

# ACCNET

Frank Zimmermann

for the WP4 coordinators

R. Assmann, J.-M. De Conto, M. Grecki, J. Osterhoff, W. Scandale,  
P. Spiller, E. Todesco, H. Videau, W. Weingarten, F. Zimmermann

EuCARD 2<sup>nd</sup> Annual Meeting, CNRS, 11 May 2011



# ACCNET



## Accelerator Science Networks



### Coordination & Management

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

### EURO-LUMI



*accelerators & colliders performance*

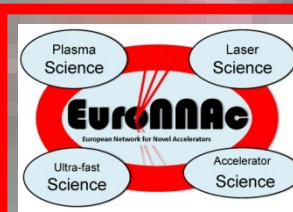
coordinated by Frank Zimmermann & Ezio Todesco, CERN



### RFTECH

*sc & nc rf technologies*

coordinated by Jean-Marie de Conto, UJF Mariusz Grecki, DESY Wolfgang Weingarten, CERN



### EuroNNAc

*novel accelerators*

coordinated by Ralph Assmann, CERN Jens Osterhoff, DESY Henri Videau, CNRS

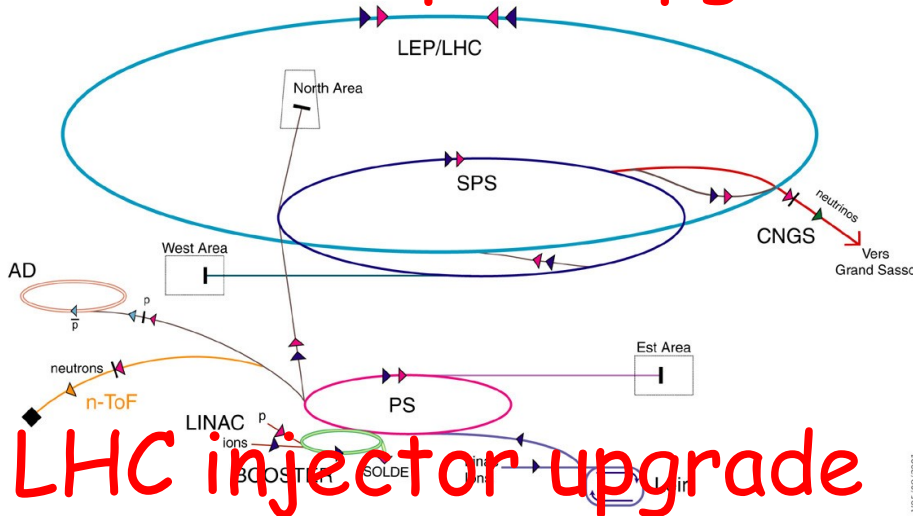
# EUROLUMI

brings together experts in beam dynamics, magnets, collimation & RF

# FAIR



# CERN complex upgrade



# LHC injector upgrade

▶ p (proton)      ▶ (antiproton)  
 ▶ ion            ▶ proton/antiproton conversion  
 ▶ neutrons      ▶ neutrons

AD Antiproton Decelerator      LHC Large Hadron Collider  
 PS Proton Synchrotron          n-ToF Neutrons Time of Flight  
 SPS Super Proton Synchrotron      CNGS Cern Neutrinos Grand Sasso

## LHC phase-2 upgrade paths for IP1 & 5

early separation (ES) J.-P. Koutchouk

stronger triplet magnets

full crab crossing (FCC) L. Evans, W. Scandale, F. Zimmermann

stronger triplet magnets

# LHC IR & beam parameter upgrade

wire compensator

- 50 ns spacing, longer & more intense bunches ( $5 \times 10^{11}$  p/s/bunch)
- $\beta^* \sim 25$  cm, no elements inside detectors
- long-range beam-beam wire compensation
- novel operating regime for hadron colliders, beam generation

- ultimate LHC beam ( $1.7 \times 10^{11}$  p/s/bunch, 25 ns spacing)
- $\beta^* \sim 10$  cm
- smaller transverse emittance
- constraint on new injectors, off- $\beta$  beat

+  
 medical accelerators?  
 +  
 initial initiative on  
 plasma acceleration

# EUROLUMI themes

LHC IR upgrade: IR magnet technology; heat deposition & shielding; magnet lifetime; performance reach; ...

LHC beam parameter upgrade: beam generation, beam stability; beam-beam performance & compensation; crab cavities; luminosity leveling; machine protection; collimation upgrade; crab waists; intensity limits ...

FAIR: beam losses; space-charge effects; vacuum; aperture; ramping issues; ...

CERN complex upgrade: SPS electron-cloud mitigation; impedance effects; intensity limits; beam manipulation; PS booster upgrade ; SPL ; ...

LHC energy upgrade: beam dynamics, magnets, ...

Applications for society: medical accelerators

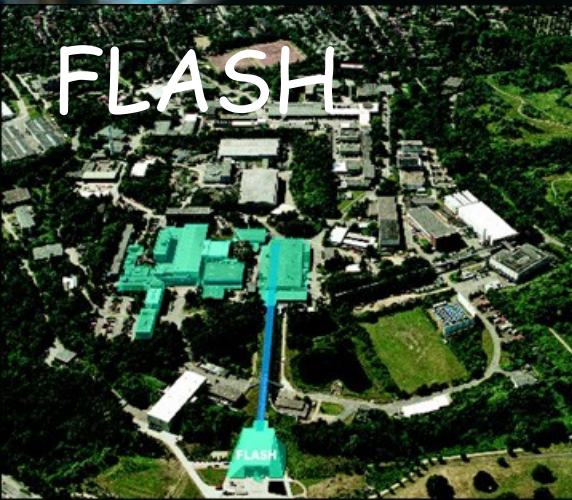
Advanced techniques: plasma acceleration, crystal tools

# RFTECH

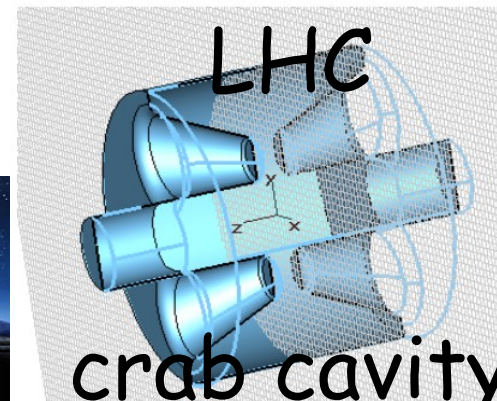
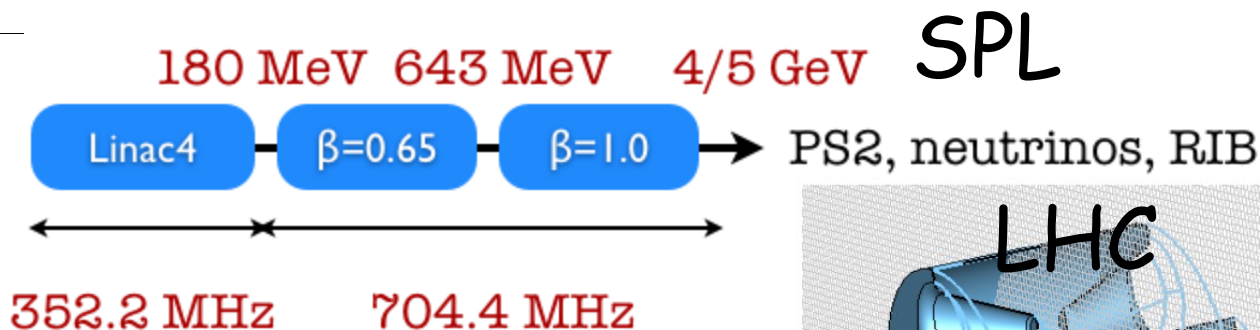
brings together RF experts from different labs, proton & electron accelerators, CLIC and ILC, ... ; encompasses all aspects of RF technology, e.g. klystron development, RF power distribution system, cavity design, and low-level RF system, for linear accelerators, storage rings, and associated research infrastructures, including transversely deflecting (crab) cavities and financial aspects such as costing tools



