



Grant Agreement No: 227579

EuCARD

European Coordination for Accelerator Research and Development
Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures,
Combination of Collaborative Project and Coordination and Support Action

PROJECT INTERIM REPORT

WORK PACKAGE ACTIVITY REPORT FOR SEMESTER 4

Document identifier:	EuCARD-S4-WP4
Period:	From Month 19 (Oct. 2010) to Month 24 (March 2011)
Work Package:	WP4 "AccNet"
Work Package leader:	Frank Zimmermann, CERN; Peter Spiller, GSI; Walter Scandale, CNRS
Contributing authors:	Ralph Assmann, CERN; Jean-Marie De Conto, UJF; Mariusz Grecki, DESY; Jens Osterhoff, DESY; Ezio Todesco, CERN; Henri Videau, CNRS; Wolfgang Weingarten, CERN
Document status:	Draft

1. EXECUTIVE SUMMARY

The **accelerator science networks** (WP4-AccNet) have further grown and expanded. In the fourth semester AccNet-EuroLumi has initiated and organized four successful & high-impact workshops: the first ever workshop on a Higher-Energy LHC (HE-LHC) charted a promising path for the future of high-energy physics; a workshop on crystal collimation further pushed this technology for hadron storage rings; the fourth workshop on LHC crab cavities established a baseline scheme for LHC crab cavities (400 MHz, compact, local) and a time schedule of crab cavity R&D for the High-Luminosity LHC, as well as provided guidelines for partners in Europe and around the world; finally, a bilateral GSI-CERN workshop on electron-cloud effects discussed modelling efforts and observations at the LHC and for FAIR. The second EuCARD-RFTech annual workshop, held at PSI, brought together about twice as many experts as the first RFTech meeting and prepared a strategy for SRF test facilities in Europe. In the 4th semester, AccNet strengthened several important collaborations, including the joint R&D of CERN and GSI, and scientific exchanges with scientists and students from other institutes and universities, notably KEK (Japan), FNAL (USA), CINVESTAV (Mexico), INFN (Italy), CELLS/ALBA (Spain) and SLAC (USA). New financial support from CINVESTAV Mexico, inspired by an initial EuCARD investment, will be used to support three visitors for continuing AccNet activities, such as electron-cloud studies and LHC crab-cavity failure modes. At the end of 2010, a new network, AccNet-EuroNNAc, has been launched to identify possible usage of advanced accelerator techniques, such as plasma acceleration, in large-scale conventional facilities, and to develop a roadmap towards an advanced accelerator facility for big science.

2. PROJECT OBJECTIVES FOR THE PERIOD

The main goals of the **accelerator science networks** (WP4) were first to maintain and update their web sites as central communications tools ([D4.1.1](#), [D4.2.1](#), [D4.3.1](#)), second to deliver a strategy/result for SRF test infrastructures in Europe ([D4.2.3](#)) (AccNet-RFTech), and third the activities themselves: for WP4 AccNet, the goal is to bring together the accelerator scientists of Europe and the rest of the world to contribute to upgrades of hadron accelerators and colliders (AccNet-EuroLumi), to the development of RF technologies (AccNet-RFTech), and, since recently, to the harnessing of advanced accelerator concepts for large facilities (the new network AccNet-EuroNNAc). These activities are performed by organizing topical workshops, exchanging experts etc. All scientific networks foresaw reviews of their activities after one year ([M4.1.2](#), [M4.2.2](#), [M4.3.2](#)).

3. PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

WP4: Accelerator Science Networks (AccNet)

AccNet is the project platform for exchange, investigations and assessment of accelerator upgrades, technologies and new infrastructures. After adding an activity on novel acceleration schemes it now includes four tasks:

- Task WP4.1: Coordination and communication
- Task WP4.2: EuroLumi network (accelerator performance)
- Task WP4.3: RFTech network (RF technologies)
- Task WP4.4: EuroNNAc (advanced accelerator techniques)

3.1 Task WP4.1: Coordination and communication

Throughout the programme, this task represents AccNet in EuCARD and to the outside. It also communicates achievements.

