Welcome !!

to the CAoPAC Workshop

Carsten P. Welsch

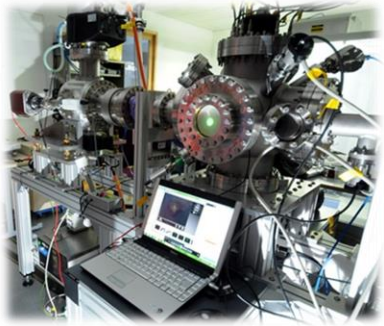
What is oPAC ?

- Optimization of Particle Accelerators
  - 23 ESRs
  - >30 Partner Institutions
  - 6 M€

www.opac-project.eu

Why needed ?

- Well suited as cross-sector collaboration is key to our research.
- Essentially all large-scale experiments require international cooperation

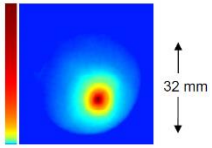


- Research area needs significantly more trained accelerator experts;
- Few universities in EU provide structured courses – oPAC drives innovation in researcher training

WP2 – Beam physics

- Development of designs for possible LHC upgrade options
- Advanced beam physics problems at light sources
- Optics and lattice design studies for the interaction region design of the LHC experimental insertions
- LHeC as a future upgrade option of the LHC
- Simulation studies into halo generation in high brightness hadron beams
- Studies into beam loss patterns at ESS
- Design and development of resonant structures as Schottky noise detectors for various frequencies
- Optimization of the layout of the LHC collimation system
- Improvement of the understanding of non-linear beam dynamics effects in light sources

WP3 – Beam Diagnostics

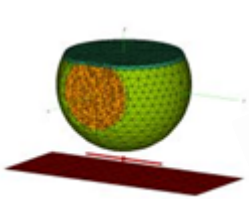


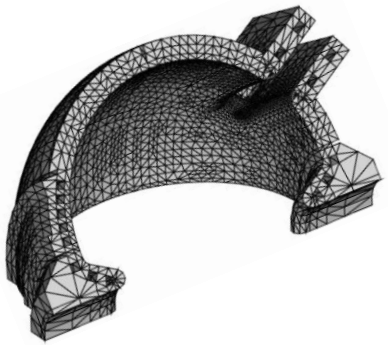
- Beam halo monitor development
- Optimization of beam instrumentation for light sources
- Cryogenic SQUID-based beam current monitor
- Beam Loss Monitors for use in Cryogenic Environments
- Methods for measuring the beam profile in high intensity beams
- Laser-wire beam profile monitor for measuring the transverse beam profile of an H- beam
- Optimization of ^{10}Be detection
- Design a detection system for verifying a 3D method of image reconstruction for Intensity Modulated Radiotherapy Treatment (IMRT)

WP4 – Simulation Tools

- Included in essentially all R&D projects, plus:

- Development of a simulation suite based on the multilevel fast multipole method
- Development 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

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 to under how R&D works at different places

➡ Motivation: *Ideal* Training.