XFEL

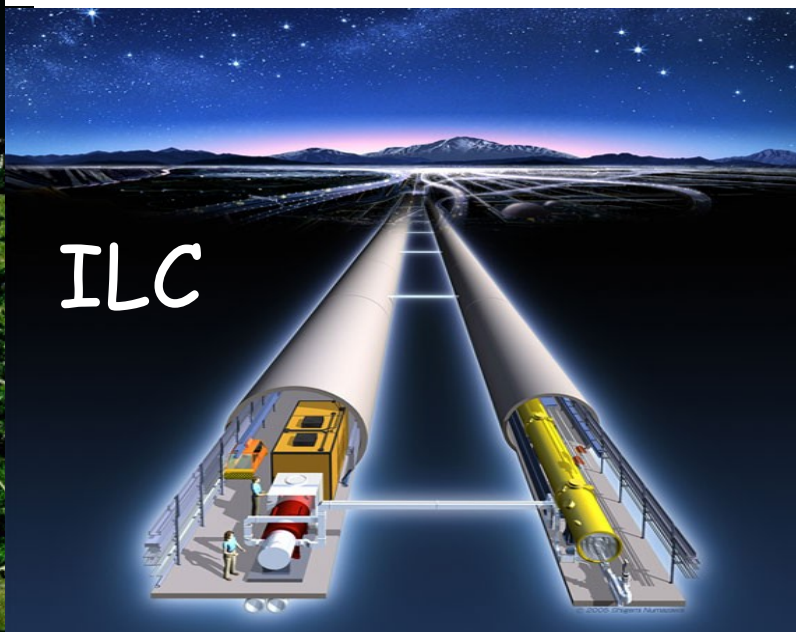


FLASH

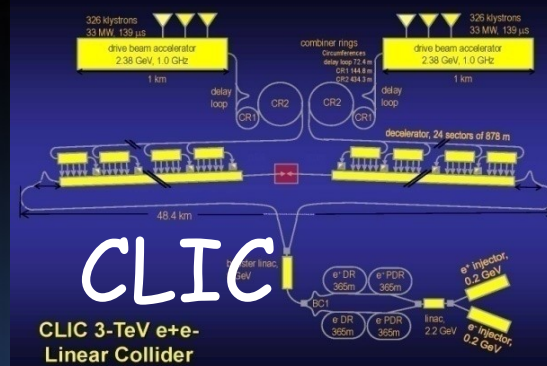


LHC

crab cavity



ILC



# RFTECH themes

low level RF: maintain RF phase (0.03 dg) & amplitude (0.03%); minimize power; built-in diagnostics; reliability; operability; reproducibility; maintainability; good understanding; development of LLRF costing tools based on SysML model; ...

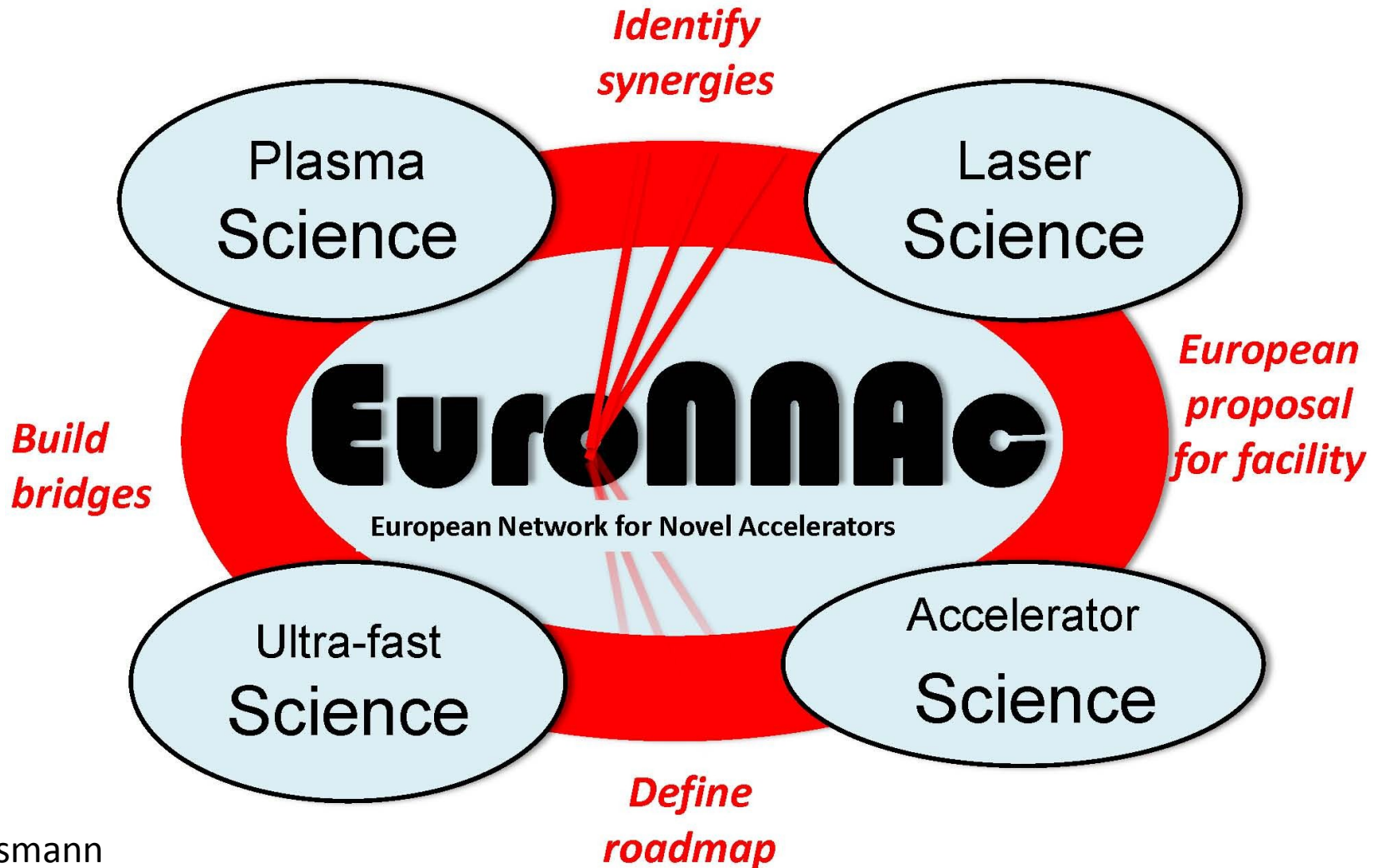
cavity design: maximize gradient; minimize breakdown; optimize efficiency; minimize cost; minimize impedance; accelerating cavities; coupler design; PETS; compact crab cavities; ....

high power RF: power distribution system; design integration; costing tools; ...