Progress towards objectives

At the 6th meeting of the EuCARD Steering Committee on 12-13 October 2010 the status and plans of AccNet were reported. AccNet also participated in the 7th EuCARD Steering Committee Meeting on 17 January 2011.

In the 4th semester AccNet launched the new network EuroNNAc on usage of plasma wake field acceleration. The scientific scope plus candidate participants for a possible fourth network, on medical accelerators have been explored.

Presentations featuring and disseminating results of AccNet studies were given at various occasions during this period, e.g. at the German KET strategy workshop in Dortmund, at the Chamonix LHC Performance workshop, and at the RFTech workshop.

Several articles describing AccNet activities were published in the EuCARD newsletter, e.g. on the Higher-Energy LHC (March 2011), on the new network for novel acceleration techniques (December 2010), and on the use of crystal for beam collimation (December 2010).

Several future AccNet mini-workshops and AccNet co-sponsored conferences have been prepared, e.g. on low-level RF for XFEL, on mixed design of integrated circuits and systems, and on optics measurement, correction and modelling for high-performance storage rings.

Early in 2011, all AccNet web sites were transferred from LAL to a CERN server for easier access and maintenance. The AccNet web site was continually updated and expanded. Budget and manpower plans were also updated and adjusted.

Contractual milestones and deliverables

D4.1.1 – The AccNet web site was transferred to a CERN server and continually updated. It features the main objectives, the network structure, activity reports, a path to the WP4 Collaboration Workspace, workshops, literature and presentations, and links, as well as access to the web sites of the three tasks EuroLumi, RFTech, and EuroNNAc (new) and “Hot News”.

M4.1.2 – The third general AccNet Steering meeting will be organized in May 2011 (at CNRS/France).

Planning, deviations and corrective actions

Task on schedule	√	Ahead of schedule		Minor delay		Significant delay	
------------------	---	-------------------	--	-------------	--	-------------------	--

Estimate of use of resources

<i>Partner</i>	<i>Personnel</i>					<i>Material</i>				
	++	+	=	-	--	++	+	=	-	--
CERN			*					*		
CNRS			*					*		

3.2 Task WP4.2: EUROLUMI

Progress towards objectives

The EuCARD-AccNet-EuroLumi Workshop on a Higher-Energy Large Hadron Collider, ‘HE-LHC10,’ held on Malta, 14-16 October 2010, was the first ever workshop discussing the possibility of building a 33 TeV centre-of-mass energy proton–proton accelerator in the LHC tunnel. The key element of such a machine will be 20-T magnets. The workshop featured many discussions about Nb3Sn and high-temperature superconductor (HTS) accelerator-magnet development in Europe, the US, and Japan. It also discussed possible parameter sets, issues related to beam dynamics and synchrotron radiation handling, and the need for new injectors, possibly with 1 TeV energy. HE-LHC10 was attended by 56 participants from Europe, the Americas, and Japan, including 26 from CERN and 13 from the United States of America (primarily US-LARP partners).

The AccNet-EuCARD mini-workshop on crystal collimation, organized at CERN from 25 to 27 October 2010, focused on collimation procedures assisted by bent crystals and suitable for collimation during the high-luminosity phase of LHC and for new large colliders. The workshop featured a critical review of the results obtained in the H8 line, discussed the results of collimation experiments in “low energy” storage rings, such as the SPS, and the possible use of bent crystals in the LHC collimation system, and surveyed other applications of crystals and alternative advanced methods of collimation in other laboratories. The workshop had 32 participants, about a third of whom from CERN, and others from Italy (INFN Ferrara, Legnaro, Napoli, Roma), Russia (JINR Dubna, IHEP Moscow, St. Petersburg), Germany (GSI Darmstadt), UK (Imperial College), USA (SLAC), and Switzerland (EPFL Lausanne).

