2 FLASH-TTF	S. Schreiber/DESY	3,143,200 €		293,200 €	
WP7	TA	**TA-STFC** Open Accelerator Science Facilities				1,517,420 €		296,040 €
			7.1 Access management		47,420 €		47,040 €	
			7.2 MICE	R. Apsimon/RAL	1,470,000 €		249,000 €	
WP8	RTD	Super-conducting High Field Magnets for higher luminosities and energies	**8. HFM**			8,394,706 €		2,654,035 €
			8.1 Coordination and communication	G. de Rijk/CERN, dep. F. Kircher/CEA	370,000 €		130,000 €	
			8.2 Support studies	M. Chorowski/WUT	2,302,550 €		779,064 €	
			8.3 Models	J.M. Rifflet/CEA	1,679,359 €		518,400 €	
			8.4 Very high field insert	P. Tixador/CNRS Grenoble	1,427,797 €		431,571 €	
			8.5 HT sc link	A. Ballarino/CERN	715,000 €		225,000 €	
			8.6 Sc wigglers for CLIC DR	H. Braun/CERN	1,300,000 €		390,000 €	
			8.7 Sc undulators	J. Clarke/STFC (DL)	600,000 €		180,000 €	
WP9	RTD	Collimators & materials for higher beam power beam	**9. ColMat**			5,249,240 €		1,712,820 €
			9.1 Coordination and communication	R. Assmann/CERN J. Stadlmann/GSI	231,860 €		79,608 €	
			9.2 Modelling, Material tests for hadron beams	A. Bertarelli/CERN	2,750,660 €		891,708 €	
			9.3 Collimator prototyping & testing for hadron beams	R. Aßmann/CERN	2,266,720 €		741,504 €	
WP10	RTD	Technology for normal conducting higher energy linear accelerators	**10. NCLinac**			9,016,752 €		2,652,630 €
			10.1 Coordination and communication	G. Blair/RHUL, E. Jensen/CERN	342,256 €		128,000 €	
			10.2 NC high gradient cavities	W. Wuensch/CERN	3,001,516 €		828,250 €	
			10.3 Linac & FF stabilization	A. Jeremie/CNRS (LAPP)	2,109,840 €		633,000 €	
			10.4 BDS (laser wire)	G. Blair/RHUL	1,243,500 €		375,580 €	
			10.5 Drive beam phase (monitor)	F. Marcellini/INFN (LNF)	1,068,920 €		321,800 €	
			10.6 DR vacuum (coatings, NEG, e-cloud)	P. Chiggiato/CERN	1,250,720 €		366,000 €	
WP11	RTD	SC RF technology for higher intensity proton accelerators and higher energy electron linacs	**11: SRF**			15,667,236 €		4,843,914 €
			11.1: SRF Coordination & Communication	D. Proch/DESY, dep. O. Napoly/CEA	643,214 €		230,470 €	
			11.2: Single Crystal Cavities	W. Singer/DESY	919,040 €		275,712 €	
			11.3: Electro-polishing & Surface Investigations	F. Eozenou/CEA	973,448 €		292,034 €	
			11.4: SC Cavities for Proton Linac	S. Chel/CEA	1,356,178 €		406,853 €	
			11.5: LHC Crab Cavities	P. McIntosh/UNIMAN	1,455,415 €		436,625 €	
			11.6: Thin Films	M. Lindroos/CERN	1,416,776 €		449,337 €	
			11.7: HOM Distribution	N. Baboi/DESY	1,152,000 €		345,600 €	
			11.8: LLRF at FLASH	S. Simrock/DESY	1,840,868 €		653,047 €	
			11.9: SCRF Gun at ELBE	J. Teichert/FZD	635,805 €		171,888 €	
			11.10: European SRF Test Infrastructure	W. Weingarten/CERN	5,274,492 €		1,582,348 €	
WP12	RTD	Assessment of Novel Accelerator Concepts	**12. ANAC**			3,572,818 €		1,069,926 €
			12.1 Coordination and communication	M. Biagini/INFN	175,910 €		50,000 €	
			12.2 crab waist	C. Milardi/INFN	1,333,088 €		399,926 €	
			12.3 FFAG (EMMA)	R. Edgecock/STFC (RAL)	1,263,820 €		380,000 €	
			12.4 Instrumentation for plasma wave acceleration	V. Malka/CNRS (LOA)	800,000 €		240,000 €	
		TOTALS				**50,275,645 €**		**14,995,581 €**

Table 2.4 c Transnational Access unit cost calculation

Calculation of the Unit Cost for Transnational Access

Participant number	1	**Organisation short name**		CERN	
Short name of Infrastructure	**CryoMagNet**	**Installation number**	**1**	**Short name of Installation**	**FRESCA**
Name of Installation	**FRESCA**			**Unit of access**	**1 test**

