EuCARD WP4 Accelerator Networks

Zimmermann, F (CERN) et al

28 October 2010

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This work is part of EuCARD Work Package 4: **AccNet: Accelerator Science Networks.**

The electronic version of this EuCARD Publication is available via the EuCARD web site [http://cern.ch/eucard](http://cern.ch/eucard) or on the CERN Document Server at the following URL: [http://cdsweb.cern.ch/record/1302996](http://cdsweb.cern.ch/record/1302996)
EuCARD WP4 - Accelerator Networks

coordinated by
Ralph Assmann, Jean-Marie De Conto, Mariusz Grecki, Jens Osterhoff, Walter Scandale, Peter Spiller, Ezio Todesco, Wolfgang Weingarten, and Frank Zimmermann

6th EuCARD Steering Committee Meeting
Malta, 12 October 2010
outline

• WP structure & changes
• workshops
• publications & talks
• achievements
• milestones
• deliverables
• issues
• use of resources
ACCNET
Accelerator Science Networks

Coordination & Management
coordinated by
Walter Scandale, IN2P3; Peter Spiller, GSI; Frank Zimmermann, CERN

EUROLUMI
accelerators & colliders performance
coordinated by
Frank Zimmermann, CERN
Ezio Todesco, CERN

RFTECH
sc & nc rf technologies
coordinated by
Jean-Marie de Conto, UJF
Mariusz Grecki, DESY
Wolfgang Weingarten, CERN

April 2010 changes:
Alessandro Variola resigns; Walter Scandale changes affiliation to IN2P3-CNRS, new coordinator Peter Spiller joins
ACCNET - new Accelerator Science Networks

PWAN - Plasma Wakefield Acceleration Network
coordinated by
Ralph Assmann, CERN
Jens Osterhoff, DESY

MAN? – Medical Accelerator Network
coordinated by
Jean-Pierre Koutchouk, CERN
AccNet Coordinators
11.-12.03.2010 Workshop on Proton Driven Plasma Wake Field Acceleration at CERN
- plan, layout, simulations for first demonstration experiment w. SPS or PS proton beam

Channeling conference in Ferrara, October 2010; co-sponsored

AccNet EuroLumi First Workshop on a Higher-Energy LHC (HE-LHC’10), Malta, October 2010
- 20-T magnets
- beam dynamics (synchrotron radiation, beam-beam, IBS)
- injector upgrade

Crystal Collimation workshop, CERN, 25-26 October 2010
- results and plans of UA9; SPS crystal collimation experiments

4th AccNet-EuroLumi Workshop on LHC Crab Cavities, LHC-CC10, CERN, December 2010
- strategy for LHC crab cavities, cavity designs
- crab-cavity test in the SPS, LHC machine protection
RFTech

MIXDES 2010 (MIXed DESign of integrated circuits and systems) conference in Wroclaw (Poland), June 2010; co-sponsored
- “xTCA” part organized by Dr Makowski (Lodz University) and by Dr Simrock (ITER)
- development of instrumentation applied in High Energy Physics. Aims: high reliability, availability and serviceability. Several standards (MTCA, ATCA or AMC) under development, using high-speed serial interfaces. xTCA objective: simplify application of MTCA and ATCA hardware in high energy physics applications.

French “Grand Emprunt”: Thanks to RFTech and after fruitful exchanges with CERN, proposals for EQUIPEX label (“EQuipment d’EXcellence”) and LABEX label (“LABoratoire d’EXcellence”) on crab-cavity development. The submission of the EQUIPEX done in September. LABEX document is under preparation (to be completed by end of October).

Next RFTech workshop will be held at PSI Villigen (Switzerland) on 2-3 December.
- preliminary scientific program focuses on RF cavity and coupler design (crab cavity design, SC/NC cavity development, power couplers), Superconducting RF (RF control, piezo control of detuning, infrastructures), Low-level and high-power RF systems (new electronics for LLRF, klystrons, solid state amplifiers), costing tools and reliability
PWAN – *Plasma Wakefield Acceleration*

Coordinator Ralph Assmann, deputy Jens Osterhoff

web site established 29.09.2010:  
[https://espace.cern.ch/pwfa-network](https://espace.cern.ch/pwfa-network)

Scientific Steering Board, Network Coordination

generation and acceleration of GeV-class e-/e+ beams
1) **comparison of different methods** to drive plasma wakefields
2) **description of required R&D** for verifying various technologies
3) **roadmap towards a possible PWFA test facility with first test applications** (medical, synchrotron, ultra-fast science).
4) **roadmap towards high energy physics applications**
5) **coordination of European expertise** towards test facilities
MAN? – Medical Accelerators

triggered by discussions with U. Amaldi and by AccNet co-sponsored Physics for Health conference

status (October 2010)

“For the network on medical accelerators, a description of the goals and deliverables was prepared and is in discussion with the coordinator of the EU-sponsored medical network to ensure complementarity and avoidance of duplications.”