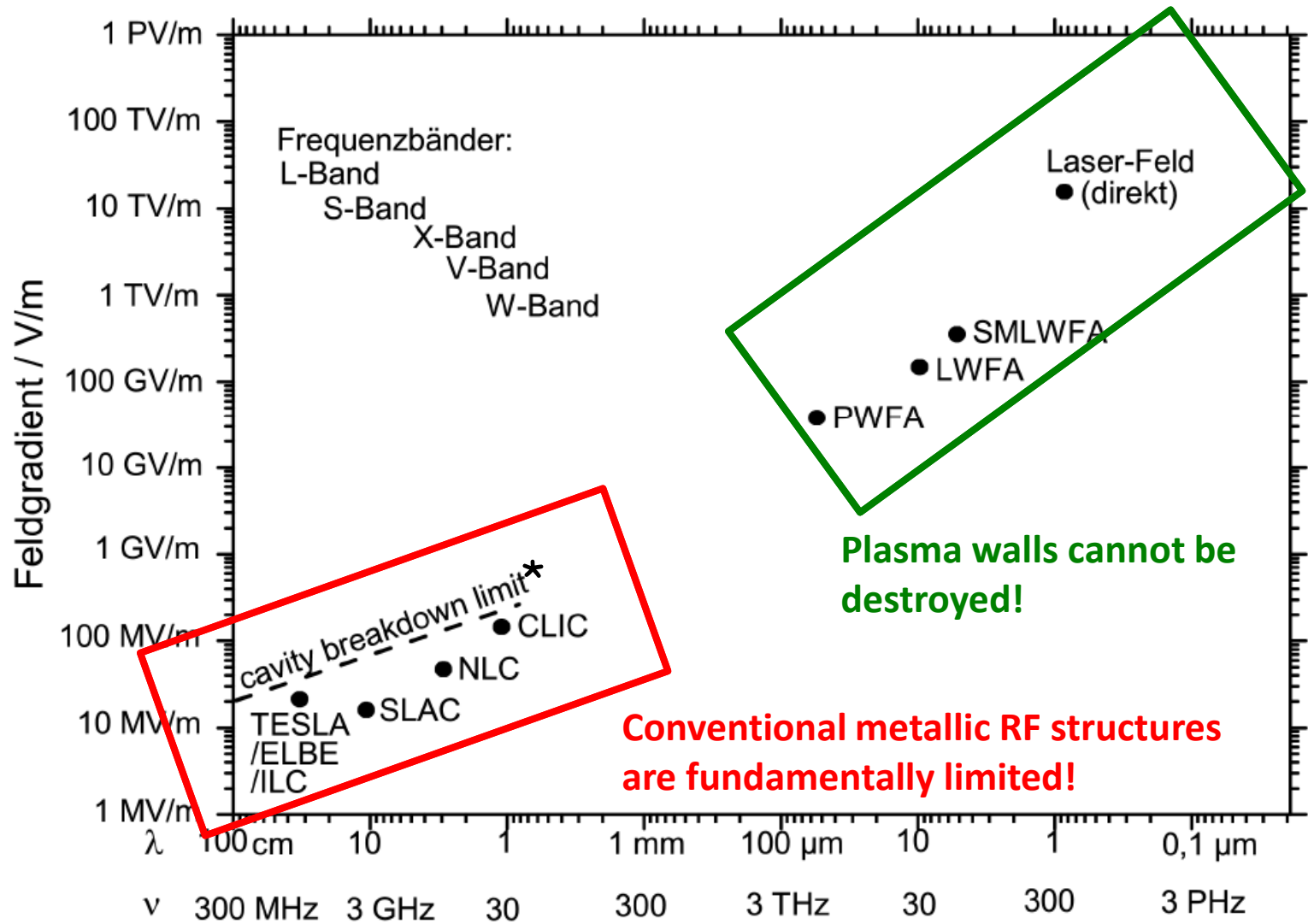
SRF test infrastructures: establish multi-purpose state-of-the art network of equipment for R&D and test of SRF cavities and cryo-modules within 2 years; future projects - required equipment - project descriptions

# EuroNNAc

The goal of this new European network is to identify possible usage of advanced accelerator techniques in large-scale conventional facilities and to identify a roadmap towards an advanced accelerator facility for big science with applications in applied and fundamental research.



# EuroNNAc themes: LWFA, PWFA for e- *no ion or p acceleration!?*





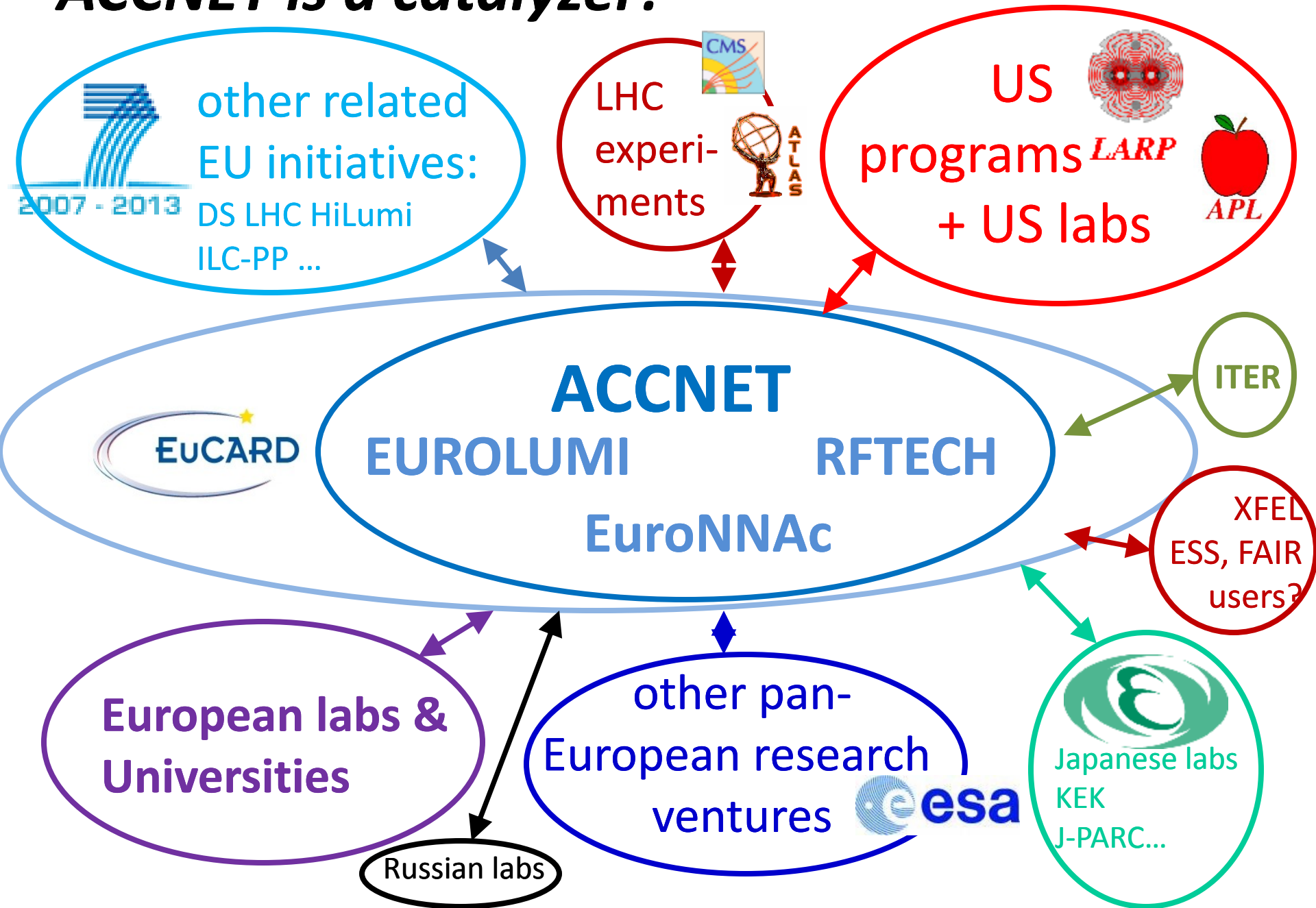
# ACCNET tools



- ❑ **annual workshops**
- ❑ **topical meetings and mini-workshops**
- ❑ **capability of inviting or exchanging experts over periods of typically a week to a month**
- ❑ **exploratory studies & collaborations**
- ❑ **opportunities for students**
- ❑ **unique place of discussion with users**

→ *exchange of ideas and expertise aimed identifying the most promising strategies and technologies*

# ACCNET is a catalyzer!



The participation is open inside and outside the consortium. A large number of institutes participate in ACCNET activities.