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 (€)**
	Yearly cost for Cryogenic Plant and electricity			250,000
	maintenance of Test station and test commissioning			55,000
	Total A			**305,000**
	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)**
	Engineer (per year)	800	65	52,000
	Technician for cable mounting and test exploitation	1200	52	62400
	Technician for cryogenic operation	100	52	5200
				0
				0
				0
				0
				0
				0
	Total B			**119,600**
C. Indirect eligible costs = 7% x ([A-A']+B)				29,722
D. Total estimated access eligible costs = A+B+C				454,322
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				80
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)				8
I. **Access Cost [2] = G x H**				**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**1**	**Organisation short name**		**CERN**	
Short name of Infrastructure	**CryoMagNet**	**Installation number**	**2**	**Short name of Installation**	**Strand Test**
Name of Installation	**Strand Test**			**Unit of access**	**1 test of samples**

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 (€)**
	Yearly cost for Cryogenic Plant and electricity			350,000
	Exploitation of Test station and test commissioning			55,000
	Total A			**405,000**
	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)**
	Engineer (per year)	1,000	65	65,000
	Technician for strand mounting and test exploitation	2,400	52	124,800
	Technician for cryogenic operation (per year)	200	52	10,400
				0
				0
				0
				0
				0
				0
	Total B			**200,200**
C. Indirect eligible costs = 7% x ([A-A']+B)				42,364
D. Total estimated access eligible costs = A+B+C				647,564
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				1500
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)				100
I. **Access Cost [2] = G x H**				**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**1**	**Organisation short name**		**CERN**	
Short name of Infrastructure	**CryoMagNet**	**Installation number**	**3**	**Short name of Installation**	**Block 4**
Name of Installation	**Block 4**			**Unit of access**	**1 week@cold**

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 (€)**
	Yearly cost for Cryogenic Plant and electricity			400,000
	Exploitation of Test station and test commissioning			110,000
	Total A			**510,000**
	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)**
	Engineer (per year)	1,200	65	78,000
	Technician for magnet mounting and test exploitation	1,700	52	88,400
	Technician for cryogenic operation (per year)	300	52	15,600
				0
				0
				0
				0
				0
				0
	Total B			**182,000**
C. Indirect eligible costs = 7% x ([A-A']+B)				48,440
D. Total estimated access eligible costs = A+B+C				740,440
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				120
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)				10
I. **Access Cost [2] = G x H**				**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**1**	**Organisation short name**		**CERN**	
Short name of Infrastructure	**CryoMagNet**	**Installation number**	**4**	**Short name of Installation**	**SM18**
Name of Installation	**SM18**			**Unit of access**	**1 week@cold**

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 (€)**
	Yearly cost for Cryogenic Plant and electricity			1,400,000
	Exploitation of Test station and test commissioning			200,000
			Total A	**1,600,000**
			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)**
	Engineer (per year)	1,000	65	65,000
	Technician for magnet mounting and test exploitation	3,500	52	182,000
	Technician for cryogenic operation (per year)	800	52	41,600
				0
				0
				0
				0
				0
				0
			Total B	**288,600**
C. Indirect eligible costs = 7% x ([A-A']+B)				132,202
D. Total estimated access eligible costs = A+B+C				2,020,802
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)				5
I. **Access Cost [2] = G x H**				**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**1**	**Organisation short name**		**CERN**	
Short name of Infrastructure	**CryoMagNet**	**Installation number**	**5**	**Short name of Installation**	**Magnetic Meas**
Name of Installation	**Magnetic Measurement**			**Unit of access**	**1 day of measurement**

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 (€)**
	Yearly cost for Electricity and infrastructure	7,500
	Magnet assembly and bench commissioning	12,000
	Total A	**19,500**
	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)**
	Engineer in charge of measurement (per year)	700	65	45,500
	Technician (per year)	3500	52	182,000
				0
				0
				0
				0
				0
				0
				0
	Total B			**227,500**

C. Indirect eligible costs = 7% x ([A-A']+B)	17,290
D. Total estimated access eligible costs = A+B+C	264,290
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	400
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)	50
I. **Access Cost [2] = G x H**	**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**1**	**Organisation short name**		**CERN**	
Short name of Infrastructure	**HiRadMat**	**Installation number**	**1**	**Short name of Installation**	**SPS HiRadMat**
Name of Installation	**SPS HiRadMat**			**Unit of access**	**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 (€)**
	Electricity consumption (60MW, 4 days/project lifetime)			200,000
	maintenance material costs (HiRadMat beam line)			30,400
			Total A	**230,400**
			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)**
	Engineer (engineer in charge of operation)	96	65	6,240
	Technician (control room technician)	96	52	4992
				0
				0
				0
				0
				0
				0
				0
			Total B	**11,232**
C. Indirect eligible costs = 7% x ([A-A']+B)				16,914
D. Total estimated access eligible costs = A+B+C				258,546
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				200
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)				96
I. **Access Cost [2] = G x H**				**0**

