

Researcher Training Fellow's perspective

Alexandra Alexandrova

University of Liverpool



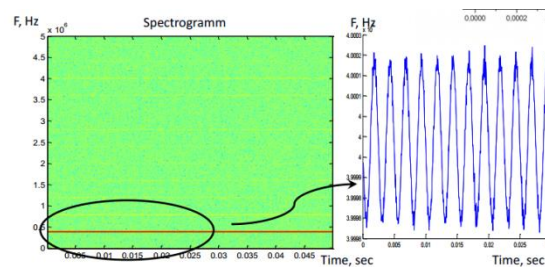
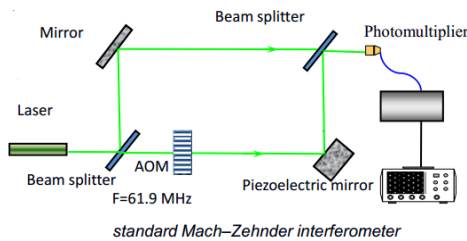
Outline

- My background
- LA³NET training and beneficial points
- Early Stage Career Researcher vs. PhD
- Challenges and how to meet them
- My results
- My current state

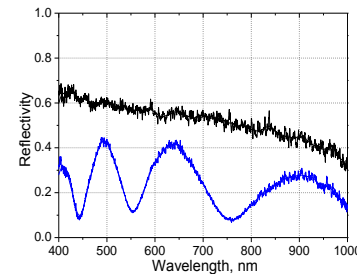
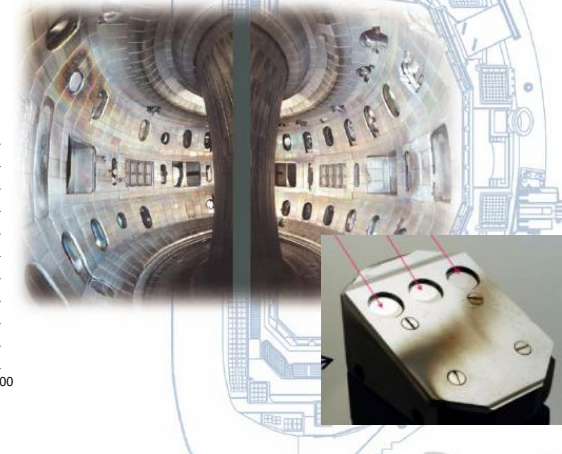
Background

Education: Moscow Engineering Physics Institute (2006-2012), Russia
Laser Physics

Photonic Doppler velocimetry



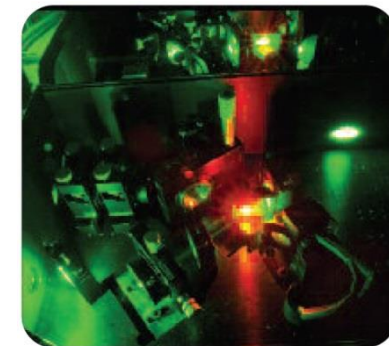
Development of the method of laser cleaning of mirror surfaces for optical diagnostic systems at the ITER



LA³NET project: September 2012

LAser Applications at Accelerators a european NETwork

- More than 35,000 accelerators in the world;
- Lasers are becoming increasingly important;
- Few experts trained in both fields;
- Large scale facilities: International collaboration is key !



Multi-disciplinary field !

