The Cockcroft Institute
of Accelerator Science and Technology

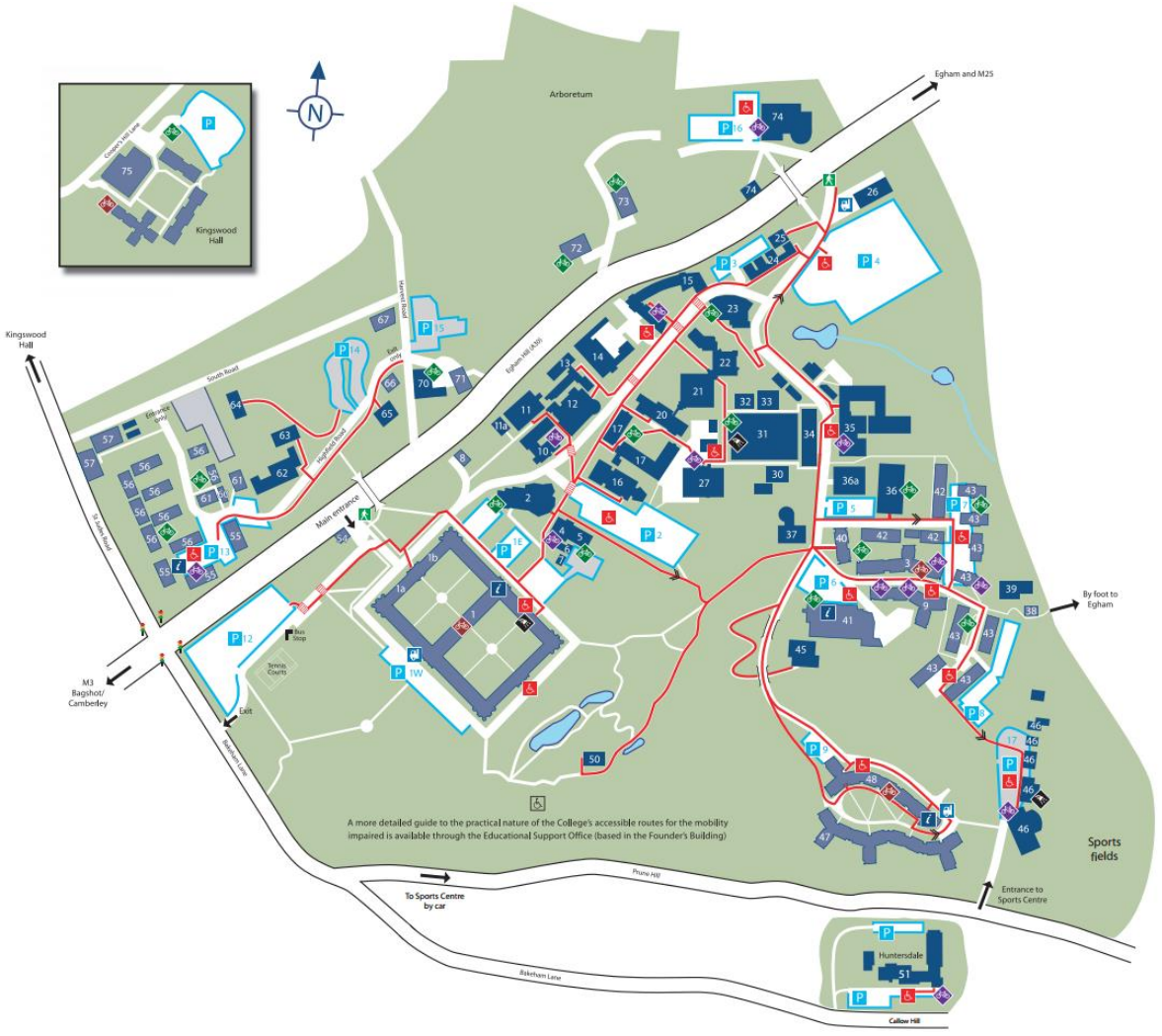
UNIVERSITY OF LIVERPOOL

oPAC Advanced School on Accelerator Optimization

7TH – 11TH July 2014
Royal Holloway University of London, London, UK

Rita Galan

Admin / Logistics: RHUL



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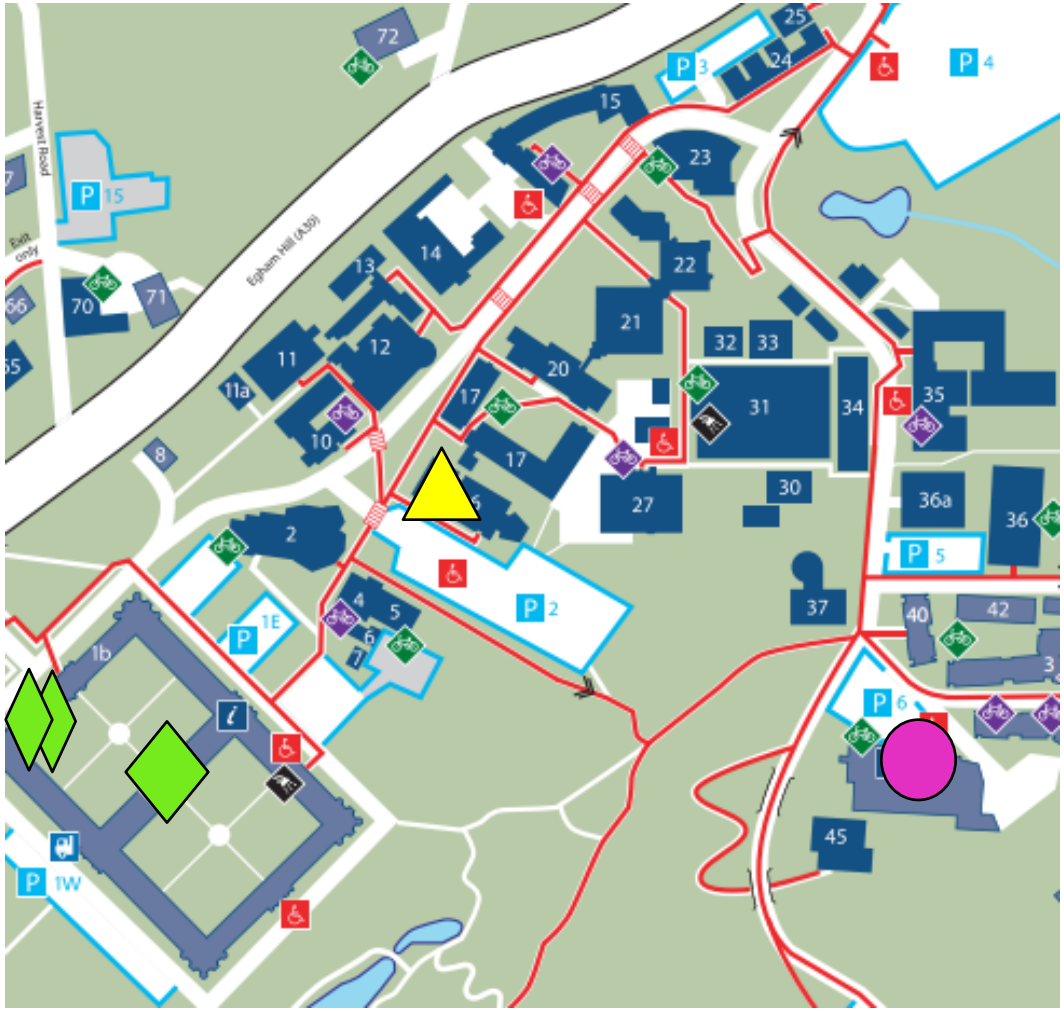


Schedule

Advanced oPAC School on Accelerator Optimization: RHUL, UK	Monday 7 July to Friday 11 July 2014				
	Monday 7th	Tuesday 8th	Wednesday 9th	Thursday 10th	Friday 11th
8:30 **9:30**	Admin/logistics oPAC Rita Galan, ULIV Welcome / Introduction Paul Hogg, RHUL Pavel Karataev, RHUL	Lattice Design: Bernhard Holzer, CERN	Beam Cooling Techniques Igor Meshkov, JINR	LHC Optimization Rogelio Tomas, CERN	09:00 start for SB and Fellows. 09:30 start for other delegates 9:00 Supervisory Board (SB) Annual Meeting: Fellows overview of progress Room AG24
9:30 **10:30**	History of Particle Accelerators: Philip Bryant, CERN	Beam Profile Measurements (basics, high intensity beams, cryo, high energy) Enrico Bravin, CERN	Beam Loss Monitoring - detectors: Sergey Vinogradov, ULIV	Numerical Optimization of Particle Accelerators Oliver Boine-Frankenheim, GSI Accelerator Control Systems Mark Plesko, Cosylab	Compact AMS Systems Jose Maria Lopez, U. Seville SB Annual Meeting continued