Calculation of the Unit Cost for Transnational Access

Participant number	**11**	**Organisation short name**		**DESY**	
Short name of Infrastructure	**FLASH-TTF**	**Installation number**	**1**	**Short name of Installation**	**FLASH-TTF**
Name of Installation	**Free-Electron Laser in Hamburg - TESLA Test Facility**			**Unit of access**	**4 hour shifts**

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 (€)**
	Yearly costs for maintenance, consumables, electricity of FLASH machine			5,000,000
			Total A	**5,000,000**
			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)**
	Scientists & Engineers of FLASH machine	203,607	34.38	7,000,009
				0
				0
				0
				0
				0
				0
				0
				0
			Total B	**7,000,009**
C. Indirect eligible costs = 7% x ([A-A']+B)				840,001
D. Total estimated access eligible costs = A+B+C				12,840,009
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				1,831
F. Fraction of the Unit cost to be charged to the proposal [1]				25%
G. **Estimated Unit cost charged to the proposal** = F x (D/E)				**1753.14**
H. Quantity of access offered under the proposal (over the whole duration of the project)				140
I. **Access Cost [2] = G x H**				**245,440**

Calculation of the Unit Cost for Transnational Access

Participant number	**27**	**Organisation short name**		**STFC-RAL**	
Short name of Infrastructure	**MICE**	**Installation number**	**1**	**Short name of Installation**	**MICE experiment**
Name of Installation	**MICE experiment**			**Unit of access**	**two weeks**

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 (€)**
	Direct eligible costs for maintenance, utilities and consumables (4 years)			300,000
	This comprises 20% of the operations costs for MICE over the 4 year period			
	of the award.			
			Total A	**300,000**
			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)**
	Band 6 administrator (0.1 year/year for 4 years)	675	37.98	25,637
				0
				0
				0
				0
				0
				0
				0
				0
			Total B	**25,637**
C. Indirect eligible costs = 7% x ([A-A']+B)				22,795
D. Total estimated access eligible costs = A+B+C				348,431
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				40
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)				**8710.78**
H. Quantity of access offered under the proposal (over the whole duration of the project)				8
I. **Access Cost [2] = G x H**				**69686**

[1] If only a fraction of the unit cost is being charged, please indicate the value of this fraction (in %) in line G. If not, insert 100%.

[2] In the case of a participant giving access to more than one infrastructure/installation with different unit costs, please report in the administrative forms the sum of all the amounts coming from the individual unit cost calculation forms

3. IMPACT

3.1 Expected impacts listed in the work program

3.1.1 Contribution towards structuring the European Research Area

The EuCARD participants, representing the major European laboratories, research institutes and universities active in the field of accelerator R&D, have expressed a strong interest and commitment to extend existing collaborations and create further synergies at European level, including industrial partners. Having gained valuable experience during the FP6-CARE programme and recognising the high potential of a leveraged initiative, they enjoy the full support of the European Committee for Future Accelerators (ECFA) and progress will be reviewed on a regular basis by the ESGARD Steering Group.

EuCARD will contribute to the development of the European Research Area in the domain of accelerator sciences as follows.

Structuring and integrating effect on the accelerator community at European level

The CERN's solid experience in coordinating large R&D collaborations allows EuCARD to admit a large number of participants sharing a common interest and a declared commitment to upgrade accelerator infrastructures. The IA will promote a strong spirit of cooperation, shared responsibilities and joint decision making. The presence of smaller institutes and Universities will enhance cross-disciplinary fertilisation and stimulate student's interest in the development of large research infrastructures.

The structure and content of work packages dedicated to Joint Research Activities has been designed to maximise the likely impact of the project and provide the necessary framework for collaboration and integration. At the WP and task levels, laboratories often share common goals, requiring coordinated studies, implementation plans and tests for the upgrade of a given infrastructure. These joint ventures will reinforce Europe's ability to meet the challenging requirements of large accelerators. The networks are common denominators in all these activities, bringing together experts from diverse and sometimes isolated fields. Their impact will be to strengthen dialogue between disciplines that has become more challenging in modern science. Faster convergence towards practical solutions is expected by avoiding a fragmented approach and bringing together elements of theory (beam dynamics), technology (performance of components) and practice (fabrication, operation efficiency, fault rates, etc).

As a first experience, EuCARD opens Trans-national free access to some large research technological infrastructures where experience shows that outside users are or have expressed interest. The actual impact needs some years to be evaluated. This experience, if successful, will lead to new unexpected synergies. In addition, accelerators for particle physics and light sources have since long very large user communities. They are institutionally open with well developed access mechanisms. The technological accelerator infrastructures are open internally to the JRA actors as an essential part of their work plans.

Development of world-class infrastructures

The LHC being the flagship of particle physics, its upgrade will have a significant impact at worldwide level. At ten-fold its nominal luminosity, a new physics reach opens, and will allow Europe to maintain the leadership in this field by providing solid ground for fundamental advances and insights in particle physics.