The EuCARD-AccNet 4th workshop on crab cavities (LHC-CC10) for the LHC luminosity upgrade project (HL-LHC) was held from 15 to 17 December 2010 at CERN. This workshop was jointly organized by EuCARD, CERN, KEK and US-LARP. Approximately 50 participants from 3 continents participated in the workshop to discuss the future implementation of the crab cavities in the LHC and related issues. At LHC-CC10, local crab crossing with the aid of 400 MHz deflecting SRF cavities was identified as the baseline scheme for geometric luminosity-loss compensation and luminosity leveling at the HL-LHC. For associated key issues such as machine protection and robust operational scenarios, more detailed studies were requested in order to identify and mitigate potential beam-dynamics or technology limits on implementing and fully exploiting crab crossing at the LHC. LHC-CC10 also recommended that all measures to test future LHC prototype cavities with and without beam outside the LHC be taken in order to ensure robust operation of the crab RF structures in the LHC. A refined roadmap will be completed by summer 2011.

A bilateral EuCARD AccNet CERN-GSI electron-cloud workshop was organized with the main goal to review the status of CERN and GSI electron-cloud studies in order to find

synergies between the two laboratories and to define a common strategy for future developments in terms of simulation tools, diagnostics and mitigation techniques for the LHC, SPS and FAIR. The workshop took place on 7–8 March 2011 at CERN, and welcomed 30 registered participants coming from CERN, GSI, INFN-LNF, KEK, CELLS, CINEVESTAV, and several other institutes.

During the 4th semester, AccNet-EuroLumi supported or organized a number of exchanges of scientists and joint studies. The Mexican doctoral student H. Maury (CINEVESTAV/Merida) has been performing electron-cloud simulations for the LHC arcs considering various LHC beam-commissioning parameters as well as upgrade scenarios. The US-LARP physicist C. Bhat (FNAL) has continued to study the generation & stability of long flat bunches for the LHC, participated in pertinent machine studies, and developed a realistic parameter set for an LHC upgrade with “Large Piwinski Angle”. US-LARP physicist R. Calaga (BNL) co-organized the LHC-CC010 workshop and helped organizing the international collaboration on LHC crab cavities. The Italian expert S. Dabagov (INFN-LNF) contributed to the activity on crystal collimation. K. Ohmi (KEK) performed beam-beam and electron-cloud simulation studies for various LHC upgrade scenarios, including HE-LHC and HL-LHC with crab cavities. The Spanish expert U. Irizo (CELLS/ALBA) visited CERN two times in this period and contributed to electron-cloud simulation studies aimed at determining the LHC vacuum-chamber surface properties. The GSI expert G. Franchetti investigated advanced incoherent resonance-crossing phenomena and the electron-cloud pinch in quadrupole magnets. The Italian surface scientist R. Cimino (INFN-LNF) presented ideas on electron-cloud mitigation, e.g. using in-situ fullerene coatings.

The third annual EuroLumi steering meeting will be held in May 2011. A mini-workshop on optics measurements, corrections and modelling for high-performance storage rings has been prepared for June 2011.

Contractual milestones and deliverables

D4.2.1 - The EuroLumi web site was transferred to a CERN server and continually updated.

M4.2.2: Instead of a single Annual EuroLumi workshop, during this period four EuroLumi topical workshops were organized: CERN-GSI Electron-Cloud Workshop (CERN, 7-8 March 2011), LHC-CC10 - the 4th LHC Crab Cavity Workshop, CERN (15-17 December 2010), Workshop on Crystal Collimation, CERN (25-26 October 2010), HE-LHC'10 Mini-Workshop on High-Energy LHC, Malta (14-16 October 2010). The topical workshops have proven a highly efficient vehicle for making progress and creating momentum. The first and largest of these was the workshop on a higher-energy LHC, with 56 participants. All AccNet workshops and links can be found at <http://accnet.web.cern.ch/accnet/Workshops/index.php>.