11:00 **12:00**	Beam Dynamics, recap: Carsten Welsch, ULIV	Beam Position Measurements (also industry aspects) Stewart Boogert, RHUL	Particle Tracking Codes: David Newton, ULIV	Tutorial session split in 4 groups SC meet Room AF28	The European Spallation Source – The first 'green' accelerator Andreas Jansson, ESS
12:00 **13:00**	Particle beam characterization Pavel Karataev, RHUL	High(er) accelerating gradients: Alan Wheelhouse, STFC	3rd generation Light source Francis Perez, ALBA		Future Accelerators: Frank Zimmermann, CERN
			LUNCH		
14:30 **15:30**	Sourcery: Jürgen Pozimski, IC	Tutorial session split in 4 groups	Next generation Light Sources Jim Clarke, STFC	Poster session	DEPARTURE
15:30 **16:30**	Accelerator Magnets: Neil Marks, STFC		Tour of London 16.50: Train to London, 2½ h walking tour, Dinner at rainforest café 20:00 Back at 22.45		
17:00 **18:00**	Q&A: Philip Bryant, CERN	Beam Loss Monitoring Eduardo Nebot, CERN		Seminar: roads into the anti-world Michael Doser, CERN	
Eve	Sunday 18:30: Reception at Foyer of the Arts building Finger food & drinks	18:30: Outreach seminar for general public and local media. Higgs – Phil Burrows		19:00 – 24:00 Formal Dinner at RHUL picture gallery	

Meals: Founders Dining Hall. Dinner: 18:00 on Monday, 20:00 Tuesday and Wednesday, 19:00 Welcome drinks & dinner on Thursday
Lectures: Art Lecture Theatre 1 (ALT1)

Tutorial Sessions: ALT1, AG24, AG3, AF1

Where and When?