Several other world-class level accelerators are involved in EuCARD and will benefit from the Joint Research Activities of this project: DAΦNE (electron-positron collider), with a potential very large luminosity increase, CNGS (intense neutrino beam), SIS and FAIR (heavy ion accelerators and project) and MICE (Muon ionization and cooling experiment), a world first implementation of non-scaling FFAG principle.

Besides particle physics, FLASH, central in EuCARD WP11, stands as a pioneering fourth generation light source (superconducting electron linac) in the VUV and soft X-ray domain. It is the test bed of a unique XFEL project producing high intensity ultra-short X-ray coherent flashes and opening up a whole range of new perspectives for the natural sciences and industry. Other sources are equally concerned by EuCARD: ESRF, PETRA and ANKA. Altogether, the accelerator infrastructures involved in this project, serve a large community of well over 10,000 physicists from all over the world.

In addition to accelerators, the goal of EuCARD is to improve and strengthen world-class test facilities for investigating the technologies needed for future accelerators. These are mainly the CLIC test facility CTF3, regarded as a key element in deciding the future world accelerator and the consortium of SC RF test stations of highest importance for all machines and projects based on superconducting RF acceleration.

During the course of EuCARD, new facilities from other branches of accelerator science and technology may use the project results, such as innovative cancer therapy centers using particle beams for patient treatment (e.g. ETOILE in France).
The novel accelerator technologies that will be developed by EuCARD will reinforce the European capacity of producing not only high-energy and high-intensity proton and electron beams in the years to come, but also in a more distant future intense neutrino and muon beams. As a consequence, the scientific excellence of Europe will also be reinforced with the potential increase of the flux of neutrinos and the flux of protons for next generation of fixed target experiments in both particle physics and nuclear physics.
International cooperation
High Energy Physics is a science which requires development of accelerator infrastructures that are more and more beyond the resources and expertise available in a single nation. Therefore, CERN and all of the large national laboratories of EuCARD – DESY and GSI (D), LAL (FR), INFN (I), PSI (CH), and STFC-RAL (UK) – are currently involved in major international, often global collaborations, such as the LHC, XFEL, and FAIR. Within the framework of this project, active international collaborations will be fostered through the networking activities. A significant number of external European and third country organizations have expressed their interest to collaborate with EuCARD, among which several accelerator laboratories and programs from the USA, Japan, Russia and China, funded by their own national agencies (Table 2.3 a).
In the years to come, globalization will become a corner stone in High Energy Physics, and the future particle accelerators are expected to be truly global projects, such as ITER. Therefore, through the EuCARD Integrating Activity, CERN and the major European laboratories will develop strong links with other HEP laboratories around the world so that Europe could benefit from the worldwide advances and developments of accelerator technologies, and could continue to play a leading role in international initiatives in the field.

3.1.2 Impact of the scientific and technological results

The innovative concepts and technological solutions developed within the framework of EuCARD aim to increase the physics reach of the machines by upgrading existing infrastructures. European research accelerators will remain at the forefront of global research as a result.

The luminosity upgrade of the LHC will be carried out in two phases. The technological requirements for the first phase are included in the SLHC-PP project. Success in the second phase, which aims to increase the luminosity by a factor of ten, will depend on the results of several EuCARD work packages. This level of performance was inconceivable during the LHC design phase and is still well beyond the current state-of-the-art. However, innovative solutions have already been proposed thanks to the success of FP6-CARE I3 and their performance and associated risks will be evaluated by EuCARD AccNet (WP4). This will facilitate the decision making process for the LHC accelerator and its detectors, ATLAS and CMS. The successful development of accelerator quality Nb_3Sn magnets (WP8) will lead to more compact and better performing final focus systems, beyond the capability of Nb-Ti magnets. The development of Nb_3Sn magnets also opens up the possibility of an energy upgrade by a factor of 2 to 3, extending the physics reach and firmly establishing European leadership in accelerators and particle physics for two decades. The availability of high performance cost-effective Nb_3Sn magnets would rapidly have a large impact on other projects with similar requirements. The FRESCA test station for superconducting cables is a good example, since it requires a higher field to test new superconductors. Wigglers and undulators used to control beam parameters in electron rings and linacs are another example. They share common technology with the above programs, especially with regard to the production and test of fragile superconducting cables, which can benefit from the synergies created by EuCARD.

An improved efficiency of collimators and of the resistance of jaw materials to beam losses from higher beam currents (WP9) will have a key impact on accelerator performance. For the LHC, the simulation results and studies of models, materials and new concepts should lead to an optimal upgrade with a direct impact on the machine and the detectors by not having to install new machine elements inside the detector volume. The demand for higher intensities in most accelerators highlights the need for efficient control of beam losses to protect delicate equipment and minimize localised machine activation. This is the case for heavy ion projects such as FAIR at GSI, and undulator protection in electron linacs. Therefore the pioneering work carried out in superconducting hadron colliders such as HERA at DESY and the LHC at CERN, will create a benchmark and provide data, experience and know-how which can be applied to existing and future accelerators.