Jean-Pierre Koutchouk
Workshops

Future ACCNET workshops and meetings:

- 2-3 December 2010: Second Annual RFTech Meeting, PSI - NEW!
- 15-17 December 2010: LHC-CC10, 4th LHC Crab Cavity Workshop, CERN - NEW!
- 25-26 October 2010: Mini-Workshop on Crystal Collimation, CERN - NEW!
- 14-16 October 2010: HE-LHC'10 Mini-Workshop on High-Energy LHC, Malta - NEW!

Past ACCNET workshops and meetings:

- 24-27 June 2010: MIXDES2010, Wroclaw
- 29 March 2010: First Annual RFTech Meeting, DESY
- 11-12 March 2010: Workshop on Proton Driven Plasma Wake Field Acceleration, CERN
- 2-4 February 2010: AccNet Co-Sponsored Workshop on "Physics for Health in Europe", CERN
- 17-18 December 2009: Working meeting on proton driven plasma acceleration PPA09 at CERN
- 9-10 November 2009: EuCARD-AccNet-EuroLumi mini-Workshop on Crystal Collimation, at CERN
- 19-22 October 2009: LLRF09, Low-Level Radio Frequency Workshop, KEK
- 12-13 October 2009: ACCNET EUROLUMI Workshop on Anti-E Cloud Coatings that require no activation "AEC'09", CERN

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<td>16-18.09.2009</td>
<td>EuCARD-ACCNET Workshop on LHC Crab Cavities &quot;LHC-CC09&quot;</td>
<td>at CERN, US-LARP, DL/CI, KEK</td>
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Foreword in Proceedings

"The xTCA for Instrumentation session has been organized in collaboration with the RFTech network of Work-Package 4 "AccNet" of the “European Coordination for Accelerator Research and Development” (EuCARD). EuCARD is an Integrating Activity co-funded by the European Commission under the Framework Programme 7, grant agreement no. 227579. The session has been partially sponsored by RFTech."
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<td>15-17.12.2010</td>
<td>LHC-CC10, 4th LHC Crab Cavity Workshop</td>
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<td>16-18.06.2011</td>
<td>AccNet co-sponsored MIXDES 2011</td>
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The MIXDES conference series started in Debe near Warsaw in 1994 and has been organized yearly in different Polish cities. This year we would like to continue the tradition of inviting you to the most attractive places in Poland and the will take place in Giwice.

The aim of the MIXDES conference is to provide an annual Central-European forum for the presentation and discussion of recent advances in design, modelling, simulation, testing and manufacturing in various areas such as micro- and nanoelectronics, semiconductors, sensors, actuators and power devices.

The MIXDES conference papers are indexed in Thomson Reuters Conference Proceedings Citation Index and available in IEEE Xplore since MIXDES 2005.

The topics of the MIXDES 2011 Conference include:

1. Design of Integrated Circuits and Microsystems

2. Thermal Issues in Microelectronics
   Thermal and electro-thermal modelling, simulation methods and tools. Thermal mapping. Thermal protection circuits.