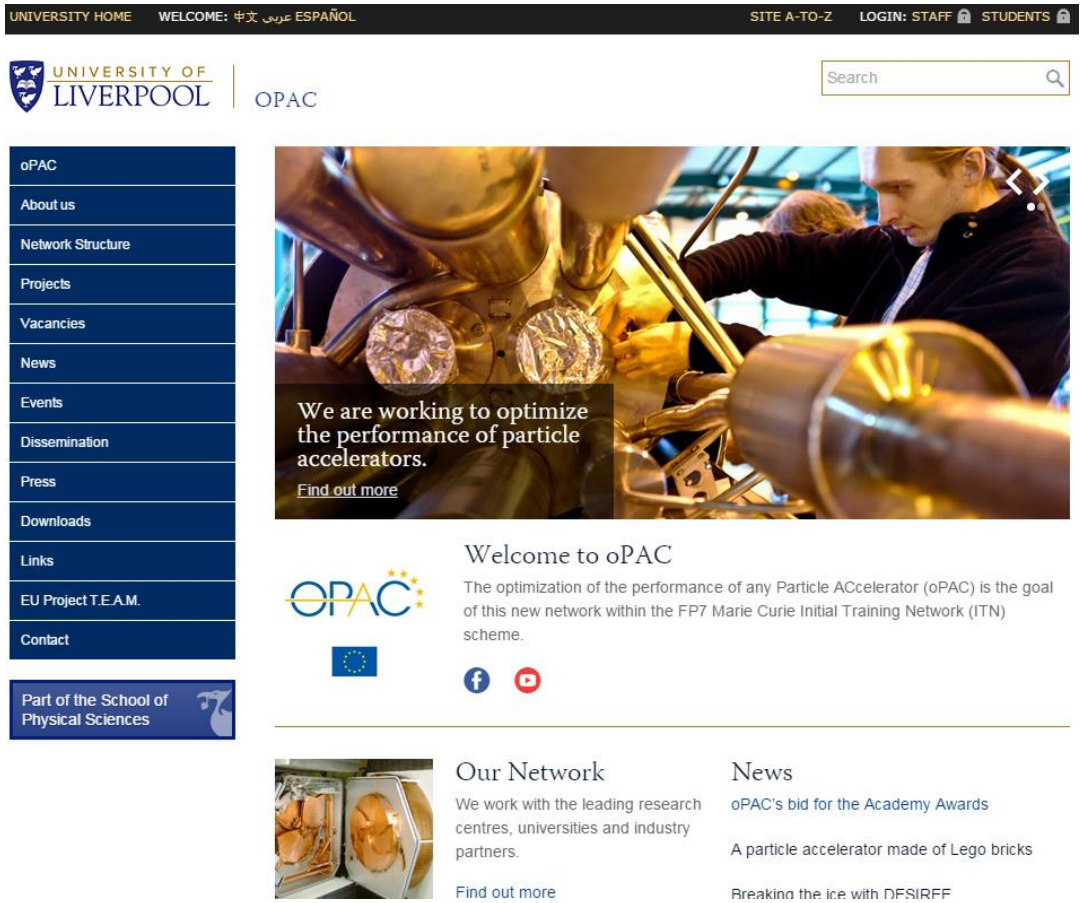
‚Success stories' (EC)

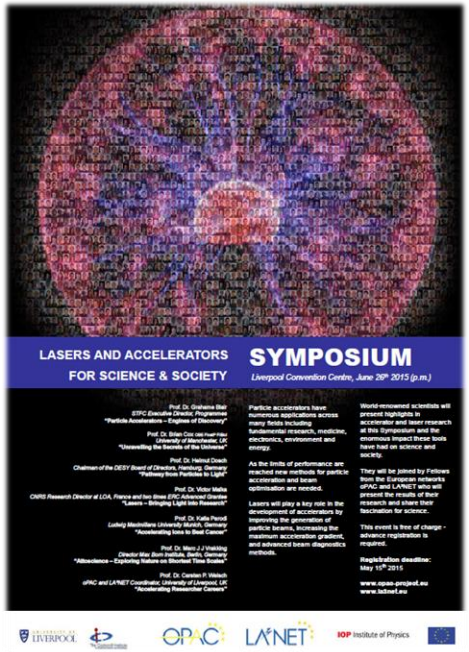
- Fellow R&D
- Researcher skills training
- Dissemination and Outreach
- Project Coordination & Management

➡ Also recognized as ‚best practice' by HEA, UKRO, etc.

Stay tuned !!