Classic PhD training vs Early Stage Career Researcher

Evolution: Marie Curie networks



- Focus on academic career path;
 - Scientific papers as key quality indicator;
 - Training through (often blue sky) research;
 - Very little training in **complementary skills**;
 - Students or researchers ?
- PhD opportunity;
 - Provides trainees with broad skills base;
 - Enable secondments between nodes;
 - Promote collaboration across the network;
 - 100% focus on research project

LA³NET project

- 19 fellows from all over the world

- Training within two fields: lasers and accelerators

- Connection and bonding with other fellows



Events

- **Topical Workshops**
 - Laser Based Particle Sources
 - Laser Technology and Optics Design
 - Novel Acceleration Schemes
 - Beam Diagnostics (tbc)
 - Laser Applications at ...
 - ...
- **International Schools**
 - Laser Applications at Accelerators, 2012, Ganil, France
 - Advanced School on Laser Applications, 2014, Salamanca
 - Advanced Researcher Skills School, Liverpool, June 2015
- **Conference and Symposium**



All presentations are available via <https://indico.cern.ch/>

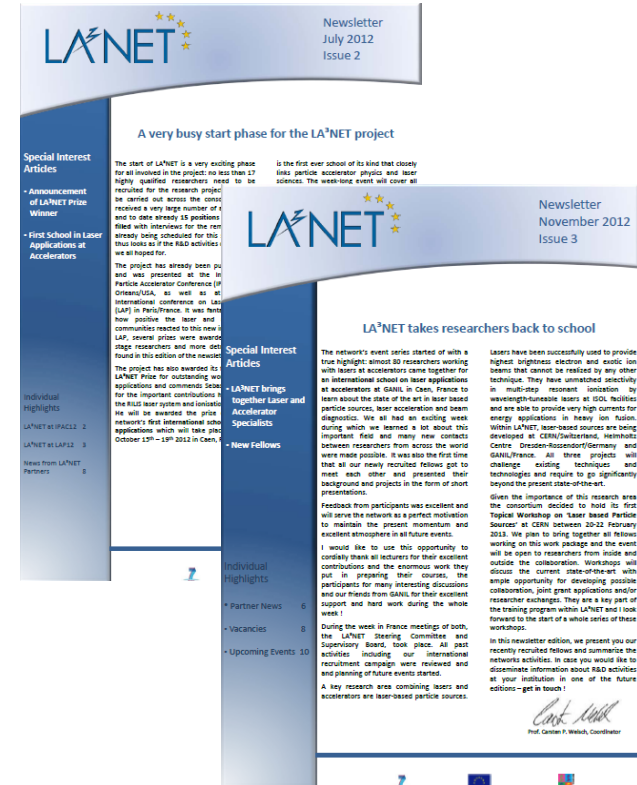


- First major event;
- Held at GANIL, Caen/France;
- IndicoID: 177701
- 80 participants
- LA³NET prize.



Quarterly Newsletter

- Part of the dissemination strategy
- Contribution from all network partners
- Announcement and review of activities
- > 500 recipients



Follow us on Facebook



Conference contributions

- **Conferences 2012**
 - IPAC stand
 - BIW, LAP, etc.

- **Conferences 2013**
 - FEL, IPAC, IBIC, HEA L&T, etc.
 - IBIC stand

- **Conferences 2014**
 - IPAC stand, ESOF
 - IBIC, IPAC

- **Conferences 2015**
 - IPAC stand, ESOF,
 - IBIC, IPAC



LANET
Beam Diagnostics R&D Within LA³NET
C.P. Welch, Cockcroft Institute and The University of Liverpool, UK
on behalf of the LANET Consortium

Abstract
Laser has become increasingly important for the successful operation and continuous optimisation of particle accelerators. For beam diagnostics laser provides the highest time and spatial resolution for transverse and longitudinal beam profile measurements. This also allows the detection of density fluctuations in particle beams with high dynamic ranges and permits measurements of very important machine parameters such as the momentum compaction factor and beam emittance. The development of these laser applications for accelerators is the focus of the LANET project funded by the UK with a total budget of £10M. The IPT (Marie Curie Intra Training Network 276) will bring together more than 20 academic and industrial organisations from around the world. 17 early stage researchers (ESRs) will be recruited to the project to work on pre-defined research projects in specific particle accelerators. In addition, the network will organise a number of international training events, have an overview of the latest research and training progress in particle accelerators at least once a year.