- Meals:
  - Breakfast: 07:30 - 08:59 Founders Dining Hall (FdH)
  - Lunch: 13:00 – 14:00 FdH
  - Dinner:
    - Monday at 18:00 FdH
    - Tuesday 20:00 FdH
    - Wednesday: 20:00 Rainforest Cafe
    - Thursday 19:00 Picture Gallery
- Lectures: Art Lecture Theatre 1 (ALT1)
- Tutorial Sessions: ALT1, AG24, AG3, AF1

Delegate package

- Schedule
- Feedback forms: important to improve
- Future events!: oPAC, LA^{3}NET
- Delegate's list
- Tutorial sessions
- oPAC Brochure

Emergency Contact Numbers

- Rita Galan +44 (0)7926682352
- Carsten Welsch +44 (0)7973 247982

What is oPAC?

- Optimization of Particle Accelerators
  - 23 ESRs
  - 35 Partner Institutions *(and growing...)*
  - 6 M€

www.opac-project.eu

Overview of Consortium

- Beneficiary partners

- Associated partners

Adjunct Partners

- Part of the long term strategy – oPAC is growing

VIALUX

IFIN-HH

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

CMAM

US University of Sussex

UNIVERSITY OF DUNDEE

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

SLAC NATIONAL ACCELERATOR LABORATORY

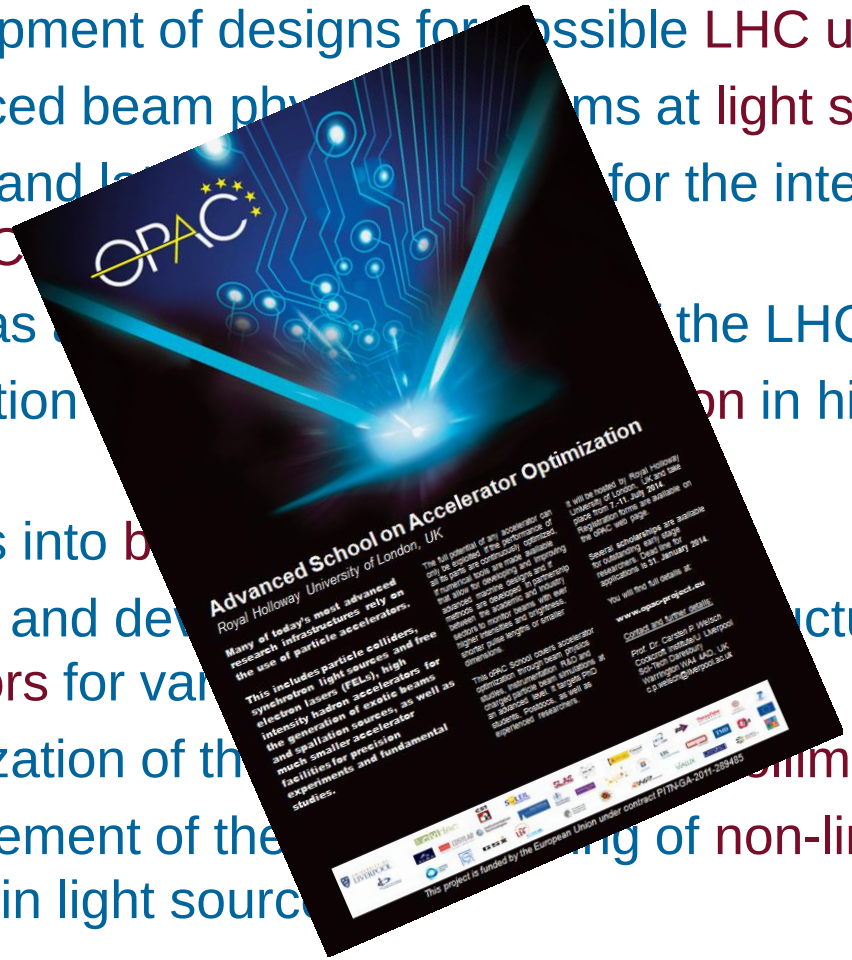
UPPSALA UNIVERSITET

MANCHESTER 1824 The University of Manchester

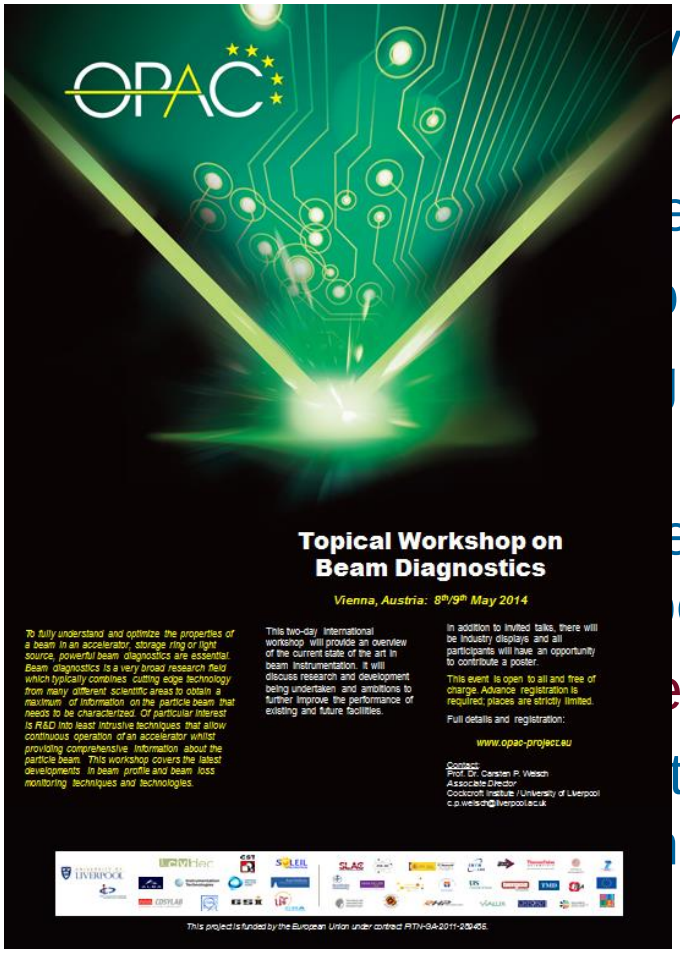
INFN LNS

WP2 – Beam physics

- Development of designs for ossible LHC upgrade options
- Advanced beam ph ms at light sources