- URL: (http://www.)opac-project.eu





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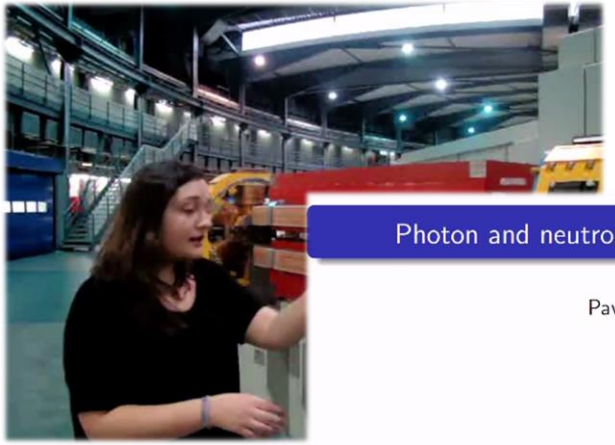
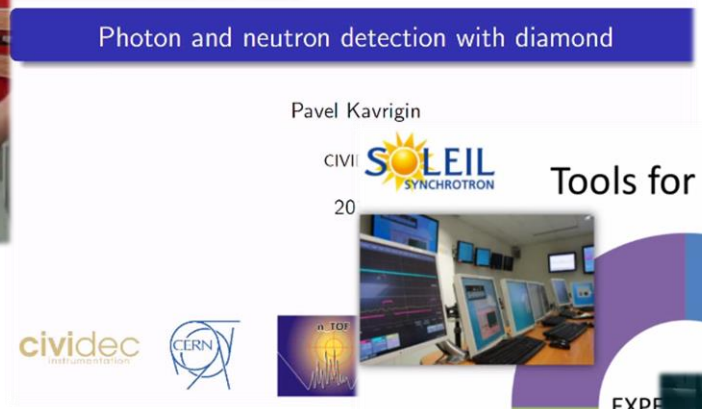
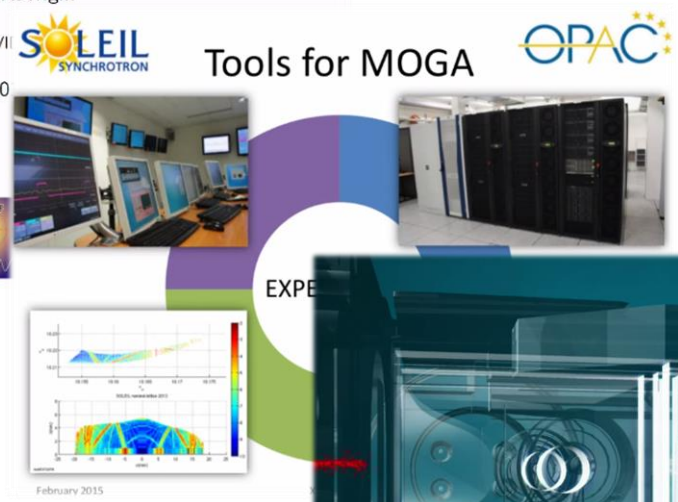
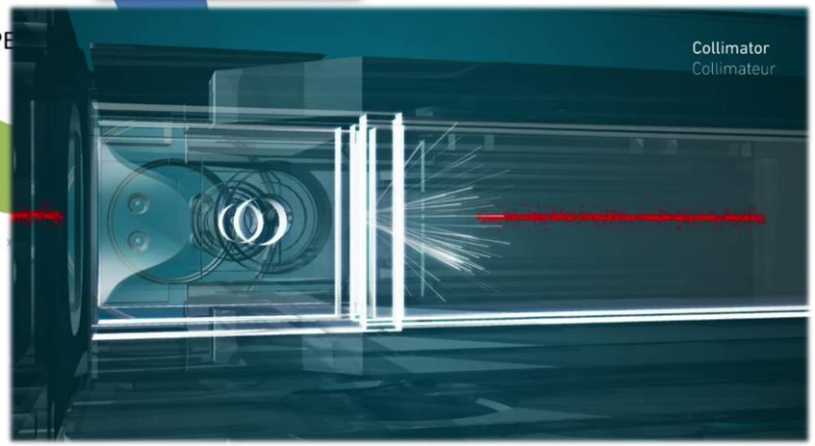
Enjoy the movies !









Examples – many more on
www.opac-project.eu

Bringing the community together

Still growing - join us !

Upcoming Events

- Symposium „Lasers and Accelerators for Science and Society“, Liverpool, UK – 26 June 2015

- Conference on Accelerator Optimization, Seville, Spain, 7-9 October 2015

- Meet the TEAM @ IPAC, USA

This Workshop...