# work organization

- *several EuroLumi workshops per year*
- *1 major workshop for RFTECH & EuroNNAc per year*
- possibility of additional *topical mini-workshops*
- possibility of *joint EUROLUMI+RFTECH mini-workshops* on topics of common interest (either by machine [SPL, LHC+injector RF upgrade, LHC crab cavities, GSI rf systems]; or by topic [RF phase and amplitude jitter, timing stabilization, beam loading compensation, flat bunches, controlled noise injection,...])
- *1 ACCNET steering meeting / year*  
(ACCNET+EUROLUMI+RFTECH coordinators)

# some AccNet 2<sup>nd</sup>-year achievements

- **AccNet-RFTech** supported WS on **Advanced LLRF Control**, April 2010
- **AccNet-RFTech session** on **xTCA at MIXDES2010** conference, June '10
- **AccNet-EuroLumi** workshop on **Higher-Energy LHC**, HE-LHC, Oct. 2010
- (invited) **talk** at **German KET Strategy Workshop**
- **AccNet-EuroLumi workshop on Crystal Collimation**, Oct. 2010
- **AccNet-RFTech 2<sup>nd</sup> Annual Workshop**, December 2010
- **AccNet workshop on LHC crab cavities**, LHC-CC10, December 2010
- **AccNet web site moved from LAL to CERN server**
- launch of **new network on novel accelerators AccNet-EuroNNAc**
- several **EuCARD Newsletter articles**
- **AccNet-EuroLumi** bilateral **CERN-GSI workshop on e-cloud**, March'11
- 1st **AccNet-EuroNNAc workshop**, May 2011
- expansion of **collaborations with CINVESTAV/Mexico, ESA, ITER,...**

# AccNet publications

## AccNet dissemination

- three **articles in 7<sup>th</sup> and 8th EuCARD newsletters** (on crystal collimation + novel acceleration techniques & HE-LHC)
- one outreach talk at KET Strategy Workshop Germany
- presentations at **Chamonix'2011 LHC Performance Workshop**

## EuCARD AccNet documents

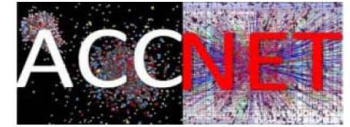
- about **68 in total**, including 16 in 4<sup>th</sup> semester
  - **1 CERN Yellow Report**
  - **2 journal articles**
  - **20 conference presentations**
  - **1 PhD thesis**
  - **1 master thesis**

<http://cern.ch/accnet/>  
*new address!*

# AccNet web site



**Accelerator Science  
Networks**  
EuroLumi, EuroNNac and  
RFTech



maintained & expanded  
by Olivier Dadoun (LAL),  
and  
Frank Zimmermann (CERN)

Coordinated by [P. Spiller, W. Scandale](#)  
and [F. Zimmermann](#)

*AccNet is a Networking Activity (WP4) in the framework of [EuCARD](#)  
(European Coordination for Accelerator Research & Development)*

<a href="#">Main Objectives</a>	<a href="#">Network Structure</a>	<a href="#">Activity Reports</a>	<a href="#">WP4 Collaboration Workspace</a>	<a href="#">Job Opportunities</a>	<a href="#">Workshops</a>	<a href="#">Literature and Presentations</a>	<a href="#">Links</a>
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Notice: this site is under construction. Please accept our apologies for its incompleteness and yet missing information.

early in 2011 (after retirement of Bernard Mouton) all AccNet web sites were transferred from LAL to a CERN server for easier access and maintenance

**AccNet is composed of three networks**

[EuroLumi](#)

[EuroNNac](#)

[RFTech](#)

## Hot News

17-21 October 2011	● <a href="#">LLRF-2011 Workshop</a> , DESY - <b>NEW!</b>
20-21 June 2011	● <a href="#">Workshop on Optics Measurement, Correction &amp; Modelling "OMCM"</a> , CERN - <b>NEW!</b>
16-18 June 2011	● <a href="#">MIXDES2011</a> , Gliwice - <b>NEW!</b>
6-8 June 2011	● <a href="#">Workshop on Linac Operation with Long Bunch Trains</a> , DESY - <b>NEW!</b>
10 May 2011	EuCARD WP4 AccNet Steering & Coordination Meeting, CNRS headquarters, room K024, 16:00, Paris - <b>NEW!</b>

*AccNet Article in EuCARD Newsletter no 8 (March 2011):*  
[Proposed increase in energy takes LHC even further into the future](#)

*AccNet Articles in EuCARD Newsletter no 7 (December 2010):*  
[A knack for novel acceleration techniques](#)  
[Crystal clear ideas for beam collimation](#)

*AccNet Article in CERN Courier (24 February 2010)*  
[Workshop pushes proton-driven plasma wakefield acceleration](#)

# AccNet EuroLumi institutes & contacts

Institute	Name	Institute	Name
<a href="#"><u>BNL</u></a>	Calaga Rama	<a href="#"><u>GSI</u></a>	Boine-Frankenheim Oliver
	Drees Angelika	<a href="#"><u>INFN-LNF</u></a>	Biagini Marica
	Fischer Wolfram		Palumbo Luigi
	Peggs Steve		Spataro Bruno
<a href="#"><u>CERN</u></a>	Bottura Luca	<a href="#"><u>INFN-NA</u></a>	Vaccaro Vittorio
	Todesco Ezio	<a href="#"><u>KEK</u></a>	Ohmi Kazuhito
	Zimmermann Frank	<a href="#"><u>LBNL</u></a>	Furman Miguel
<a href="#"><u>CI</u></a>	Chattopadhyay Swapan	<a href="#"><u>MPP</u></a>	Caldwell Allen
<a href="#"><u>CNRS-LAL</u></a>	Mouton Bernard		Xia Guoxing
	Scandale Walter	<a href="#"><u>TEMF</u></a> <a href="#"><u>Darmstadt</u></a>	Mueller Wolfgang
	Variola Alessandro		Weiland Thomas
<a href="#"><u>CNRS-LPSC</u></a>	Baylac Maud	<a href="#"><u>TUBE</u></a>	Bruns Warner
<a href="#"><u>CSIC - IFIC</u></a>	Faus Golfe Angeles		Henke Heino
<a href="#"><u>DESY</u></a>	Mais Helmut	<a href="#"><u>UJF</u></a>	De Conto Jean-Marie
<a href="#"><u>FNAL</u></a>	Bhat Chandra	<a href="#"><u>UOM</u></a>	Sammut Nicholas
	Sen Tanaji	<a href="#"><u>UPSA</u></a>	Ekelof Tord
	Shiltsev Vladimir	<a href="#"><u>USAN</u></a>	Petracca Stefania
	Valishev Alexander		



# AccNet RFTech institutes & contacts

Institute	Name
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<a href="#">BNL</a>	Ben-Zvi Ilan
	Calaga Rama
<a href="#">CEA-DSM</a>	Chel Stéphane
	Daël Antoine
	Devanz Guillaume
<a href="#">CERN</a>	Duperrier Romuald
	Angoletta Maria Elena
	Brunner Olivier
	Calatroni Sergio
	Capatina Ofelia
	Chiaveri Enrico
	Garoby Roland
	Hofle Wolfgang
	Jensen Erk
	Junginger Tobias
	Montesinos Eric
	Ruber Roger
	Vretenar Maurizio
	Vullierme Bruno
Weingarten Wolfgang	
<a href="#">CI</a>	McIntosh Peter
<a href="#">CNRS-IPNO</a>	Bousson Sébastien
	Gardès Daniel
	Gassot Hui Min
<a href="#">CNRS-LAL</a>	Olry Guillaume
	Mouton Bernard
<a href="#">Darmstadt University-IKP</a>	Variola Alessandro
	Eichhorn Ralf