In the post-LHC era, accelerator-based research in particle physics will be at a cross-road. New concepts will be needed to reduce the size, cost and complexity of higher energy machines. Solutions could include lepton linear colliders with significantly higher accelerating gradients, neutrino factories and novel accelerating techniques. In all cases, the challenges are exceptional. The expected long lead time requires that technology decisions be made within the time scale of this IA. The current preference and largest investment is oriented towards lepton colliders with a high enough energy and luminosity to determine the precise properties of any new particles discovered by the LHC. EuCARD results will have an impact on two lines of research, namely high efficiency superconducting linacs (ILC) and two-beam acceleration with large accelerating gradients (CLIC. Decisions concerning the next “world” machine will have a major impact on European infrastructures; the feasibility of CLIC technology must be demonstrated and the ILC technical design must be improved. The two largest EuCARD JRA work packages and one network are dedicated to these investigations (WP 4.2, WP 10, and WP 11). Technological development and major test stations are the focus for superconducting RF. The results will contribute to the understanding of phenomena which currently limit superconducting cavity performance, thereby improving the technology beyond what is presently available. The better understanding of parameters, test results and manufacturing quality will benefit applications in several other fields, such as light sources like FLASH (WP 6), XFEL projects and proton linacs for the LHC injector chain. If the size and cost of superconducting linacs becomes excessive because accelerating gradients are limited to no more than about 30 MV/m to 35 MV/m, the two-beam acceleration principle used in CLIC offers a more compact solution with significantly higher gradients up to 100 MV/m. EuCARD will explore various challenges offered by CLIC, including high power, high mechanical precision, HOM damping in CTF3 which is a large and unique two-beam acceleration test facility. Whether normal or superconducting, these high energy linacs must guarantee the production, preservation and control of extremely small (nanometre) beam sizes to reach the required luminosity. Therefore, the beam control experience gained in the CTF3 and ATF2 test facilities will be essential to find ways of preserving emittance at the required level when facing problems of stability, reproducibility and vibration (WP10).

The precise control of RF phase is also a common challenge for future linear colliders and free electron lasers. The development of phase control to well below the picosecond level will have an important impact in an even wider domain. Crab cavities are an obvious example; if the required accuracy is obtained, it will be possible to upgrade the LHC luminosity without adding dipole inserts inside the detectors and without significantly increasing the beam current. The potential of this solution for simple luminosity levelling during data-taking is remarkable.

The likely impact of innovative concepts emerging from ANAC (WP 12) can be estimated but not guaranteed. Nevertheless it is clear that a successful demonstration of the crab waist principle could lead to an increased luminosity in DAΦNE and beauty factories by an unexpectedly large factor with only minimal changes to the collider hardware. Similarly, an implementation of the non-scaling FFAG principle is expected to provide suitable accelerators for the generation of intense neutrino beams as well as for cancer therapy with hadrons. Likewise, the ability to measure ultra-short pulses is critical for the development of laser-plasma acceleration that opens the way to very high accelerating gradients.

Finally, the NEU2012 network (WP3) will strengthen the European neutrino community and create opportunities for collaboration on a global scale. The impact is expected to include long term plans for neutrino facilities, incorporating the results from CNGS upgrade studies, the EuroNu design study and other options.

3.1.3 Impact on European industry

European industry is a natural partner capable of supplying advanced devices to the accelerator laboratories and institutes, often requiring serial production of high-tech components. A salient example is the fabrication of some 1300 15 m long superconducting dipoles at the tip of technology by 3 European firms in 3 countries for a approximate total cost of 1.2 BCHF. The funding strategy chosen for EuCARD exploits the leverage offered by EU investment to promote collaboration with industrial partners and develop synergies. Consequently, the investment in material is expected to be much greater than the EU funding, allowing procurement of technologically advanced components, such as Nb_3Sn superconducting cables. Similarly, the industrial production of superconducting RF cavities with reproducibly high performance will be possible. Orders like these, together with the planned prospective meetings, should have a favourable impact on European industry, while remaining within the available budgets.

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

The free and timely dissemination of information to all participants is a key feature of EuCARD. As project coordinator, CERN is in the best position to guarantee the widest possible audience, manage intellectual property rights and exploit results to their fullest. The DCO network will reinforce this role and provide project management support.

The majority of EuCARD beneficiaries are public institutions and the intention is to make public almost all research reports and results. The few exceptions, such as those subject to specific confidentiality clauses and Intellectual Property Rights (IPR) safeguards, will be dealt with explicitly in the Consortium Agreement.

Highly developed tools for the global dissemination of information in accelerator sciences already exist. The International, European and US Accelerator Conferences, as well as topical workshops share a unique database of articles with a simple web interface (http://www.JACoW.org/). A number of academic journals, some web-based, accept contributions on accelerator science. Registered users can receive automatic notification of new publications. The EuCARD Dissemination network (WP2) will ensure that all significant results of the IA are published using these facilities and specific measures will be taken to increase the awareness, usefulness and impact of the IA results on a targeted public.

