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# 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 INTERIM ACTIVITY REPORT FOR SEMESTER 2

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### 1. PUBLISHABLE SUMMARY

During the second semester, AccNet has made excellent progress in connecting the European and worldwide accelerator communities, fulfilling its role as catalyser between various institutes and entities, with a special emphasis on accelerator performance and RF technologies. AccNet highlights during the reporting period included several invited talks at the PAC 2009, EPS HEP2009 & LLRF09 conferences, and a series of topical mini-workshops, on LHC crab cavities, "LHC-CC09," in September 2009, on anti-e-cloud coatings, "AEC'09," in October '09, on crystal collimation, in November 2009, and on proton-driven plasma acceleration, in December 2009. All AccNet mini-workshops were well attended by experts from many European laboratories, universities, industry, US laboratories, Japan, and international organizations. AccNet also co-sponsored the workshop "Physics for Health in Europe", in February 2010. A first annual workshop of RFTech was organized in March 2010. Two AccNet General Steering Meetings took place in November 2009 and April 2010. The AccNet web site at LAL and the AccNet mailing lists were continually updated. The lists of contact persons from all participating institutes for both networks have grown steadily. Man power and budget plans were finalized and updated. Importantly, with additional funding from CERN, and in response to community requests, the scope of AccNet was expanded to include plasma acceleration and medical accelerators. AccNet dissemination & outreach activities comprised two articles in the 2nd EuCARD Newsletter, one article in the CERN Courier of February 2010, two seminar talks at DESY and at the University of Heidelberg, contributions to the CERN Academic Training lecture series on LHC upgrade, presentations at the ATLAS upgrade week and to LHCC, presentations at the Chamonix'2010 LHC Performance Workshop, to the LHC Upgrade Task Force, and to various collaboration meetings. About 20 EuCARD AccNet documents testify to the success of the network. These include 2 journal articles, 6 conference papers, 1 PhD thesis, and 1 master thesis. In summary, AccNet has made an impact on the most relevant topics, in particular it has initiated a crab-cavity program for the LHC, promoted novel anti e-cloud coating techniques, and helped revising the LHC upgrade strategy. AccNet has also operated highly cost efficiently. During the semester, the exchange of 13 expert visitors was supported. In conclusion, AccNet had a supreme start; all its success indicators are positive; EuroLumi is giving significant input to the LHC upgrade; RFTech is approaching its "cruising speed;" and AccNet is breaking new grounds on medical accelerators, plasma acceleration, and crystal collimation.

## 2. WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

### 2.1. WP4: ACCELATOR NETWORKS (ACCNET)

#### 2.1.1. Task WP4.1: Coordination and communication

##### **Objectives**

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

##### **Progress**

At the 3<sup>rd</sup> meeting of the EuCARD Steering Committee on 4 November in Frascati. the status and plans of AccNet were reported.

A general AccNet Steering meeting was organized at the same time.

A description of AccNet, news from two AccNet workshops, and progress on AccNet activities were reported in two articles for the EuCARD Newsletter and in an article of the CERN Courier.

Presentations featuring results of AccNet studies were given at various occasions during this period, e.g. at the Heidelberg Graduate Days, to several LHC experiments, and to various scientific bodies and committees (e.g. LHCC, LHC Upgrade Task Force, ATLAS experiment).

The AccNet web site was continually updated and expanded. Budget and manpower plans were also updated and finalized. Lists of EuroLumi and RFTech contact persons at participating institutes were completed. Pertinent mailing lists were maintained.

In February 2010 some AccNet coordinators participated in the “Physics for Health in Europe” workshop in preparation for a new AccNet network on medical accelerators. Late in 2009, some discussions on the requests for future medical accelerator had already taken place with U. Amaldi of the TERA Foundation.

##### **Contractual milestones and deliverables**

There were no official deliverables for this reporting period. The AccNet web site (D 4.1.1.) created in the first semester was continually updated. A general AccNet Steering meeting was organized in November 2009.