3. Analysis and Modelling of ICs and Microsystems

4. Microelectronics Technology and Packaging

5. Testing and Reliability
   Design for testability and manufacturability. Measurement instruments and techniques.

6. Power Electronics

7. Signal Processing

8. Embedded Systems
   Design, verification and applications.

9. Medical Applications
   Medical and biotechnology applications. Thermography in medicine.

10. Student Projects
AccNet publications

AccNet dissemination & outreach
• two articles in 2nd EuCARD newsletter (on LHC-CC09 + AccNet & on concept of proton plasma acceleration)
• one article in CERN Courier Feb. 2010 (on PPA’09 workshop)
• three seminar talks at DESY, KEK and University of Heidelberg
• CERN Academic Training lecture series on LHC upgrade
• presentations at ATLAS && CMS upgrade weeks and to LHCC
• presentations at Chamonix’2010 LHC Performance Workshop and to LHC Upgrade Task Force
• various collaboration meetings

EuCARD AccNet documents
• about 40 in total, including
  - 2 journal articles
  - 15 conference presentations
  - 1 PhD thesis
  - 1 master thesis


Y.-P. Sun, F. Zimmermann, R. Tomas, “Tune Shift Due to Crossing Collision and Crab Collision”, PAC'09 Vancouver

Y.-P. Sun, R. Assmann, J. Barranco, R. Tomas, T. Weiler, F. Zimmermann, CERN; R. Calaga, BNL; A. Morita, KEK, “Study with One Local Crab Cavity at IR4 for LHC”, PAC'09 Vancouver

J.P. Koutchouk, F. Zimmermann, “LHC Upgrade Scenarios”, PAC'09 Vancouver


C. Bhat, *LPA Scheme for the LHC Luminosity Upgrade* (*updated pdf*), *CERN Accelerator Physics Forum* 13 August 2009


AccNet publications & talks – 3

G. Sterbini, Early Separation Scheme for LHC Luminosity Upgrade, **PhD Thesis**, EPFL

F. Zimmermann, “Ingredients (necessary ones and desirable one) of a phase II upgrade,” **LHC Upgrade Task Force**, 26 February 2010


F. Zimmermann, **Parameter space beyond 10^{34}** (paper), **LHC Performance workshop, Chamonix**, 25-29 January 2010

F. Zimmermann, **Update on LHC Upgrade Plans**, **ATLAS Upgrade Week**, CERN, Tuesday 10 November 2009

F. Zimmermann, A. Variola, W. Scandale, **EuCARD WP4 Accelerator Networks** (pdf), Report at 3rd **EuCARD Steering Committee Meeting** Frascati, 4 Nov. 2009


R. Calaga, **LHC Crab Cavities**, AccNet Highlight Talk at **First Annual EuCARD Meeting**, RAL, UK, 14 April 2010

A. Caldwell, **Proton Driven Plasma Wakefield Acceleration**, AccNet Highlight Talk at **First Annual EuCARD Meeting**, RAL, UK, 14 April 2010

F. Zimmermann, **Machine Plans for Upgrades - “SLHC”-type Luminosities - Issues and Solutions**, **CMS Upgrade Week**, CERN, 29 April 2010

Adam Piotrowski, **PCIExpress Hot-Plug Mechanism in Linux-based ATCA Control Systems** (word summary), **MIXDES 2010**, Wroclaw, 26-27 June 2010

Konrad Przygoda, **Power Supply Unit for ATCA-based Piezo Compensation System** (word summary), **MIXDES 2010**, Wroclaw, 26-27 June 2010

Samer Bou Habib, **Design of Eight-channel ADC Card for GHz Signal Conversion** (word summary), **MIXDES 2010**, Wroclaw, 26-27 June 2010

Jan Wychowaniak, **Application for Management and Monitoring of xTCA Hardware** (word summary), **MIXDES 2010**, Wroclaw, 26-27 June 2010
Tomasz Kozak, AMC Radiation Monitoring Module for ATCA/µTCA Based Low Level RF Control System, 17th International Conference Mixed Design of Integrated Circuits and Systems (word summary), MIXDES 2010, Wroclaw, 24-26 June 2010

Piotr Perek, ATCA Carrier Board with Dedicated IPMI Controller (1), MIXDES 2010, Wroclaw, 26-27 June 2010

Pawel Predki, ATCA Carrier Board with Dedicated IPMI Controller (2), MIXDES 2010, Wroclaw, 26-27 June 2010

F. Zimmermann, LHC Beyond 2020, KEK Accelerator Seminar, Kobayashi Hall, 14 July 2010

K. Ohmi, Beam-Beam Studies for the High-Luminosity and High-Energy LHC Plus Related Issues for KEKB, 24 August 2010

B. Yee Rendon, Setting up Simulations of Failure Scenarios for a Crab Cavity in the Nominal LHC, CERN, 22 September 2010

B. Yee Rendon, Manual of Crab-Cavity Analysis Tools, Crab cavity Voltage Calculation, Setting Up Simulations of Failure Scenarios for a Crab Cavity in the Nominal LHC, CERN, September 2010
AccNet achievements - facts