Institute	Name
<a href="#">WUT</a>	Czuba Krzysztof
<a href="#">DESY</a>	Elsen Eckhard
	Grecki Mariusz (Proch Dieter)
	(Simrock Stefan)
<a href="#">ESRF</a>	Jacob Jorn
<a href="#">FZD</a>	Teichert Jochen
<a href="#">Goettingen University</a>	Quadt Arnulf
<a href="#">GSI</a>	Huelsmann Peter
<a href="#">IFJ PAN</a>	Wierba Wojciech
<a href="#">INFN-LNF</a>	Ghigo Andrea
<a href="#">INFN-Milano</a>	Pagani Carlo
<a href="#">INFN-Roma</a>	Tazzari Sergio
<a href="#">Institute for Nuclear Studies, Swierk</a>	Nietubyc Robert
	Szcwinski Jaroslaw Wronka Slawomir
<a href="#">Karlsruhe University?</a>	Ustinov Alexey?
<a href="#">LPNHEP (IN2P3 Jussieu)</a>	Augustin Jean-Eudes Debu Pascal
<a href="#">Rostock University</a>	Glock Hans-Walter van Rienen Ursula
<a href="#">Royal Holloway</a>	Molloy Stephen
<a href="#">TEMF Darmstadt</a>	Mueller Wolfgang Weiland Thomas
<a href="#">TUL</a>	Makowski Dariusz
	Napieralski Andrzej Smage Bogna
<a href="#">UFJ and LPSC</a>	De Conto Jean-Marie
<a href="#">Wuppertal University</a>	Mueller Guenter

# AccNet EuroNNAc institutes & contacts

Europe	Name			Affiliation
<b>EuCARD, CERN</b>	Dr.	Assmann*	Ralph	EuCARD/CERN
	Dr.	Geschonke	Gunther	CERN
	Dr.	Koutchouk	Jean-Pierre	EuCARD/CERN
	Dr.	Zimmermann	Frank	EuCARD/CERN
<b>France</b>	Dr.	Cros	Brigitte	LPGP -CNRS
	Prof. Dr.	Malka	Viktor	LOA
	Dr.	Martin	Philippe	CEA
	Prof. Dr.	Mourou	Gerard	ILE
	Dr.	Specka	Arnd	Ecole polytechnique
	Dr.	Videau*	Henri	Ecole polytechnique
<b>Germany</b>	Prof. Dr.	Caldwell	Allen	MPI-P Muenchen
	Dr.	Floettmann	Klaus	DESY
	Prof. Dr.	Gruener	Florian	LMU Muenchen/MPQ
	Dr.	Osterhoff*	Jens	University Hamburg, DESY
	Prof. Dr.	Sauerbrey	Roland	FZD Rossendorf
<b>Italy</b>	Dr.	Ferrario	Massimo	LNF
	Dr.	Ghigo	Andrea	INFN Frascati
	Prof. Dr.	Guiletti	Danilo	INFN Frascati
	Dr.	Serafini	Luca	INFN Frascati
<b>Portugal</b>	Prof. Dr.	Mendonca	Jose Tito	Instituto Superior Tecnico
<b>Russia</b>	Dr.	Kostyukov	Igor	Institute of Applied Physics
<b>Sweden</b>	Prof. Dr.	Wahlstroem	Claes-Goran	Lund University
<b>Switzerland</b>	Prof. Dr.	Rivkin	Leonid	EPFL, PSI
<b>United Kingdom</b>	Prof. Dr.	Jaroszynski	Dino	University of Strathclyde
	Dr.	Najmudin	Zulfikar	Imperial College
	Prof. Dr.	Neely	David	Rutherford Appleton Lab
	Prof. Dr.	Seryi	Andrei	John Adams Institute

\*Coordinators

Status 11.1.2011

Non-Europe	Name			Affiliation
<b>China</b>	Prof. Dr.	Sheng	Zhengming	Institute of Physics, CAS
<b>India</b>	Dr.	Naik	Prasad	RRCAT
<b>Japan</b>	Prof. Dr.	Yokoya	Kaoru	KEK
<b>United States</b>	Prof. Dr.	Chou	Weiren	ICFA/Fermilab
	Prof. Dr.	Joshi	Chan	University of California
	Prof. Dr.	Katsouleas	Thomas	Duke University
	Dr.	Leemans	Wim	LBNL
	Prof. Dr.	Muggli	Patric	USC
	Prof. Dr.	Raubenheimer	Tor	SLAC
	Prof. Dr.	Tajima	Toshiki	ICUIL/LMU

# EuroLumi exchanges & joint studies

Mexican PhD student Humberto Maury (CINVESTAV)

- **e-cloud simulations for LHC & HL-LHC**

Mexican master student Bruce Yee (CINVESTAV)

- **simulations of LHC crab-cavity failure scenarios**

Spanish expert Ubaldo Iriso (CELLS/ALBA)

- **simulations of LHC e-cloud build up**

Italo-german expert Giuliano Franchetti (GSI) → **WP4 highlight talk by**

**Giuliano Franchetti**

- **incoherent e-cloud effects & resonance trapping**

US-LARP physicist Chandra Bhat (FNAL)

- **generation & stability of long flat bunches for LHC**

LARP physicist Rama Calaga (BNL), LARP physicist Uli Wienands (SLAC)

- **LHC crab cavities** - **lessons from SSC and VLHC for HE-LHC**

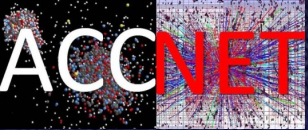
Japanese expert Kazuhito Ohmi (KEK)

- **beam-beam & e-cloud simulation studies for LHC, HE-LHC & HL-LHC**

Italian expert Roberto Cimino (INFN-LNF)

- **e-cloud surface physics & mitigation**

Russian and European experts S. Dabagov (INFN-LNF) – **crystal collimation**



# Higher-Energy LHC workshop

<http://indico.cern.ch/conferenceDisplay.py?confId=62873>

Malta, 14-16 October 2010; 56 participants (13 US, 26 CERN); **1<sup>st</sup> workshop on 33-TeV pp collider in LHC tunnel**

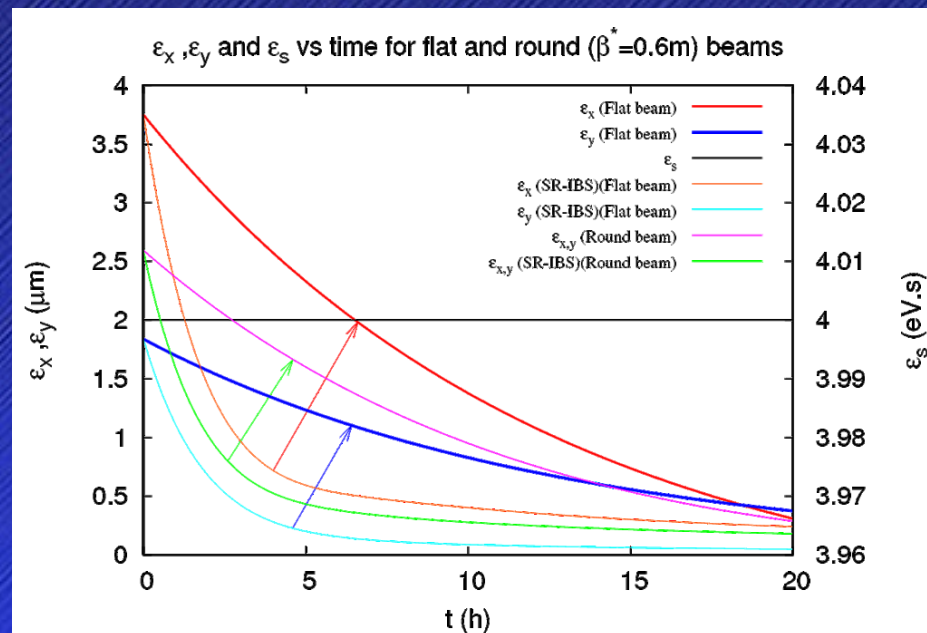
proceedings : E. Todesco and F. Zimmermann (eds), *The Higher-Energy Large Hadron Collider, Proceedings of the EuCARD-AccNet HE-LHC workshop, Malta, 14-16 October 2010, CERN, EuCARD-CON-2011-001*; published as CERN Yellow Report

## key topics

→ WP4 highlight talk by Ezio Todesco

**beam energy 16.5 TeV; 20-T magnets; cryogenics: synchrotron-radiation heat load; radiation damping & emittance control; vacuum system: synchrotron radiation**  
**new injector: energy > 1 TeV; parameters**