##### **Planning, deviations and corrective actions**

Task on schedule	√	Ahead of schedule		Minor delay		Significant delay	
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##### **Estimate of use of resources**

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

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CNRS			*					*		
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### **Plans for next semester**

- Representation of AccNet at the EuCARD Annual Meeting with status report and highlight talks in April 2010
- General AccNet Steering Meeting in April 2010
- Dissemination of AccNet results, e.g. in the EuCARD Newsletter and general presentations or seminars
- Representation of AccNet, including report on status & plans, at EuCARD Steering Meetings

### **2.1.2. Task WP4.2: EUROLUMI**

#### **Objectives**

The objective of EuroLumi is bringing together experts in beam dynamics, magnets, collimation, RF, and accelerator applications to improve the performance of existing accelerators and prepare upgrades of these as well as new facilities. In particular, EuroLumi is preparing the upgrade of the Large Hadron Collider (LHC), the FAIR complex at GSI, and the rejuvenation of the CERN injector complex. Interim EuroLumi has encouraged and supported new initiatives on proton driven plasma acceleration and on medical accelerators, giving birth to two new networks in AccNet.

#### **Progress**

A number of successful high-impact mini-workshops were organized. The LHC Crab Cavity Workshop, LHC-CC09, was jointly organized by CERN, EuCARD-ACCNET-EuroLumi, EuCARD-AccNet-RFTech, US-LARP, KEK, & Daresbury Lab/Cockcroft Institute, at CERN, 16-18 September 2009. More than 50 participants attended this event, during which a permanent LHC Crab Cavity Advisory Board was established. This workshop resulted in an official statement on LHC crab cavities, it gave a tremendous boost to crab cavity development for the LHC and it triggered several follow-up activities, such as the creation of a CERN working group for a crab-cavity test in the SPS. Close to ten cavity designs were presented, both of a conventional elliptical “global” and of an advanced, exotic compact “local” type. In October 2009, EuroLumi and the SPS Upgrade Study Team jointly organized a mini-workshop on Anti Electron-Cloud Coatings (AEC’09), with 41 participants, where various novel coatings (e.g. DLC, insulating microparticles) were presented. Collaboration with other communities such as institutes working with the European Space Agency was enhanced. From 19 to 20 November 2009, AccNet-EuroLumi held a mini-workshop on crystal collimation, with about 20 participants, covering crystal experiments in the SPS and Tevatron, test and test beams, and the future of the “UA9” experiments. A first AccNet mini-workshop on proton-driven plasma acceleration took place 17-18 December, with 24 leading experts from around the world as participants.

AccNet-EuroLumi supported or organized a number of exchanges of scientists and joint studies. The Mexican master student H. Maury (CINVESTAV) performed electron-cloud

simulations for various LHC upgrade scenarios. The US-LARP physicist C. Bhat (FNAL) studied the generation & stability of long flat bunches for LHC. US-LARP physicist R. Calaga (BNL) pushed forward the LHC crab cavities and co-organized the LHC-CC09 workshop on LHC crab cavities Austrian physicist D. Seebacher (TU Graz & U. Vienna) contributed his expert knowledge on the impedance of anti-e-cloud coatings. US expert G. Hoffstaetter (Cornell), and RFTech's M. Grecki participated in the LHC-CC09 workshop. The German experts A. Caldwell and G. Xia (MPI Munich) spearheaded the proton-driven plasma acceleration and helped to organize the pertinent AccNet mini-workshop. The Russian and European experts A. Taratin (JINR Dubna), and S. Dabagov (INFN-LNF) contributed to the activity on crystal collimation.

The AccNet-EuroLumi web site was continually updated and expanded.

### **Contractual milestones and deliverables**

There were no official deliverables for this reporting period. The EuroLumi web site (D 4.2.1.) created in the first semester was continually updated. Instead of a single Annual EuroLumi workshop, 4 EuroLumi topical mini-workshops were organized. This was partly motivated by the need to minimize interference with LHC commissioning. The mini-workshops proved a highly efficient vehicle for making progress.