Planning, deviations and corrective actions

Task on schedule		Ahead of schedule	√	Minor delay		Significant delay	
------------------	--	-------------------	---	-------------	--	-------------------	--

Estimate of use of resources

Partner	Personnel					Material				
	++	+	=	-	--	++	+	=	-	--
CERN			*					*		

3.3 Task WP4.3: RFTECH

Progress towards objectives

A highlight of this 4th semester was the second RFTech workshop, held at Paul Scherrer Institute (Switzerland), on 2-3 December 2010, with 30 participants (as expected). This workshop has been a good opportunity to share experience among several fields of RF technology, from low-level systems to solid-state power amplifiers. More specifically, the workshop covered the following topics: 1) Low Level RF: CERN's PS complex LLRF renovation, proposal for the SuperB project, status of the FLASH system, as well as the use of specific components like uTCA for XFEL machines, with presentations by specialists from CERN, CNRS and DESY. 2) Solid State Amplifiers, including both general presentations and particular techniques for this technology (with presentations from GANIL and CERN), as well as some specific developments, like at PSI, ESRF and SOLEIL (presentations by PSI and SOLEIL specialists). 3) RF technology for FELs, comprising normal- and superconducting RF aspects (X Band structures, the Swiss FEL project, cryomodule technology) with presentations by specialists from CEA and PSI, and a summary of the XFEL RF synchronization workshop (presentation from Warsaw University). 4) RF limitations related to the LHC ultimate beam with two presentations by CERN experts. 5) Cavity optimization, such as crab-cavity design for the LHC and high-order-mode free copper cavities (with talks given by BNL, CERN, Lancaster University and ESRF). 6) Superconducting RF, e.g. cryomodule assembly in Saclay, SRF infrastructures in Saclay/Orsay, SBT in Grenoble, with an analysis and a round-table discussion on the need of a European SRF test infrastructure for R&D and test of cavities & cryomodules. Part of the 2nd RFTech workshop has been used to present the work of young scientists, in order to exchange information, ideas and advices about cavity RF design or theoretical modelling.

Several RFTech experts attended the workshop on X-Band RF technology, XB-10, on X-band RF structures, beam dynamics and sources, at the Cockcroft Institute (UK), 30.11-3.12.2010.

The plan for the next two semesters includes an AccNet-RFTech co-sponsored workshop on Advanced Techniques in LLRF Control for XFEL at the Polish Academy of Sciences, 18-20 April 2011; the third annual RFTech workshop; the third annual RFTech steering meeting in May 2011; the AccNet(-RFTech) co-sponsored MIXDES2011 conference, Gliwice, June 2011; the possible co-organization of a "long bunch-trains" workshop at DESY in June 2011; and an AccNet-RFTech co-sponsored workshop on LLRF at DESY in October 2011.

Contractual milestones and deliverables

D.4.3.1 – The RFTech web site was transferred to a CERN server and continually updated.

D4.3.2 – Strategy/result for SRF test infrastructures: a final strategy report is in preparation, at the moment comprising 30 pages. Final checks with other institutes are planned during the EuCARD Annual Meeting 10-13 May 2011.

M.4.3.2: The second annual RFTech workshop was organized in December 2010 at PSI-Villigen (Switzerland)

Planning, deviations and corrective actions

Task on schedule	√	Ahead of schedule		Minor delay		Significant delay	
------------------	---	-------------------	--	-------------	--	-------------------	--

Estimate of use of resources

Partner	Personnel					Material				
	++	+	=	-	--	++	+	=	-	--
CERN			*					*		
DESY			*						*	
UJF			*					*		

3.4 Task WP4.4: EuroNNAc

EuroNNAc – a European Network for Novel Accelerators looking at the Next Generation of Novel Electron Accelerators – has been launched in December 2010.