- An exciting program has been put together by our Fellows
- Engage in discussions – find out about new tools, latest upgrades and advanced computation techniques

Simulation techniques in beam instrumentation	*Adam JEFF*	
GSI main auditorium		09:00 - 09:30
RF cavity simulations using CST	*Beatriz BRAVO*	
GSI main auditorium		09:30 - 10:00
Beam cleaning in experimental IRs in HL-LHC for the incoming beam	*Hector GARCIA MORALES*	
GSI main auditorium		10:00 - 10:30
Coffee Break		
GSI Helmholtz Centre for Heavy Ion Research		10:30 - 11:15
Simulation of Accelerator Components with CST Studio Suite	*Maryam KIYANI*	
GSI main auditorium		11:15 - 12:15
Contributed talk		
GSI main auditorium		12:15 - 12:45

Numerical Tools for Accelerator Optimization

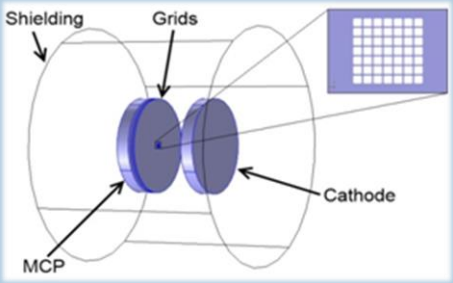
Carsten P. Welsch

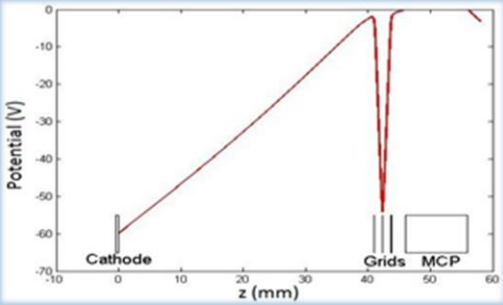
Looking back 2 years...

- Workshop @ CERN
- IndicoID: 243 336
- Several talks about numerical tools between ‚big science‘ experiments

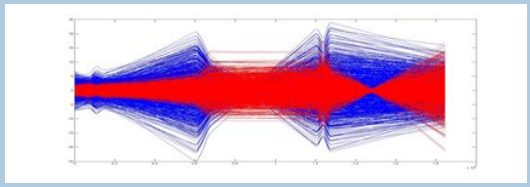
Computer-aided design...

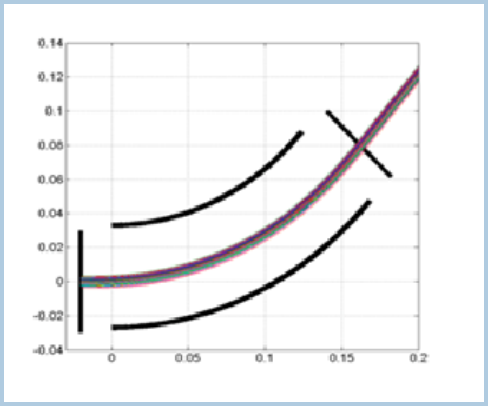
...we can‘t do without it ! *(all examples from www.quasar-group.org)*