- Optics and la for the interaction region design of the LHC
- LHeC as the LHC
- Simulation on in high brightne dron beams
- Studies into b
- Design and de uctures as detectors for va
- Optimization of th limation
- Improvement of the g of non-linear be effects in light sourc



WP3 – Beam Diagnostics



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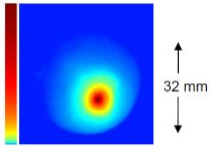

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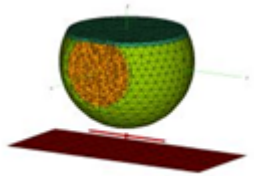
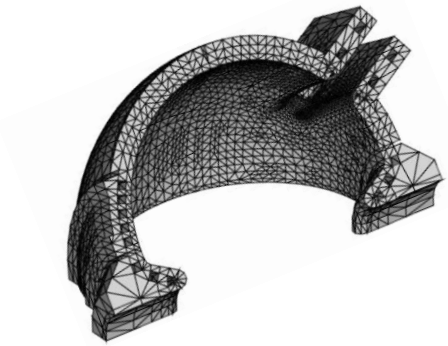
WP4 – Simulation Tools

- Included in most R&D project, plus:

- Development of a simulation suite based on th[illegible]ultilevel fast multipole method



- [illegible]ent of a GPU-based PIC solver



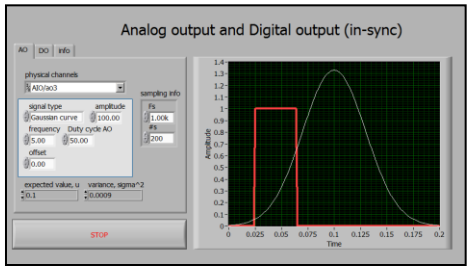
WP5 – Control Systems

- Links all R&D projects, plus:
- Adaptation of existing open-source control systems from compact accelerators to large scale facilities
- Improvement of the process to identify the needs for accelerator instrumentation

Accelerator Optimization: Examples

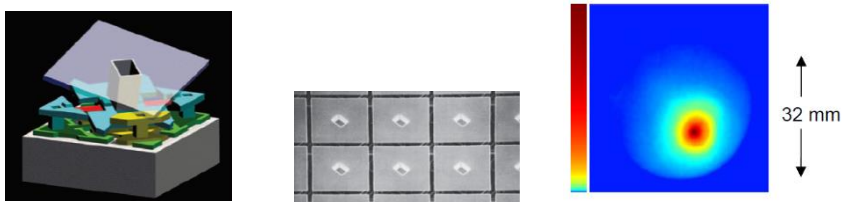
- Adaptation of existing open-source control systems from compact accelerators to large scale facilities

  P. Maslov, Cosylab



- Beam Halo R&D

  B. Lomberg, University of Liverpool



C.P. Welsch, et al., Meas. Sci. Technol. **17** (2006)
Phys. Rev. ST-AB (2012).