	LHC	HE-LHC
beam energy [TeV]	7	16.5
dipole field [T]	8.33	20
dipole coil aperture [mm]	56	40
#bunches	2808	1404
IP beta function [m]	0.55	1 (x), 0.43 (y)
number of IPs	3	2
beam current [A]	0.584	0.328
SR power per ring [kW]	3.6	65.7
arc SR heat load dW/ds [W/m/ap]	0.21	2.8
peak luminosity [ $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ ]	1.0	2.0
events per crossing	19	76



# EuCARD Newsletter article



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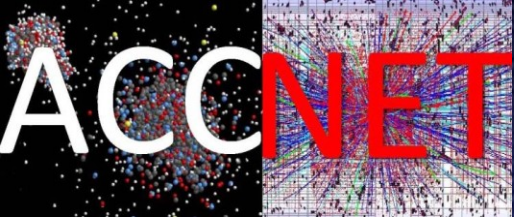
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## Proposed increase in energy takes LHC even further into the future

Accelerator scientists from around the world came together in Malta in October to discuss the possibility of increasing the energy of the present LHC. Organised by [AccNet](#) within EuCARD, the High Energy (HE) LHC workshop was convened to discuss the possible future LHC upgrade to a 16.5 TeV beam machine.



Participants in the HE-LHC'10 workshop. *Image courtesy of Kazuhito Ohmi. Thumbnail image on main page courtesy of CERN.*



# AccNet mini-workshop on crystal collimation

CERN, 25-27 October '10, ~32 participants, about 1/3 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).

<http://indico.cern.ch/conferenceDisplay.py?confId=109124>

## topics:

- collimation procedures assisted by bent crystals for HL-LHC and future large colliders
- critical review of results from H8 line,
- results of collimation experiments in “low energy” storage rings, such as the SPS,
- possible use of bent crystals for LHC collimation
- other applications of crystals and alternative advanced methods of collimation in other laboratories

# EuCARD Newsletter article



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## Crystal clear ideas for beam collimation

October marked the annual crystal collimation workshop at CERN, where encouraging results from tests in CERN's Super Proton Synchrotron (SPS) were revealed. These show potential for crystal collimation applications, possibly even in the LHC.

### Crystallizing collimation ideas

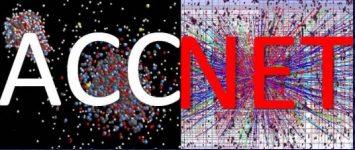
In particle accelerators, collimators trim and filter a beam, removing stray particles and keeping the beam focused and on track. Collimator R&D forms part of the EuCARD project ([WPS](#)) and conventional collimators are usually made from about 1 metre of carbon, though designs vary (see newsletter [issue 3](#)).

What makes crystal collimation a novel approach is that it performs the role of the 1m of carbon with just half a centimetre of silicon crystal. Large magnetic fields created by the atoms of the crystal create a large deflection of the beam halo.

The current SPS experiment, known as UA9, is looking at effects of crystal collimation in a circular machine, where the beam interacts with the crystals many times.



This 2mm-thick transparent slice (shown here in a metallic frame) is a quasimosaic silicon crystal. It is one of the new crystals currently being tested in CERN's Super Proton Synchrotron (SPS). *Image courtesy of Walter Scandale. Thumbnail image main page courtesy of Nico van Diem, [sxc.hu](#).*



# LHC-CC10 workshop



**LHC Crab Cavity Workshop, jointly organized by CERN, EuCARD-ACCNET, US-LARP, KEK, & Daresbury Lab/Cockcroft Institute, CERN, 15-17 December 2010**

<http://indico.cern.ch/conferenceDisplay.py?confId=100672>



~50 participants

- local crab crossing with compact 400 MHz deflecting SRF cavities has become HL-LHC baseline scheme for geometric luminosity-loss compensation and luminosity leveling
- further studies on machine protection and beam-dynamics or technology limits
- recommendation to test future LHC prototype cavities with & without beam out- & inside LHC
- refined roadmap by summer 2011



workshop summary: **R. Calaga (BNL), S. Myers (CERN), F. Zimmermann (CERN), Summary of the 4th LHC Crab Cavity Workshop "LHC-CC10", EuCARD-REP-2011-001 (2011)**



# LHC Crab Cavities – for High Luminosity-LHC

endorsed after LHC-CC09 workshop, September 2009

progress at LHC-CC10 workshop, December 2010

key points from LHC-CC10

**local scheme with compact crab cavities at 400 MHz;**

no SPS test with KEKB crab cavity;

several compact cavity candidates to be prototyped;

machine protection issues need detailed investigation;

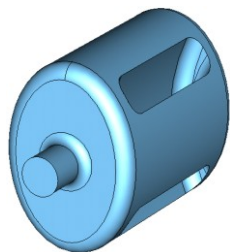
SPS & LHC beam test program with consistent time line;

**4-5 promising compact cavity designs**

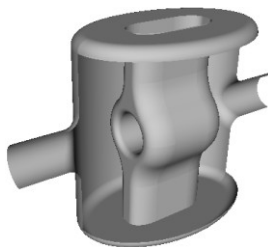


R. Calaga,  
P. Collier,  
S. Myers,  
R. Tomas,  
F. Zimmermann,  
et al, et al

Parallel bar  
elliptical TEM  
cavity (JLAB)



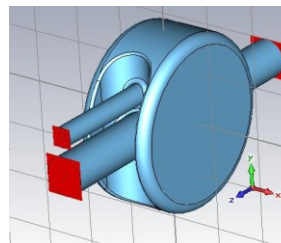
Half wave  
spoke  
resonator  
(SLAC)



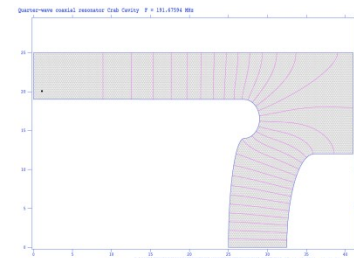
Four rod  
compact crab  
cavity  
(Cockcroft)

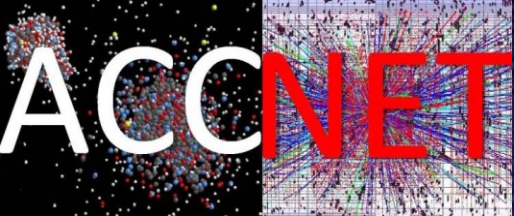


Rotated pill-  
box cavity  
(KEK)



Quarter-wave  
resonator  
(BNL)





# bilateral CERN-GSI workshop on electron cloud

CERN, 7-8 March '11, 30 participants, from CERN, GSI, INFN-LNF, KEK, CELLS, CINEVESTAV, and several other institutes.

**Goals:** <http://indico.cern.ch/conferenceDisplay.py?confId=125315>

- review the status of CERN and GSI electron-cloud studies
- find synergies between the two laboratories
- define a common strategy for future developments in terms of simulation tools, diagnostics and mitigation techniques for the LHC, SPS and FAIR



workshop summary: G. Rumolo, F. Zimmermann, O. Boine-Frankenheim, Summary of EuCARD-AccNet CERN-GSI Workshop on Electron Cloud, CERN, 7-8 March 2011

# AccNet progress on LHC e-cloud studies

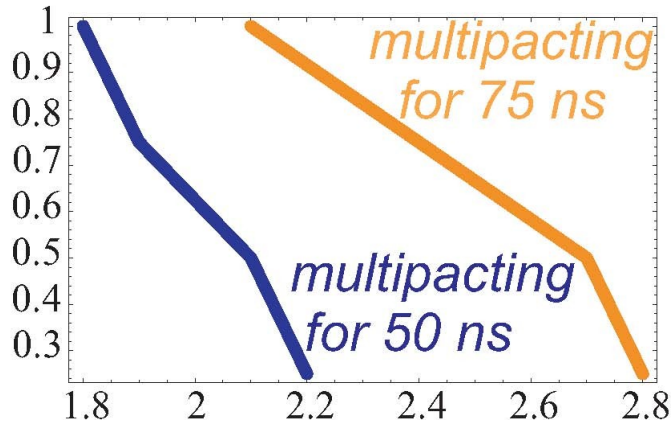
**objectives:**

O. Dominguez, G. Franchetti, U. Iriso, K. Li, H. Maury, G. Rumolo, F. Zimmermann

**surface properties** from benchmarking simulations with observations;  
**scrubbing and running scenario** for 2011; longer-term operation  
**modes & upgrade path ; beam stability & emittance growth**