### **Planning, deviations and corrective actions**

Task on schedule	√	Ahead of schedule		Minor delay		Significant delay	
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### **Estimate of use of resources**

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

### **Plans for next two semesters**

- Topical workshop on LHC energy upgrade, addressing magnets for arcs and insertions, cryogenics, and vacuum pipe
- Annual EuroLumi workshop “EuroLumi 2010”, in November or December 2010, covering items like LHC limitations, LHC luminosity upgrade, LHC energy upgrade, SPS upgrade, PS Booster upgrade, FAIR challenges
- Mini workshop on LHC crab cavities, end of 2010
- AccNet(-EuroLumi) co-sponsored workshop on plasma acceleration
- Crystal collimation mini-workshop
- Brainstorming meetings and mini-workshop on medical accelerators
- Visits by C. Bhat (FNAL, LARP) and H. Maury (CINVESTAV) to work on topics related to the LHC luminosity upgrade

### 2.1.3. Task WP4.3: RFTECH

The objective of RFTech is bringing together RF experts from different laboratories, proton & electron accelerators, ILC, CLIC, FAIR, etc. to exchange ideas and promote innovation on all aspects of RF technology, e.g. klystron development, RF power distribution system, cavity design, and low-level RF system, for linear accelerators, storage rings, and associated research infrastructures, including transversely deflecting (crab) cavities and financial aspects such as costing tools.

#### **Progress**

RFTech co-organized the LHC Crab Cavity Workshop, LHC-CC09, 16-18 September 2009, together with EuroLumi. Contributing to SLHC upgrade studies for a Superconducting Proton Linac RFTech established contacts to European and worldwide experts on SRF, created an international working group on SRF cavities and accessories (members: CERN, CNRS-IPN-Orsay, CEA-Saclay (France), BNL (USA), TRIUMF (Canada), and the Universities of Rostock, Darmstadt (Germany), and Royal Holloway London (UK)), which participated in several SPL collaboration meetings.

On 29 March 2010 RFTech organized the first Annual RFTech Meeting at DESY. The 17 participants came from DESY, CERN, TUD, UROS, ASTeC, LPSC, UJF, ESS, Royal Holloway U London, TUL, UG, and SINS. This event was organized by the RFTech coordinators M. Grecki, J.-M. De Conto, and W. Weingarten with the help of a DESY support team. Topics addressed included Spiral-2 couplers, proton driver simulations & measurements, FLASH full beam loading, LHC LLRF, xTCA, high reliability digital system, HIE ISOLDE cavity & test cryostat, TUD SRF test stand, LHC crab cavities, RF costing tools, SRF test & R&D infrastructure.

RFTech supported the attendance of the LHC-CC09 workshop by M. Grecki, that of the EuCARD SRF Annual Meeting by E. Ciapala and W. Weingarten, the participation by 4 specialists from DESY and WUT (C. Czuba, M. Grecki, W. Koprek, et al) at the LLRF09 workshop, as well as the Annual RFTech Meeting.

The AccNet-RFTech web site was continually updated and expanded.

#### **Contractual milestones and deliverables**

There were no official deliverables for this reporting period. The RFTech web site (D 4.3.1.) created in the first semester was continually updated. The Annual RFTech workshop was organized in March 2010.

#### **Planning, deviations and corrective actions**

Task on schedule	√	Ahead of schedule		Minor delay		Significant delay	
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#### **Estimate of use of resources**

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



UJF			*				*			
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### Plans for next two semesters

- RFTech Annual Meeting at PSI, end of 2010
- AccNet(-RFTech) co-sponsored MIXDES conference, Wroclaw, June 2010

## 3. ANNEXES

### 3.1. EVENTS

AccNet events held during this semester are listed on the AccNet web site <http://accnet.lal.in2p3.fr/Tasks/Workshops/index.php>.