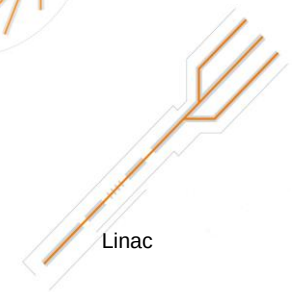
Accelerator Optimization: Examples

- Design and development of common applications for different particle accelerators

  Manuel Cargnelutti, Instrumentation Technologies

Synchrotron Light Source

Hadron Collider



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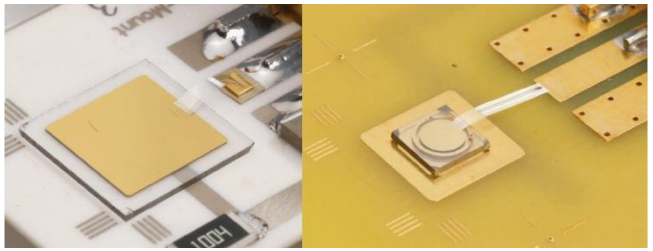
- Development of a versatile beam loss monitor

  Pavel Kavrigin, CIVIDEC



Publications and Talks

Publications

M. Bartosik, et al., ‘Characterisation of Si Detectors for use at 2 Kelvin’, Proc. IPAC, Shanghai, China 2013.

M. Bartosik, et al., ‘Radiation Tolerance of Cryogenic Beam Loss Monitor Detectors’, Proceedings IPAC, Shanghai, China 2013.

E. Cruz, et al., 'LHeC IR Optics Design Integrated Into the HL-LHC Lattice', Proceedings IPAC, Shanghai, China 2013.

P. Kavrigin, et al., ‘Diamond Detectors for LHC’, Proceedings of the International Conference on Beam Instrumentation, IBIC 2012 Conference, Tsukuba, Japan, 2012.

P. Kavrigin, et al., ‘Recent Results of the Diamond Beam Loss Monitors at LHC’, , Conference Proceedings of the International Conference on Beam Instrumentation, IBIC 2013 Conference, Oxford, Great Britain, 2012.

K. Kruchinin, et al., 'Backward X-ray Transition Radiation from Multi-layered Target for Submicron Beam Diagnostics', Proceedings IPAC13, Shanghai, China 2013.

K. Kruchinin, et al., 'Sub-micrometre resolution laser wire transverse beam size measurement system', Proceedings IPAC13, Shanghai, China, 2013.

B. Lomberg, et al., ‘Beam Halo Monitor Based on an HD Digital Micro Mirror Array’, Proceedings , IBIC, Oxford, UK, 19.09.2013.

M. McAteer et al., ‘Preliminary Results of Linear Optics from Orbit Response in the CERN PSB’, Proceedings IPAC’13, Shanghai, China 2013.

M. McAteer et al., ‘Determination of Octupole and Sextupole Polarities in the LHC’, Proceedings IPAC’13, Shanghai, China 2013.

S. Naveed, et al., 'Beam Position Monitor R&D for keV ion beams', Proceedings IBIC, Oxford University, Oxford, UK 19.09.2013.

X. Nuel Gavaldà, et al., 'Modelling resulting from magnetic and beam based measurements of the ALBA gradient dipoles', Proceedings IPAC13, Shanghai, China, 2013.

L. Torino and U. Iriso, 'Charge Distribution Measurements at ALBA', Proceedings IBIC, Oxford, UK, 2013.

L. Torino, et al., 'Transverse beam size measurements using interferometry at Alba', Proceedings IBIC, Oxford, UK, 2013.

L. Torino ‘Charge Distribution Measurements at ALBA’, IBIC, 16-19.09.2013.

Valloni, 'Strawman optics design for the LHeC ERL Test facility’, Proceedings IPAC, Shanghai, China 2013.

G.P. Wall, C.P. Welsch, 'Employability in Europe: Enhancing Post Graduate Complementary Skills Training', Proc. HEA STEM: Annual Learning and Teaching Conference, Birmingham, UK (2013)

C.P. Welsch, 'Accelerator Optimization within the oPAC Project', Proc. IPAC13, Shanghai, China (2013)

C.P. Welsch, ‘Optimal Acceleration’, PanEuropean Networks: Science & Technology 6 (2013)

C.P. Welsch, ‘Beam Instrumentation R&D within oPAC”, Proc. IBIC, Oxford, UK (2013)

C.P. Welsch, 'oPAC - optimizing accelerators through international collaboration', Proc. IPAC, New Orleans, USA (2012)

C.P. Welsch, 'Beam diagnostics research within OPAC', Proc. BIW, Virginia, USA (2012)

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Talks

M. McAteer ‘Optics Measurements in the FNAL Booster and the CERN PSB’, 2nd Joint HiLumi LHC-LARP Annual Meeting, INFN, Frascati, Italy, 14-16.11.2012.

M. McAteer ‘Polarity checks of non-linear circuits’, LHC Optics Measurement and Corrections Review, CERN, Geneva, Switzerland, 17-18.06.2013.

A. Valloni ‘Beam Physics in Future Electron Hadron Colliders’, 25th North American Particle Accelerator Conference, NA-PAC’13, Pasadena, USA, 30.09-04.10.2013.

Valloni ‘Beam Physics in Future Electron Hadron Colliders’, Physics Opportunities at an Electron-Ion Collider workshop, Jyväskylä, Finland, 2-5.09.2013.

M. Sofranac ‘ Development of a Multi GPU based PIC’, KWT 2013 Workshop on Advances in Electromagnetic Research, Riezlern, Austria, 17-23.08.2013.