**multipacting threshold in the LHC arcs**

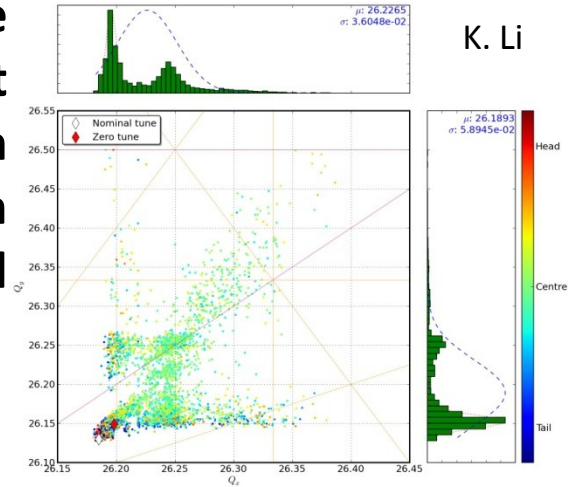
reflectivity  $R$



H. Maury

SEY  $\delta_{max}$

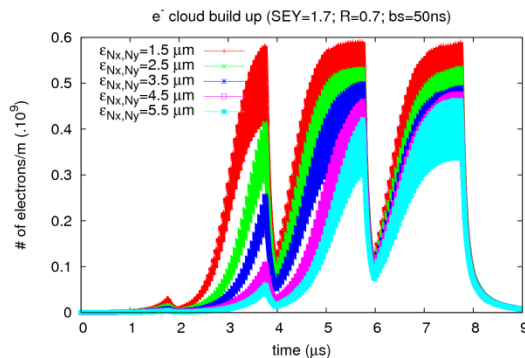
**tune footprint with electron cloud**



K. Li

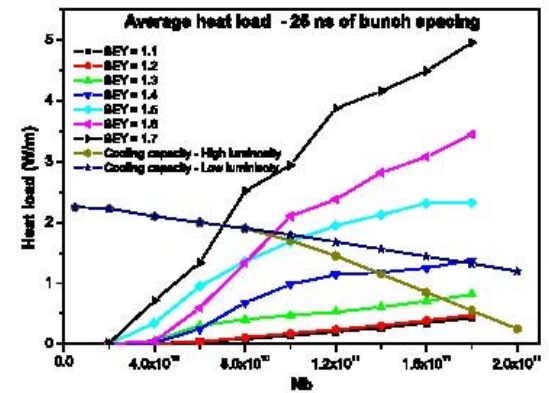
**effect of emittance on e- build up**

O. Dominguez



**e-cloud arc heat load for 25-ns spacing, vs. bunch intensity**

H. Maury



# RFTech activities

Workshop on "**Advanced Techniques in LLRF control for XFEL**", Cracow, PAS, 18-20 April 2010

RFTech organized with ITER, "**xTCA**" session of **MIXDES2010**, Wroclaw, 24-26 June 2010; devoted to development of HEP instrumentation, with high reliability, availability and serviceability; several standards (MTCA, ATCA or AMC) profiting from high-speed serial interfaces; objective: simplify the application of MTCA and ATCA hardware in HEP; RFTech supported 7 diploma and doctoral students

participation in workshop on X-Band RF technology, **XB-10**, on X-band RF structures, beam dynamics & sources, at CI (UK), 30.11-3.12. 2010

**2<sup>nd</sup> RFTech Annual Meeting** 2-3 December, PSI

joint organization of **LHC-CC10** together with EuroLumi

**R&D for SPL** (high-power Superconducting Proton Linac), RFTech established contacts to European and worldwide experts on SRF, & created 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

developing **strategy for SRF test infrastructures** in Europe;  
recommendation to push new materials & approaches: Nb film, high-Tc SC,...

# Advanced Techniques in LLRF for XFEL Workshop, Cracow 18- 20.04.2011

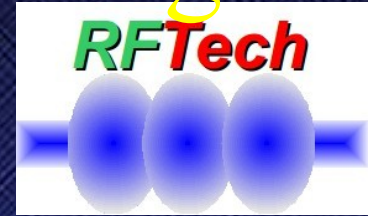
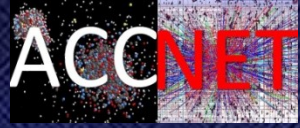
36 participants from Poland, Germany  
& US, 35 talks including 2 invited talks

topics:

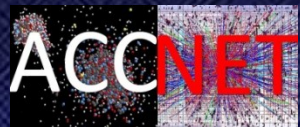
- towards CW operation of XFEL,
- summary of 9 mA test at FLASH,
- developement of uTCA based LLRF system (several talks)
- RF synchronization system for XFEL (several talks)
- LLRF software developement for XFEL
- quality management



# Second Annual RFTech Meeting PSI, 2-3 December '10



# Second Annual RFTech Meeting



PSI, 2-3 December '10



<https://indico.desy.de/conferenceDisplay.py?confId=2831>

*30 participants, ~2x 1<sup>st</sup> meeting! (BNL, DESY, CERN, CNRS, CEA, ESRF, IPJS, LU, LPSC, PSI, RHUL, SBT, SOLEIL, UJF, TUD, TUL, WU, ...) organized by T.Garvey, M.Grecki, J.-M.DeConto, W.Weingarten & PSI ; sharing experience among several fields of RF technology!*

- **Low Level RF:** CERN's PS complex LLRF renovation, SuperB project, FLASH system, as well as use of specific components like uTCA for XFEL machines
- **Solid State Amplifiers**, both in general and particular techniques as well as some specific developments, like at PSI, ESRF and SOLEIL
- **RF technology for FELs:** normal- and superconducting RF aspects (X Band structures, the Swiss FEL project, cryomodule technology) , summary of XFEL RF synchronization workshop
- **RF limitations related to LHC ultimate beam**
- **Cavity optimization:** crab-cavity design for the LHC, HOM free copper cavities
- **Superconducting RF**, e.g. cryomodule assembly in Saclay, SRF infrastructures in Saclay/Orsay, SBT in Grenoble, with **analysis and round-table discussion** on the need of a European SRF test infrastructure for R&D and test of cavities & cryomodules. Presenting **work of young scientists**, about cavity design & modelling

# EuroNNAc activities

regular phone meetings

PDPWA workshop organized at University College London, 10-11 February 2011

visit of Guoxing Xia (MPI) to CERN in March 2011

preparation of LOI for PDPWA experiment using SPS beam to be submitted to CERN SPSC Committee later in 2011

preparatory meeting of the EuroNNAc organisation committee at Paris Ecole Polytechnique on 8 April 2011

first major EuroNNAc workshop 3-6 May at CERN, firmly established new network and defined path towards novel accelerator facilities in Europe; about 100 expert participants

→ *highlight talk by Ralph Assmann*



# EuCARD Newsletter article



## European Coordination for Accelerator Research and Development Newsletter

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## A knack for novel acceleration techniques

**A new EuCARD network, EuroNNAc - European Network on Novel Accelerators, plans to unite advanced acceleration researchers to identify a coordinated European approach.**

On the initiative of CERN, DESY (Germany) and the École polytechnique (France), EuroNNAc will look at plasma wakefield acceleration and direct laser acceleration for electrons and positrons.

This is useful for High Energy Physics (HEP) and synchrotron radiation sources. It could allow for the next generation of free electron lasers, more powerful, more compact and hopefully cheaper. Other applications include material testing, nanoscience and fast diagnostics of chemical and medical processes.