Research
Diagnostic systems are essential constituents of any accelerator; they meet the requirement of beam analysis and feedback in a regular, without an appropriate set of diagnostic systems, it would not be possible to operate an accelerator at any significant performance.
The LANET project has pioneered a new approach to researcher training in the field and the concepts developed by this consortium have formed the basis view for the LANET Intra-4 Research R&D program to now extend beyond diagnostics, as a central element of the LANET project and have a new research program.

Development of a Laser Velocitymeter
The development of a laser velocitymeter (LVM) is a key element of the LANET project. The LVM is a non-invasive diagnostic tool for measuring the velocity of particles in a beam. It is based on the Doppler effect and is used to measure the longitudinal velocity spread of a beam. The LVM is a key element of the LANET project and is used to measure the longitudinal velocity spread of a beam.

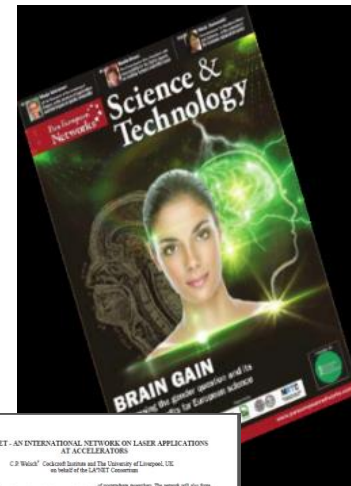
Laser Emittance Meter for LHC4
The LHC4 is a key element of the LANET project. The LHC4 is a key element of the LANET project and is used to measure the longitudinal velocity spread of a beam.

High Resolution Longitudinal Beam Profile Measurements
The LANET project is focused on the development of high resolution longitudinal beam profile measurements. This is a key element of the LANET project and is used to measure the longitudinal velocity spread of a beam.

International Conference on Laser Applications
The LANET project is focused on the development of high resolution longitudinal beam profile measurements. This is a key element of the LANET project and is used to measure the longitudinal velocity spread of a beam.

Publications

- IPAC 13: fellows publications
- Pan European Networks, Science and Technology 6 (2013)
- STFC's UK news from CERN 2013: Issue 14 on LA³NET
- Higher Education Academy's Annual Learning and Teaching Conference in Birmingham, UK
- LA³NET Brochure and Booklet



Find out more !



- www.opac-project.eu
- www.la3net.eu
- www.cockcroft.ac.uk

@cockcroft_news



TheCockcroftInstitute

QUASARGroup



LA³NET project

- Research project and PhD project;
- Training: within LA³NET project plus Additional Training (Vacuum training; Matlab; etc.)



- Secondment

Worked in collaboration with the University of Bari, Italy

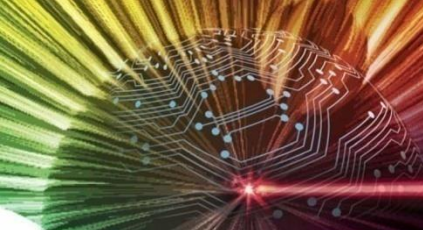
Established other collaborations



Leading your own project

- Self-motivation
- Planning projects
- Building collaborations
- Critical view of own abilities
- Writing about results
- Being pro-active