L. Torino, ‘Charge Distribution Measurements at ALBA’, IBIC, Oxford, 19.9.2013

M. C. Battaglia ‘Design of a detection system to verify 2D dose maps for Intensity Modulated Radiation Therapy (IMRT) treatment’, talk CNA, Seville, Spain, 09.2013.

K. Kruchinin, ‘Extremely Low Emittance Beam Size Diagnostics with Sub-Micrometer Resolution Using Optical Transition Radiation’, IBIC, Oxford, 17. 9.2013

S. Naveed, ‘Multi-level fast multipole method for accelerator optimization’, University of Ankara, 20.8.2013

C.P. Welsch, 'Cross-sector collaboration in Accelerator R&D', Thorlabs, Munich, Germany, 20.9.2013

C.P. Welsch, 'Industry-Academia Collaboration', CST AG, Darmstadt, Germany, 15.8.2013

C.P. Welsch, 'Roles & Goals of EC projects: A Vision for Europe - View of a University', EUCard2 kickoff meeting/Visions for the future of Particle Accelerators, Cern, Switzerland, 11.06.2013

C.P. Welsch, 'Re-Structuring Post Graduate Researcher Training', HEA STEM: Annual Learning and Teaching Conference, Birmingham, UK 11.06.2013

C.P. Welsch, 'Employability in Europe: Enhancing Post Graduate Complementary Skills Training', HEA STEM: Annual Learning and Teaching Conference, Birmingham, UK, 17.4.2013

S. Davies, 'Industry-Academia Collaboration', Soltan, Slovenia, 10.10.2012

C.P. Welsch, 'Research & Training Initiative in Accelerator Sciences – the oPAC Project', University of Mainz, Germany, 2.8.2012

C.P. Welsch, 'Accelerator and Beam Instrumentation R&D', Karlsruhe Institute of Technology, Germany, 30.7.2012

…

Publications and Talks

Journal Papers

- 'Sub-micrometer transverse beam size diagnostics using optical transition radiation', K. Kruchinin, et al., Journal of Physics: Conference Series 517 (2014)
- 'Laserwire: A high resolution non-invasive beam profiling diagnostic', L. Corner, A. Aryshev,..., K. Kruchinin, et al., Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Volume: 740, Pages: 226 - 228, (2014)

WP6 - Training

- Objective: Train the next generation of accelerator experts in best possible way
- Provide them with ideal skills basis for their future careers
- Promote collaboration and cross sector exchange
- Secondments R&D at different places

Motivation: *Ideal* Training.

Training

- Local training by host;
- Network-wide schools on accelerator techniques;
- Intra-network exchange of researchers;
- Secondments to other network partners (cross sector);
- Training in complementary skills.

➡ Motivation: *Ideal* Training.

Skills training for first year PGRs
Course Structure

- PhD project-specific part
  - Presentation skills
  - Scientific writing
  - Project management

- Generic skills through outreach project
  - Team working
  - Proposal writing
  - Peer review
  - Working under (time) pressure

"I hadn't really thought of myself as a project manager until today!"

'Best practice'

Secondments

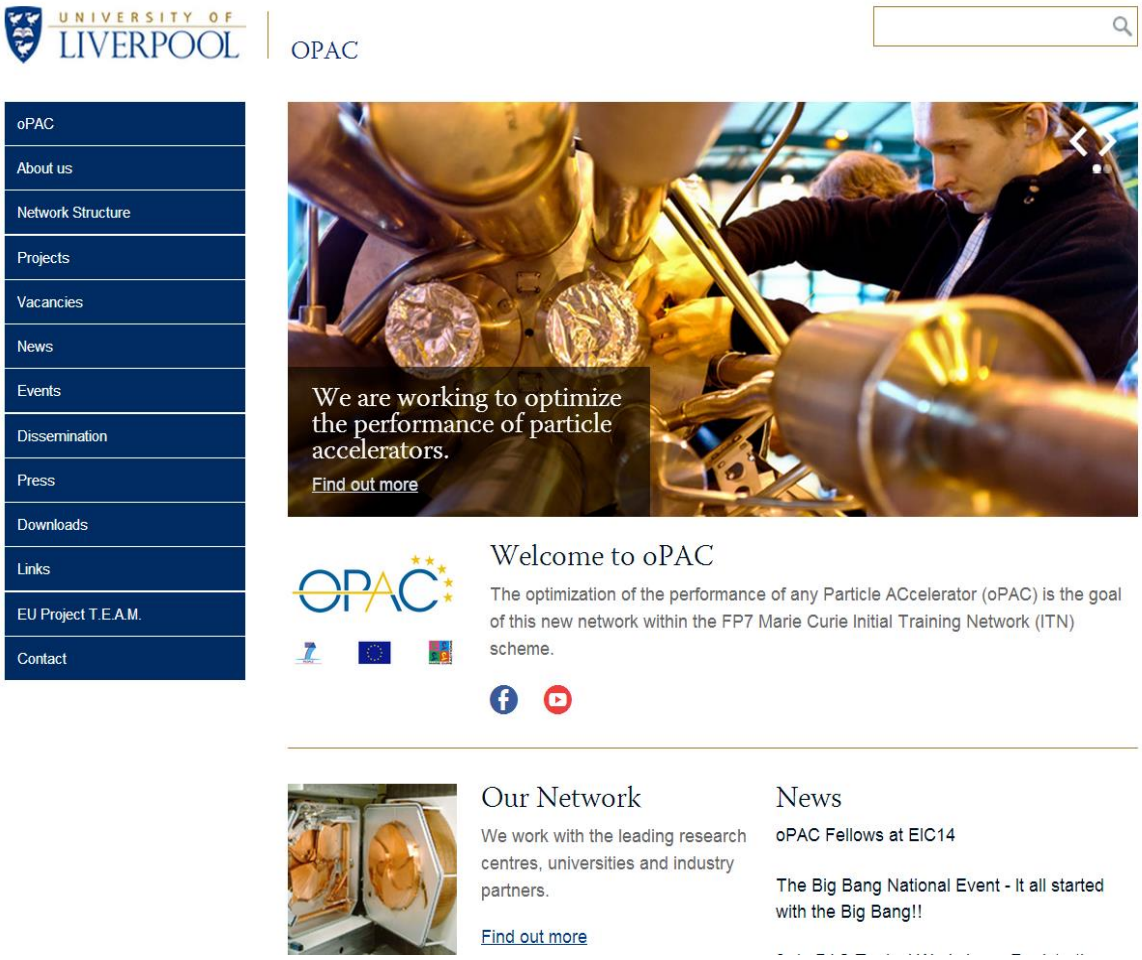
- Part of every R&D projects;
- Duration: 2 weeks – several months;
- Ensures cross-sector experience;
- Helps understanding different needs and success criteria;
- Gives access to important infrastructures/tools;