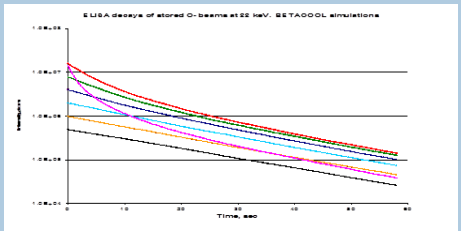


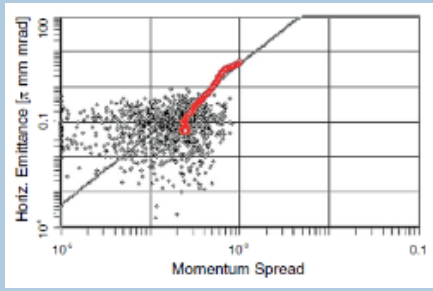
Beam generation





Transport

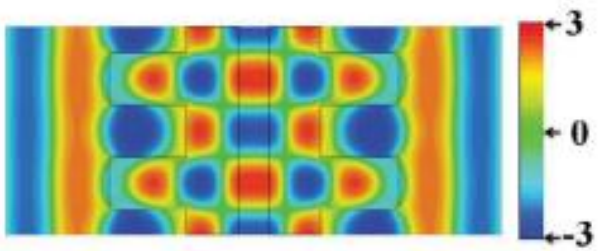


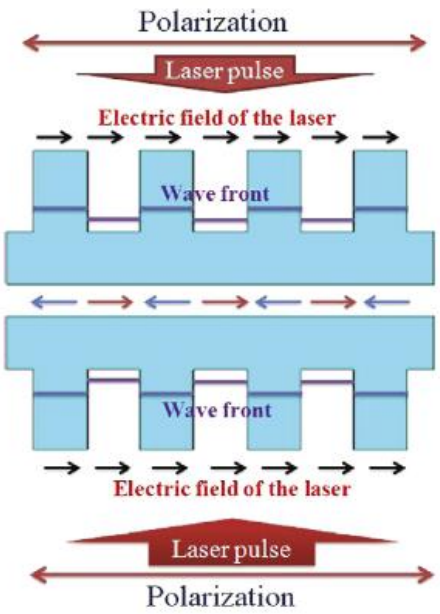


Storage

Exploring new concepts

- Dielectric stuctures

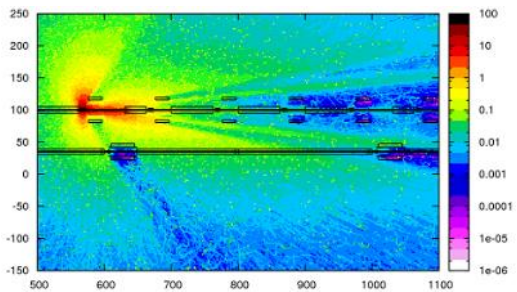




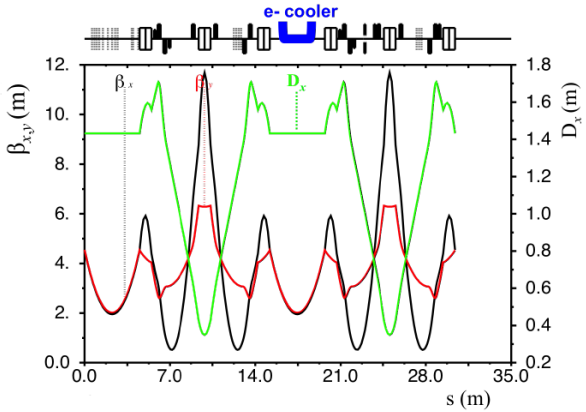
- Particle-driven plasma wakefield acceleration
  - Beam-plasma interaction
  - Diagnostics specification

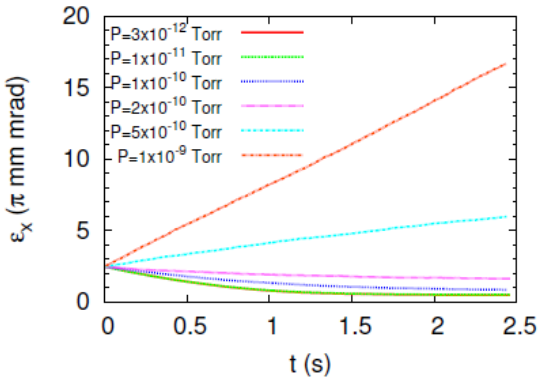
Diagnostics and beam dynamics

- See Adam Jeff's talk for more details
- Examples include: Beam Loss Monitoring



- Next generation low energy antimatter facilities





BeaPhy

Easy to forget:

- Simulations support experiments – they do not replace them !
- Advantages and disadvantages in using purpose-built codes vs. commercial solutions
- Building up a real understanding of the physics of your problem first
- Computer power will only replace careful planning of your simulation to a certain degree.
- This workshop: Overview of various codes, meet the experts, build up a knowledge network !

Goals of oPAC

- Promote international collaboration

- Provide access to world-class research infrastructures
- Include blue sky <u>and</u> applied research
- Strengthen industry – academia partnership
- Organize workshops and conferences as drivers for knowledge exchange

Be part of it !