### The need for speed

The current state-of-the-art is electron/positron beams with 1GeV energy. Within EuroNNAc, the goal is to push that figure to 10-100 GeV.

To achieve this, EuroNNAc will look at four



In 1509, Leonardo da Vinci noted and sketched that a rigid obstacle in flowing water creates wake of turbulence behind it. The passage of a moving body through a static medium has the same effect, and the turbulence can be used to accelerate a following body. What is true for a boat in water also applies to electrons passing through a gas. *Text, image and thumbnail image on main page courtesy of Nature v445 (1997).*

# RFTech exchanges & joint studies

participation in XB-10

HP-SPL R&D

strategy on SRF infrastructures & cryomodule

organizing & co-sponsoring several workshops / year

# EuroNNAc exchanges & joint studies

German PhD student Steffen Hillenbrand (KIT)

- **proton-driven plasma acceleration**

German experts Allen Caldwell, Guoxing Xia (MPI Munich)

- **proton-driven plasma acceleration**

Participation in German KET Strategy meeting, Dortmund  
2010

# EuCARD-AccNet highlights

so far **13 primary AccNet workshops, 68 AccNet documents, numerous exchanges of scientists**

**significant impact:**

- **crab cavities** established as HL-LHC baseline,
- pushing **HL-LHC large-Piwinski-angle** scheme
- **Higher-Energy LHC** – 1<sup>st</sup> ever workshop!
- joint **e-cloud effort** CERN-GSI-CELLS-KEK-TUD, **anti-e coatings**
- **roadmap for SRF test facilities**
- advancing **crystal collimation**
- **community organizer** for RF technologies (RFTech)
- community organizer for novel acceleration scheme (EuroNNAc)
- **add'l financial support from CINVESTAV Mexico**, inspired by initial EuCARD investment, for three visitors to continue AccNet activities, such as electron-cloud studies and LHC crab-cavity failure modes

# AccNet plans for next 6-12 months

## future AccNet workshops

- mini-workshop on **optics measurements, corrections and modelling** for high-performance storage rings 20-22 June 2011
- **3<sup>rd</sup> annual RFTech workshop**
- RFTech co-sponsored MIXDES2011 conference, Gliwice, June 2011
- co-organization of “**long bunch-trains**” workshop at DESY , June '11
- acceleration session at **ESA workshop MULCOPIM'2011**, Sept.'11
- RFTech co-sponsored workshop on **LLRF** at DESY in October 2011
- “**EuroLumi 2011**” (tentative) November or December 2011  
LHC limitations, LHC luminosity upgrade, LHC energy upgrade,  
SPS limitations, FAIR challenges
- mini workshop on **LHC crab cavities**, end of 2011 or early 2012
- **2<sup>nd</sup> plasma acceleration** workshop in 2012
- **Crystal collimation** mini-workshop, fall 2011
- brainstorming meeting(s) on **medical accelerators**

# AccNet plans for next 6-12 months – cont'd

## further development of LHC upgrade scenarios

- HL-LHC beam parameters (e.g. Piwinski angle scheme; experiments at PS, SPS, LHC; simulations)
- e-cloud benchmarking & mitigation (e.g. scrubbing scheme, coating, clearing electrodes)
- injector upgrade path (e.g. SPS limitations)
- energy upgrade (flat beam, crab waist, SR issues)
- intensity & luminosity limitations

# AccNet highlights talks at EuCARD 2011

## **Higher-Energy LHC**

*Ezio Todesco (CERN & EuCARD)*

**multiple resonance crossing with space  
charge and electron cloud**

*Giuliano Franchetti (GSI)*

**the new laser and plasma acceleration  
network**

*Ralph Assmann (CERN & EuCARD)*

# AccNet success indicators

excellent attendance to AccNet workshops  
from many European labs, universities, US laboratories,  
Japan, international organizations  
attendance of 2<sup>nd</sup> RFTech meeting doubled!

impact:

- on most relevant topics
- higher-energy LHC
- established crab-cavity scheme for LHC
- novel anti e-cloud coating techniques

high cost efficiency

- return on investment! (CINVESTAV)

# AccNet conclusions

AccNet had an excellent 2<sup>nd</sup> year

**EuroLumi gives input to LHC upgrades**

compact crab-cavity baseline, “LPA” scenario

e-cloud mitigation, modeling & predictions

revisions of LHC upgrade plans

higher-energy LHC

link to DS LHC HiLumi, US-LARP, KEK, etc.

**RFTech assumed cruising speed**

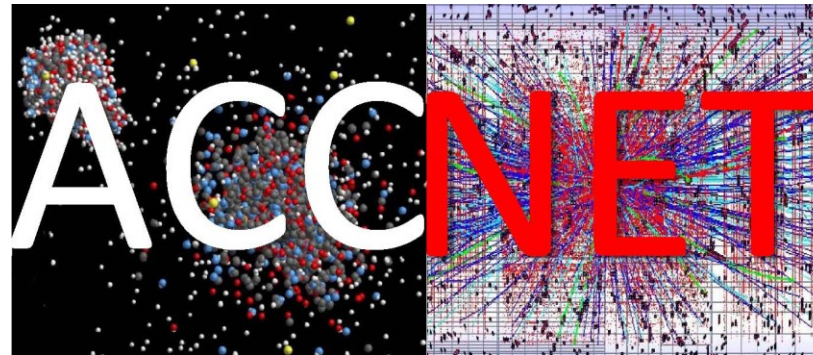
input to XFEL, LHC, GANIL etc. RF systems

**AccNet is breaking new grounds**

plasma acceleration, crystal collimation

**Rich workshop programme in 2010-11**





**pushes frontiers**

*for accelerators in Europe  
and around the world*

# Appendix

*AccNet  
expenses & deliverables*

# AccNet deliverables

**D.4.1.1** –Continually updated **AccNet web site**

<http://cern.ch/accnet/> )

**D.4.2.1** – A continually updated **EuroLumi web site**

(<http://cern.ch/accnet/Tasks/Eurolumi/> )

**D.4.3.1** – A continually updated **RFTech web site**

(<http://cern.ch/accnet/Tasks/Rftech/> )

**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.

The AccNet web sites are documented in a **report**

<https://edms.cern.ch/file/1001866/4/EuCARD-Del-D4.1.1-D4.2.1-D4.3.1-1001866-v3.0.pdf>

The completed deliverables are available from the link

<http://cern.ch/EuCARD/about/results/deliverables/> .

# AccNet milestones

## **M.4.1.2**

- 3<sup>rd</sup> **general AccNet Steering meeting** during the 2nd EuCARD Annual meeting at CNRS at Frascati.

## **M4.2.2:**

- Instead of a general annual EuroLumi workshop, **4 topical mini-workshops** have been organized and supported during the second year (high efficiency of topical workshops; minimum interference with LHC consolidation and re-commissioning): **HE-LHC'10, LHC-CC10, CrystalCollimation'10, CERN-GSI e-cloud**
- **next major EuroLumi workshop in fall 2011**

## **M4.3.2:**

- 2<sup>nd</sup> annual **RFTECH workshop was held 2-3 December 2010**



# AccNet expenses

travel & per diem for **Mexican CINVESTAV visitors**

H. Maury (1 year) and B. Yee (2 months)

travel support & per diem for **KEK expert** K. Ohmi

travel support for **3 experts** R. Cimino, U. Iriso, and G.

Franchetti to attend CERN-GSI e-cloud workshop

travel support of **expert** U. Wienands for HE-LHC'10

support of **several workshops** (participation in HE-LHC'10, 2<sup>nd</sup> RFTech workshop, XB-10, LLRF Control for XFEL, MIXDES2011)

travel support for **crystal expert** (S. Dabagov)

moderate **support for** LHC-CC10, Crystal-Collimation 2010

and CERN-GSI **workshops**

travel costs for **SC mtgs** and **EuCARD annual meetings**