*expanded scope* (1-2 new networks)

organized or co-organized *13 workshops*

> *41 talks and papers*,

  incl. 1 master thesis & 1 PhD thesis

*visitor exchanges & student support*

(e.g. K. Ohmi, B. Yee, H. Maury, 2 diploma students & 5 PhD students 6 from Lodz & Warsaw for MIXDES10, G. Hoffstaetter, J. Schwartz, E. Tsyganov)

collaboration with *CINVESTAV Mexico*

  incl. 1 master student & 1 PhD student
AccNet achievements - view

• **catalyzer for LHC upgrades & FAIR**
  - *crab cavities (!)*, magnets, collimations,...
  - large Piwinski angle
  - *high energy LHC* (new initiative)

• **advanced concepts & synergies**
  - *e-cloud assessment & mitigation*
  - *plasma acceleration, medical accelerators, crystal collimation*

• **community organizer**
  - RFTech
Simulations of Electron-Cloud Heat Load for the Cold Arcs of the LHC and Its High-Luminosity Upgrade Scenarios

Humberto Maury Cuna and Jesus Guillermo Contreras Nuño
Departamento de Física Aplicada, CINVESTAV-IPN,
Unidad Mérida, A.P. 73 Cordemex, 97310 Mérida, Yucatán, México

Frank Zimmermann
CERN, BE Department, 1211 Genève 23, Switzerland
(Dated: December 13, 2010)

The heat load generated by an electron cloud in the cold arcs of the Large Hadron Collider (LHC) is a concern for operation at and beyond nominal beam current. We report the results of simulation studies, with updated secondary-emission models, which examine the severity of the electron heat load over a range of possible operation parameters, both for the nominal LHC and for various luminosity-upgrade scenarios, such as the so-called full crab crossing and early separation schemes, the large Piwinski angle scheme and a variant of the latter, providing compatibility with the (upgraded) LHCb experiment. The variable parameters considered are the maximum secondary emission yield, the number of particles per bunch, and the spacing between bunches. In addition, the dependence of the heat load on the bunch length and on the longitudinal bunch profile is investigated.
AccNet-CINVESTAV collaboration: crab-cavity failures (B. Yee)

Local loss map for nominal LHC (top energy, $\beta^*(\text{IP5}) = 0.55$) with one GCC and horizontal beam halo, when the phase of the CC ic changed by 50° in 1 turn.
UA9 crystal-collimation result in 2010 (W. Scandale)

Angular scan of crystal 3

Crystal
- with a small residual torsion
- mounted on the IHEP high quality goniometer

- Loss reduction in channeling mode ($\times 16$)
  - larger than in MonteCarlo simulation ($\times 33$)
  - larger than in crystal 1 ($\times 5$)

- Small variations of the deflection angle in different scans [better control of the alignment errors]
Collimation leakage in dispersive area

A) tail of the circulating beam
- fast depletion in channeling mode
- linear descent of the population in amorphous orientation (or with the tungsten scatterer)

B) multiple Coulomb scattering area
- fast depletion by high probability of prompt channeling at the first crystal hit
- slow depletion due to multi-turn hits of the amorphous primary (very slow extraction)

C) shadow of the absorber
- low population due to low probability of nuclear interaction in channeling mode
- off-momentum halo due to diffractive hits with the amorphous primary and TAL

\[ \text{AM} = \text{amorphous orientation} \]
\[ \text{CH} = \text{channeling orientation} \]
AccNet milestones

M.4.1.1
- Second **general AccNet Steering meeting**, RAL, UK, 13 April 2010

M.4.2.1:
- many **topical mini-workshops** have been organized and supported
  - first major EuroLumi workshop is HE-LHC’10 in Oct. 2010
  - another EuroLumi workshop is LHC-CC10 in Dec. 2010

M.4.3.1:
- Annual **RFTECH workshop** was held at DESY, 29 March 2010
  - Next RFTECH workshop at PSI, 2-3 December 2010
2nd general AccNet Steering meeting, RAL, 13 April 2010
EuCARD-AccNet mini-workshop on a higher-energy LHC “HE-LHC’10” – 14-16 October ‘10

Scope:

This mini-workshop will take a first look at a higher-energy LHC (HE-LHC) with about 16.5 TeV beam energy and 20-T dipole magnets, in particular at parameters, luminosity optimization, operation mode, beam dynamics, injector, magnets (for arcs, insertions and injector), cryogenics, collimation, and vacuum system.