Adds value to training !

Future Events

- ***Accelerator School* with RHUL, July 2014**
- *CAoPAC:* Computer Aided optimization of Particle Accelerators Workshop, March 11th-13th 2015, GSI
- *Technology transfer* with UoL/CI, June 2015
- *Advanced Researcher Skills* with UoL/CI, June 2015
- *Symposium* with UoL/CI, June 2015
- *Conference* with US/CNA, October 2015

Dissemination: oPAC Website



www.liv.ac.uk/opac

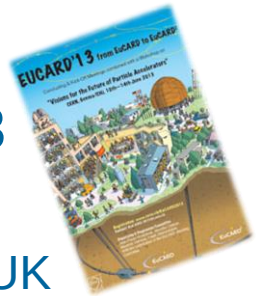
Dissemination: Quarterly Newsletter

- Part of the dissemination strategy
- Contribution from all network partners
- Announcement and review of activities
- > 500 recipients, growing
  - All available via home page.

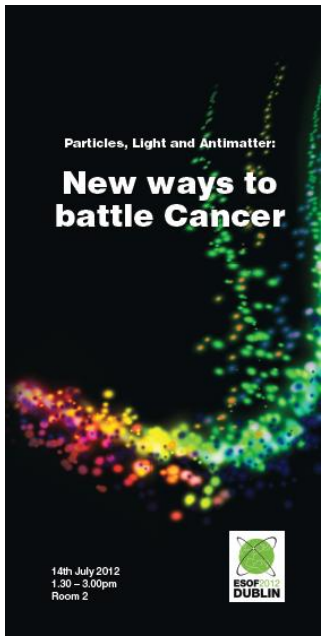
Follow us on Facebook

Dissemination: Conferences

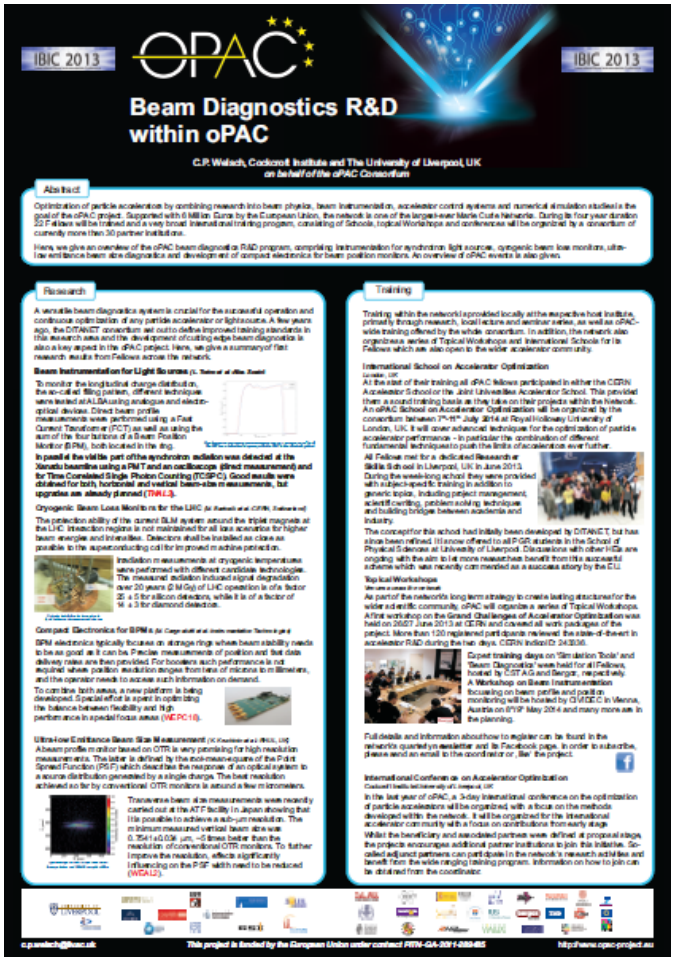
- Conferences 2012
  - IPAC stand and contribution
  - BIW contribution
  - ESOF session



- Conferences 2013
  - IPAC contributions
  - IBIC stand in Oxford, UK
  - Many seminars, conferences, etc.