1. **EuCARD Web-site:** The site will inform internal and external users about EuCARD opportunities, trans-national accesses, meetings and forthcoming events such as workshops. The site will be easily accessible from the participants' web sites and will provide links to more detailed and specialized project information.
2. **Publication monitoring:** The DCO coordinator will monitor the quality and quantity of publications. He will inform WP and task coordinators in the event of complementary or possibly duplicated work to maximize synergies and efficiency within the Integrating Activities. He will report to the Coordinator and Governing Board.
3. **Efficient and targeted access to scientific published information**: The DCO network will maintain a relational database of EuCARD supported publications with easy Web access using free format contextual searches.
4. **Open Access Publications:** Open Access Publications will be encouraged for EuCARD publications. Each WP task will receive the full support of EuCARD, subject to approval from the Coordinator, to publish at least one refereed article in an academic journal participating in OAP. Under the OAP agreement, readers have free access to these publications.
5. **Fast dissemination of workshop information:** The impact of network workshops will be enhanced by an internal publications policy designed to ensure rapid distribution of proceedings. In the 2 weeks following the end of a workshop, the organisers and session chairpersons will publish a 10 page summary and the talk transparencies. Documents will be stored in a dedicated relational database with simple access via the web. Publication in traditional journals will be required for research reaching maturity.
6. **Information centre on trans-national accesses and other infrastructures:** This database will contain information about
    a. Infrastructures open to trans-national access, with their main characteristics, an inventory of state-of-the art equipment and access rules.
    b. Shared infrastructures not formally open as TA's. These would include facilities forming part of a JRA which could be opened to outside users on request at the discretion of the hosts.

   c. Infrastructures being upgraded within the framework of this IA. The planned completion date and characteristics of the facility would be shown.

7. **Regional small-scale prospective meetings** will be organised to inform potential industrial partners about new developments in accelerator technology and possible spin-offs. The aim is to anticipate the needs and exchange ideas on future trends.
8. **EuCARD Who's Who** will be available on the Web site as a list of IA work packages and tasks, together with the names and contact details of the scientists involved, and a short summary of their interests and expertise.

The DCO network will collect information about other European activities that could either benefit from EuCARD or have an impact on accelerator sciences (e.g. material sciences and superconductivity, plasma wave physics, synchrotron light sources, energy transport).

- **Intellectual Property Rights management**

The principles for dissemination, access and use of knowledge generated through the project (Foreground) will be in full compliance with the *Rules for participation in FP7 and for dissemination of research results*, adopted by the European Council and Parliament in December 2006. The participants will specify in an annex to the Consortium Agreement all background knowledge, to which they will give limited access. Unless stipulated otherwise, the access rights to foreground knowledge shall not include the right of sub-licensing to third parties. Access rights to Background or to Foreground needed by a participant for use for internal research purposes shall be granted on a royalty free basis. Access rights to third parties, whether for research or for commercial purposes, shall be granted upon written request, and with the agreement of all participants that own the Foreground.

4. ETHICAL ISSUES

The EuCARD project dos not involve any ethical issues that relate to:

- Informed consent
- Data protection issues
- Use of animals
- Human embryonic stem cells
- Dual use

ETHICAL ISSUES TABLE

	YES	PAGE
Informed Consent		
• Does the proposal involve children?	**no**	
• Does the proposal involve patients or persons not able to give consent?	**no**	
• Does the proposal involve adult healthy volunteers?	**no**	
• Does the proposal involve Human Genetic Material?	**no**	
• Does the proposal involve Human biological samples?	**no**	
• Does the proposal involve Human data collection?	**no**	
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?	**no**	
• Does the proposal involve Human Foetal Tissue / Cells?	**no**	
• Does the proposal involve Human Embryonic Stem Cells?	**no**	
Privacy		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)	**no**	
• Does the proposal involve tracking the location or observation of people?	**no**	
Research on Animals		
• Does the proposal involve research on animals?	**no**	
• 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	**no**	
• Use of local resources (genetic, animal, plant etc)	**-**	
• Benefit to local community (capacity building ie access to healthcare, education etc)	**-**	
Dual Use		
• Research having potential military / terrorist application	**no**	
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	**YES**	

5. CONSIDERATION OF GENDER ASPECTS

The observed gender unbalance in the EuCARD project reflects the gender unbalance in accelerator sciences as a whole, especially in the intermediate and senior positions. The participating laboratories and institutes are already engaged in gender equality and anti-discrimination actions and regulations, that will in addition be included in the Consortium Agreement. The Consortium will endeavour opening all opportunities independently of any other consideration than competence in an environment free of gender bias. In support of the European initiative, the EuCARD Consortium will encourage women's involvement at all levels in science, technology and management. The participants commit themselves to respect the European Charter for Researchers.