Composition of the programme committee:

Oliver Bruning (CERN), Antoine Dael (CEA), Gijs de Rijk (CERN), Steve Gourlay (BNL), Jean-Pierre Koutchouk (CERN), Steve Myers (CERN, Chair), Eric Prebys (FNAL & US-LARP), Peter Spiller (GSI), Lucio Rossi (CERN), Nicholas Sammut (U Malta), Walter Scandale (IN2P3), Vladimir Shiltsev (FNAL), Ezio Todesco (CERN), Akira Yamamoto (KEK), Frank Zimmermann (CERN).

General goals:

- Investigate critical questions for HE-LHC and propose solutions or follow-up
- Document the HE-LHC concepts for future reference
- Initiate collaborative work around HELHC challenges amongst CERN, EuCARD partners, US, and KEK
- Generate and/or identify synergies with FAIR and past VLHC studies

Workshop secretariat & travel organization: Merethe Morer-Olafsen

Written proceedings edited by Ezio Todesco and Frank Zimmermann, contributions by 31. December 2010

Place and date:

Malta, Villa Bighi, Headquarters of the Malta Council for Science and Technology, 14-16 October 2010
17 participants (DESY, CERN, TUD, UROS, ASTeC, LPSC, UJF, ESS, U London, TUL, UG, SINS) organized by M. Grecki, J.-M. De Conto, W. Weingarten & DESY

Spiral-2 couplers, SPI 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
## AccNet deliverables

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<th>Nature</th>
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<td>O</td>
<td>M2</td>
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<td>AccNet Strategy for future proton &amp; electron facilities in Europe</td>
<td>R</td>
<td>M48</td>
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<td>EuroLumi Strategy and issues for LHC IR, LHC injector and beam-parameter upgrade path(s), with comment on longer-term prospects, and for FAIR</td>
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<td>R</td>
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AccNet issues - 1

• inclusion of AccNet papers & talks in EuCARD database (secretarial support!?, access rights, duplication, simplicity) automatic email approval? (never!), 17 entries??, WP4 in CDS
example of merger in CDS
EuCARD & sLHC
since merger
document is no longer available
in CDS there is no obvious way to look/search for one work package
many WP4 documents which WP coordinator was/is not aware of, and which have not been listed on WP4 web site approval & qualification?
all known WP4 AccNet papers & presentations are posted on LAL AccNet web site
AccNet issues – cont’d

• **inclusion of AccNet papers & talks in EuCARD database** (secretarial support!?, access rights, duplication, simplicity) automatic email approval? (never!), 17 entries??, WP4 in CDS

• **web site editorial access** for WP coordinator?! server changes have hindered updates

• **relation between AccNet and new HL-LHC project?**

• **support for AccNet web site** after the step-down of A. Variola and retirement of B. Mouton

• **launch of network on medical accelerators?**

• **budgets for PWAN and MAN**
use of resources

most/all AccNet mini-workshops have moderate expenses (<10 kCHF)

collaborators cover part of the costs

management with a lot of enthusiasm devotes extra time
AccNet success indicators

excellent attendance to AccNet workshops from many European labs, universities, US laboratories, Japan, international organizations

impact:
  - on most relevant topics
  - initiated crab-cavity program for LHC
  - novel anti e-cloud coating techniques
  - push for higher-energy LHC

high cost efficiency

exchange of 13 expert visitors
two theses, 6 conf. papers, 2 journal articles
AccNet conclusions

AccNet had an excellent start

EuroLumi gives input to LHC upgrade

- Crab Cavity Advisory Board,
- endorsement of LHC crab cavities,
- task force preparing SPS crab-cavity tests,
- “LPA” scenario, novel e-cloud mitigation techniques,
- revisions of LHC upgrade plans, energy upgrade

RFTech organizes RF community

AccNet is breaking new grounds

- medical accelerators
- plasma acceleration, crystal collimation

Ambitious programme
Appendix

AccNet

institutes & contacts
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## AccNet RFTech institutes & contacts

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