- Conferences 2014
  - IPAC stand in Dresden, Germany
  - HEA Workshop
  - ESOF
  - Contributions to BIW
  - Learning & Teaching Conference ULIV

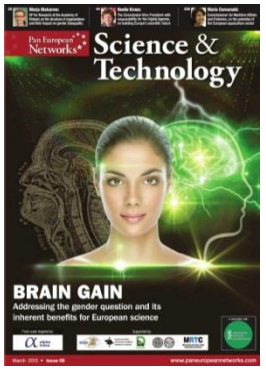


Outreach

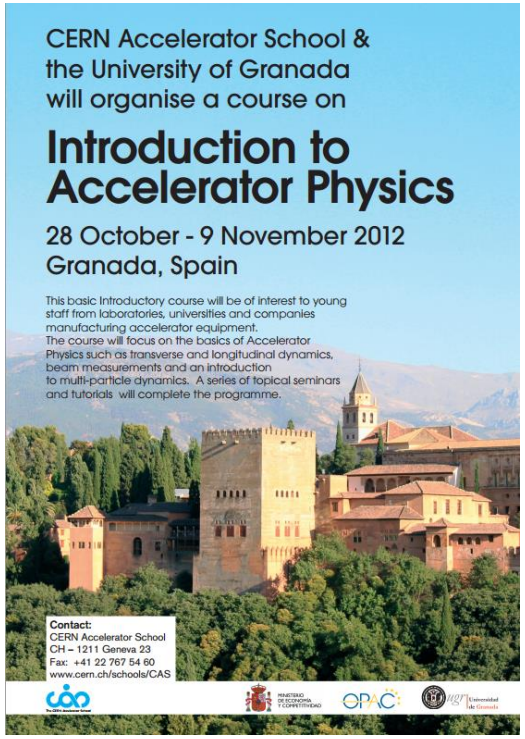
- Leaflet for all events and personal contacts
- ESOF contributions – Session coordination
- Media interaction
- Fellows:
  - Webcasts about projects
  - Engagement with local schools
  - Specific opportunities (e.g. CERN guide, STEM ambassadors, etc.)
- Conference – Symposium

Publications

- IPAC 13: Fellows publications
- Pan European Networks, Science and Technology 6 (2013)
- STFC‘s UK news from CERN 2013: Issue 17 on oPAC
- Higher Education Academy‘s Annual Learning and Teaching Conference in Birmingham, UK



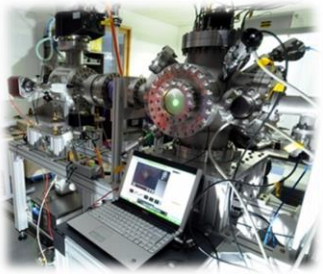
Partnership



oPAC has already become an important part of the accelerator community !!

Accelerator R&D

- Cross-sector collaboration key to research
- Large-scale experiments require international cooperation



- Research area needs significantly more trained accelerator experts
- Few universities in EU provide structured training – oPAC is unique initiative.

Summary: Status

- Very good research results beyond expectations!
- Training program helped to created links between Fellows; recognized as success (UKRO, HEA, etc.);
- Excellent contributions from industry;
- Events as drivers for knowledge exchange.

Further information

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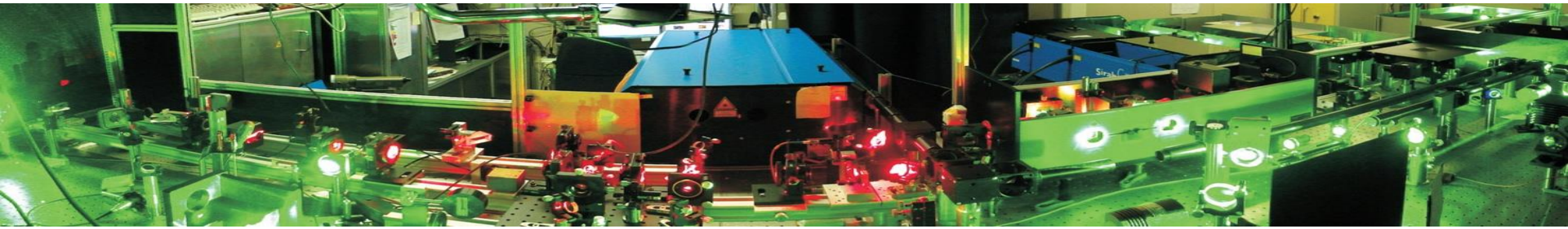

Panorama photograph of the RILIS setup at CERN (image courtesy V. Fedosseev).