6. GLOSSARY

AMC	advanced mezzanine card
AMC/RTM	andvanced mezzanine card / rear transition module
ANKA	Ångström and Karlsruhe - a 2.5 GeV synchrotron radiation facility
ASIC	application specific integrated circuit
ATCA	advanced telecommunication computing architecture
b*	minimum value of the amplitude optical function at the focal point of the final quadrupoles in an accelerator lattice
BCP	buffered chemical polishing
BCS Theory	theory developed to explain the properties of Type 1 superconductors by John Bardeen, Leon Cooper, and Robert Schrieffer. Key elements of the theory are Cooper Pairs of electrons.
BENE	Beams for European Neutrino Experiments (CARE network)
BetaBeam	refers to the acceleration of radioactive ions in a decay ring where the decays in the long straight sections give rise to well-collimated neutrino beams
BPM	beam position monitor
BSCCO	HTS compound containing Bi, Sr, Ca, Cu, O, and typically including Pb for the best possible TC . Also known as Bi-2223 or (Bi,Pb)2Sr2Ca2Cu3O10,.
CARE	Coordinated Accelerator Research in Europe (ESGARD)
CERN	European Organisation for Nuclear Research
CHECHIA	RF cavity test stand
CHORUS	CERN Hybrid Oscillation Research apparatUS
CLIC	CERN Linear Collider
CNGS	CERN Neutrinos for Grand Sasso
Cooper pairs	Two electrons in a material that couple together as a result of interacting with the lattice. Main cause of superconductivity in BCS theory.
Cryogenics	A branch of physics and engineering that studies and produces very low temperatures (below –150 °C, –238 °F or 123 K) and the behavior of materials at those temperatures.
CTF3	CLIC Test Facility 3
CW	continuous wave
DAFNE	
DALINAC	Darmstadt Linac
Diamagnetism	The ability of a material to repel a magnetic field. Superconductors exhibit strong diamagnetism below TC. In a few rare compounds, a material may become superconductive at a higher temperature than the point at which diamagnetism appears. But, as a rule, the onset of strong diamagnetism is one of the most reliable ways to ascertain when a material has become superconductive.
DOE	(United States) Department of Energy
DSP	digital signal processing
ECFA	European Committee for Futire Accelerators
EDX	energy dispersive x-ray
EFE	enhanced field emission
ELBE	Electron Linac for beams with high Brilliance and low Emittance, FZD Rossendorf
ELFE	Electron Laboratory For Europe
EMMA	Experiment with MultiMuon Array
ERLP	energy recovery linac prototype

ESGARD	European Steering Group for Accelerator R&D
ETOILE	European Light Ion Oncological Treatment Centre
ETOILE	European Light Ion Oncological Treatment Centre
EURISOL	EURopean Ion Separation On-Line
EURONu	High Intensity Neutrino Oscillation Facility in Europe
FB	feedback
FEL	Free Electron Laser
FESM	field emission scanning microscope
FF	feedforward
FFAG	fixed field alternating gradient
FINUDA	Fisica Nucleare a DAFNE
FLASH	Free electron LASer in Hamburg
Flux lattice	Magnetic flux lines in a superconductor arrange themselves into a regular lattice.
Flux lines	Lines of magnetic flux inside a superconductor. Also known as vortices because the current spirals around them. These form a lattice structure, and flow through the material as the magnetic or electric field changes. The motion of flux lines dissipates energy and destroys the superconductor state. As the external magnetic field increases, the number of lines will increase, until the superconductor is full of them and the superconductor state is destroyed.
Flux pinning	Preventing the movement of flux lines within a superconductor. This prevents destruction of superconductivity, and can be achieved by defects in the superconductor structure.
FNAL	Fermi National Laboratory (USA)
FPGA	field programmable gate array
FRESCA	Facility for the REception of Superconducting CAbles (CERN)
GENEPI	Générateur de NEutrons Pulsé Intense
H	Henry. Magnetic field strength in units of Amps/meter. Related to B (magnetic flux density in teslas) via B =mH
HARP	Hadron Production Experiment at the Proton Synchrotron (CERN)
HFM	high field magnet
HGHG-FEL	High-Gain Harmonic-Generation FEL
HHH	High energy High intensity Hadron beams (a networking activity in the framework of CARE)
HoBiCaT	Horizontal Bi-Cavity Test facility (RF)
HOM	higher order mode
HPR	high pressure water rinse
HPRF	high power radio frequency
HRSEM/EDX	high resolution secondary electron microscope
HTS	High temperature superconductor – ceramic materials that superconduct with a Tc of 30 K or greater. Some examples are YBCO and BSCCO. Also known as HTS.
I_C	critical current - maximum current through a material that allows it to remain in the superconducting state.
ILC	International Linear Collider
IOT	Inductive Ouput Tube (RF)
ISIS	not an acronym - Pulsed Neutron & Muon Source at RAL
ITER	Formerly interpreted to stand for International Thermonuclear Experimental Reactor
J_C	critical current density