### 3.2. PUBLICATIONS AND DOCUMENTS

<b>WP 4.1:</b> (written before this semester: 2)
A. Caldwell, <i>Proton Driven Plasma Wakefield Acceleration</i> , AccNet Highlight Talk at First Annual EuCARD Meeting, RAL, UK, 14 April 2010
R. Calaga, <i>LHC Crab Cavities</i> , AccNet Highlight Talk at First Annual EuCARD Meeting, RAL, UK, 14 April 2010
F. Zimmermann, <i>Report from EuCARD WP4 - Accelerator Networks</i> , First Annual EuCARD Meeting, RAL, UK, 14 April 2010
F. Zimmermann, <i>AccNet</i> , First Annual AccNet Meeting, RAL, UK, 13 April 2010
R. Assmann, A. Caldwell, C. Sutton, G. Xiao, F. Zimmermann, <i>Workshop pushes proton-driven plasma wakefield acceleration</i> , CERN Courier (24 February 2010)
F. Zimmermann, A. Variola, W. Scandale, <i>EuCARD WP4 Accelerator Networks</i> , Report at 3rd EuCARD Steering Committee Meeting Frascati, 4 November 2009
R. Assmann, A. Caldwell, K. Kahle, K. Lotov, A. Pukhov, G. Xiao, F. Zimmermann, <i>Breaking news for Proton "Surfatrons"</i> , EuCARD Newsletter no 2 (September 2009)
K. Kahle, F. Zimmermann, <i>Start by probing the crab cavities</i> , EuCARD Newsletter no 2 (September 2009)
<b>WP 4.2:</b> (written before this semester: 9)
F. Zimmermann, <i>Machine Plans for Upgrades - "SLHC"-type Luminosities - Issues and Solutions</i> , CMS Upgrade Week, CERN, 29 April 2010
F. Zimmermann, <i>Ingredients (necessary ones and desirable one) of a phase II upgrade</i> , LHC Upgrade Task Force, 26 February 2010
F. Zimmermann, <i>Phase-2 Scenarios</i> , LHCC Upgrade Review, 16 February 2010
F. Zimmermann, <i>Parameter space beyond <math>10^{34}</math></i> , LHC Performance Workshop, Chamonix, 25-29 January 2010
F. Zimmermann, <i>Update on LHC Upgrade Plans</i> , ATLAS Upgrade Week, CERN, Tuesday 10 November 2009
Y.-P. Sun (孙一鹏), R. Assmann, R. Tomás, and F. Zimmermann, <i>Crab dispersion and its impact on the CERN Large Hadron Collider collimation</i> , Phys. Rev. ST Accel. Beams 13, 031001 (2010)
Y.-P. Sun, B. Auchmann, S. Fartoukh, M. Giovannozzi, S. Russenschuck, R. Tomás, F. Zimmermann, <i>Impact of CMS Stray Field on the Large Hadron Collider Beam Dynamics and Thin Solenoid in SixTrack</i> , LHC-Project-Note-426; CERN-LHC-Project-Note-426 (2009)

Yi-Peng Sun (孙一鹏), Ralph Assmann, Javier Barranco, Rogelio Tomás, Thomas Weiler, Frank Zimmermann, Rama Calaga, Akio Morita (森田 昭夫), *Beam dynamics aspects of crab cavities in the CERN Large Hadron Collider*, Phys. Rev. ST Accel. Beams 12, 101002 (2009)

G. Sterbini, *An Early Separation Scheme for the LHC Luminosity Upgrade*, Lausanne : EPFL, 2009, CERN-THESIS-2009-136 Thèse N. 4574, 27 November 2009

F. Zimmermann, *LHC Accelerator*, Heidelberg Graduate Days, Heidelberg 5 October 2009

**WP 4.3:** (published before this semester: 0)

K. Czuba, Timing and Synchronization (Tutorial/Overview), LLRF09, Tsukuba, 19-22 October 2009

M. Grecki, *Piezo Control for LFD Compensation*, LLRF09, Tsukuba, 19-22 October 2009

W. Koprek, *ACTA-based LLRF System for XFEL - Demonstration at FLASH*, LLRF09, Tsukuba, 19-22 October