Progress towards objectives

The first major EuroNNAc workshop is planned for 3-6 May at CERN. This workshop should firmly establish this new network and define the path towards novel accelerator facilities in Europe. About 100 expert participants from around the world are expected.

A preparatory meeting of the EuroNNAc organisation committee has been held on 8 April 2011 at the Ecole Polytechnique in Paris.

A letter of intent (LOI) for a demonstration experiment on proton driven plasma wakefield acceleration (PDPWA) using a proton beam from the CERN SPS has been drafted and is being finalized. This LOI is to be submitted to the CERN SPSC Committee later in 2011. The German experts A. Caldwell and G. Xia (MPI Munich) helped to organize and coordinate the PDPWA effort. A pertinent PDPWA workshop was organized at the University College London, 10-11 February 2011.

Contractual milestones and deliverables

None

4. PUBLICATIONS

WP 4.1: (published before this semester: 12)
F. Zimmermann, <i>EuCARD WP4 Accelerator Networks</i> , Report at 5th EuCARD Steering Committee Meeting Malta, 11 October 2010
F. Zimmermann, <i>Outlook for PWA Experiments</i> , KET Strategy Workshop, Dortmund, 25-26 October 2010
K. Pozniak <i>Modeling of Synchronous Data Streams Processing in the RPC Muon Trigger System of the CMS Experiment</i> , Intl Journal of Electronics and Telecommunications, 2010, VOL. 56, NO. 4, PP. 489–502,

EuCARD-PUB-2010-019 (2010)
K. Kahle, W. Scandale, <i>Crystal clear ideas for beam collimation</i> , EuCARD Newsletter no 7 (December 2010)
K. Kahle, R. Assmann, <i>A knack for novel acceleration techniques</i> , EuCARD Newsletter no 7 (December 2010)
N. Wyles, F. Zimmermann, E. Todesco, <i>Proposed increase in energy takes LHC even further into the future</i> , EuCARD Newsletter no 8 (March 2011)
WP 4.2: (published before this semester: 23)
E. Todesco and F. Zimmermann (eds), <i>The Higher-Energy Large Hadron Collider</i> , Proceedings of the EuCARD-AccNet HE-LHC workshop, Malta, 14-16 October 2010, CERN, EuCARD-CON-2011-001
R. Calaga, <i>Crab Status and Plans</i> , US-LARP CM15 Collaboration Meeting, SLAC, 1-3 November 2010
R. Calaga (BNL), S. Myers (CERN), F. Zimmermann (CERN), <i>Summary of the 4th LHC Crab Cavity Workshop "LHC-CC10"</i> , EuCARD-REP-2011-001 (2011)
F. Zimmermann, <i>HL-LHC: parameter space, constraints and possible options</i> , Proc. Chamonix 2011 workshop on LHC performance, CERN-ATS-2011-005 (2011)
U. Iriso (CELLS/ALBA), <i>Electron Clouds Thresholds with 75 ns Bunch Spacing</i> , 11 February 2011
R. Calaga et al, <i>Beam Losses due to Abrupt Crab Cavity Failures in the LHC</i> , PAC2011 New York (2011)
G. Rumolo, F. Zimmermann, and O. Boine-Frankenheim, <i>Summary of EuCARD-AccNet CERN-GSI Workshop on Electron Cloud</i> , CERN, Geneva, 7-8 March 2011
WP 4.3: (published before this semester: 17)
F. Zimmermann, <i>LHeC Linac-Ring Option</i> , 2nd RFTech Workshop, PSI, 2-3 December 2010
WP 4.4: (published before this semester: 0)
G.X. Xia et al, <i>Update on Proton Driven Plasma Wakefield Acceleration</i> , Proc. AAC'10, 13-19 June 2010, Annapolis, MD (2011)
G.X. Xia et al, <i>A Proposed Experimental Test of Proton-Driven Plasma Wakefield Acceleration Based on CERN SPS</i> , PAC2011 New York (2011)