KLOE	
LAGUNA	Large Apparatus studying Grand Unification and Neutrino Astrophysics
LARP	U.S. LHC Accelerator Research Program
LHC	(CERN) Large Hadron Collider
LINAC4	(CERN) proton linac
LLRF	low level RF
MICE	Muon Ionisation Cooling Experiment - neutrino production
Nb_3Sn	A superconductor - a compound of Niobium and Tin
Nb-Ti	An alloy of Niobium and Titanium - a Type 2 superconductor
NC	normal conducting
NED	Next European Dipole
NEG	non-evaporable getter
NuFACT	refers to a series of workshops dedicated to Neutrino Factories and Superbeams
NuMI	Neutrinos at the Main Injector (Fermilab)
NUPEX	Nuclear Physics Experience (database)
NWDA	Northwest Development Agency
PETRA	Positron-Elektron-Tandem-Ring-Anlage, "positron-electron tandem-ring facility" at DESY
Piwinski angle	normalised crossing angle for colliding beams
PM	phase monitor
POLFEL	Polish Free Electron Laser
PS	(CERN) Proton Synchrotron
QE	quality factor vs. electric field
QWR	quater wave resonator
RF	radio frequency
RHIC	Relativistic Heavy Ion Collider (Brookhaven, USA)
RRR	Residual Resistivity Ratio (ratio of resistance at 293 K to the resistance at 10K)
SC	superconducting
SEM/AES	secondary electron microscope
SEY	secondary electron yield
SIS	Heavy Ion Synchrotron, GSI
SLHC-PP	Super LHC Preparatory Phase
SPARCX	Sorgente Pulsata Auto-amplificata di Radiazione Coerente - SASE-FEL based X-ray source
SPIRAL2	A facility to produce heavy exotic nuclei, rich in neutrons and protons
SPS	(CERN) Super Proton Synchrotron
Sputtering	A process whereby atoms in a solid target material are ejected into the gas phase due to bombardment of the material by energetic ions. It is commonly used for thin-film deposition and analytical techniques.
SRF	superconducting radio frequency (cavity)
STFC	Science and Technology Facilities Council

superconductor	An element, inter-metallic alloy, or compound that will conduct electricity without resistance below a certain temperature. Once set in motion, current will flow forever in a closed loop of superconducting material. This applies only to direct current (DC) electricity and to finite amounts of current. All known superconductors are solids. superconductor can be classified into Type 1 and Type 2, and can be categorized further by their dimensionality. Most are 3-D, but some compounds, like surface-doped NaWO3 and some organic superconductors are 2-D. Li2CuO2 and single-walled carbon nano-tubes have shown rare 1-D superconductivity. In addition to repelling magnetic fields, enhanced thermal conductivity, higher optical reflectivity and reduced surface friction are also properties of superconductors.
T2K	Tokai To Kamioka (next generation long baseline neutrino oscillation experiment, Japan)
T_C	Critical temperature - maximum temperature at which a material is superconducting. Also known as transition temperature
TESLA	TeV-Energy Superconducting Linear Accelerator
Tesla	Unit for magnetic flux density (B). Equal to one weber per square meter or one newton per ampere-meter.
Tevatron	Fermilab 1TeV superconducting proton synchrotron (Chicago, USA)
Thin film deposition	A method of fabricating ceramic superconductors to more precisely control the growth of the crystalline structure to eliminate grain boundaries and achieve a desired Tc. This can involve Pulsed-Laser Deposition (PLD) or Pulsed-Electron Deposition (PED) of the superconductor material onto a substrate. The substrate and possible buffer layers support the film and can increase the Jc of the HTS directly in contact with it. The part of the HTS nearest to the supporting layer carries high Jc. Further away from the support (less than a micron) Jc falls off very rapidly. A variation of this technique can be used to increase the Tc of a superconductor by growing it on a supporting material with a smaller interatomic spacing. The supporting material acts as a molecular "girdle" to compress the atomic lattice of the superconductor, thereby raising its transition temperature. Superconductive tape/wire is made using thin film deposition technology.
Ti-Zr-V	a ternary alloy of titanium, zirconium and vanadium (getter)
TTC	TESLA Technology Collaboration
Type 1 superconductor	The Type 1 category of superconductors is mainly comprised of metals and metalloids that show some conductivity at room temperature. They require incredible cold to slow down molecular vibrations sufficiently to facilitate unimpeded electron flow in accordance with what is known as BCS theory.
Type 2 superconductor	Also known as the "hard" superconductors. They have higher TC than Type 1 and their transition from a normal to a superconducting state is gradual across a region of "mixed state" behavior. This allows some penetration of external magnetic fields. All metallic compounds or alloys (except for vanadium, technetium and niobium), including the perovskites, BSCCO
UHV	Ultra High Vacuum
uTCA	micro telecommunication computing architecture
VUV	vacuum ultraviolet (FEL)
W7-X	Wendelstein 7-X (Stellerator)
WASA	Wide Angle Shower Apparatus (Svedberg Lab)
XFEL	X-ray Free Electron Laser
YBCO	YBa2Cu3O7-d (also Y-123, YBCO-123, YBa2Cu3O7) A high temp superconductor material developed in 1991 by Fujikara.