My project

Secondment:
University of
Bari, Italy

Host



Labs
Facility
Research
R&D

Fellow

Specific training
Collaboration
establishing

Network

Schools
Training
Contacts
Network



Networking impacts and plans

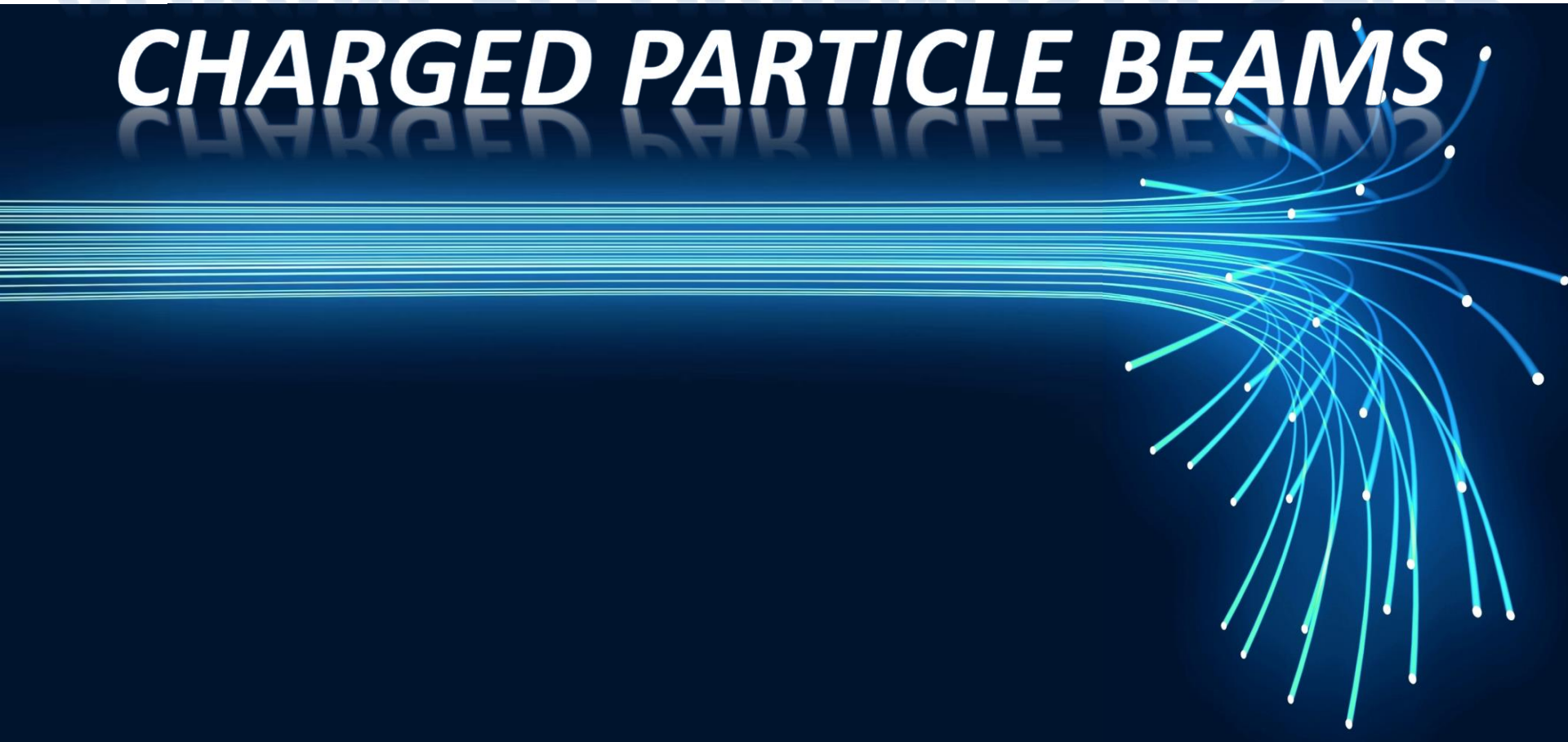
- management of own project: design of the monitor from the scratch;
- Intensive plans;
- Collaboration: within LA³NET project and building new collaboration with groups that are working in the same field;
- Interdisciplinary project: laser physics, mathematics, fluid dynamics, beam diagnostics ;
- Opportunity to expand knowledge and be aware of own strength

Challenges

- New country; new language; new culture
 - » Better integration? Social life?
- Dealing with problems arising during work in the new atmosphere
 - » Problems = opportunities?
 - » It is OK to have problems 😊
- Collaboration with other groups and fellows
 - » Encouraging? Give freedom?
- Time is precious
 - » Planning? Support?

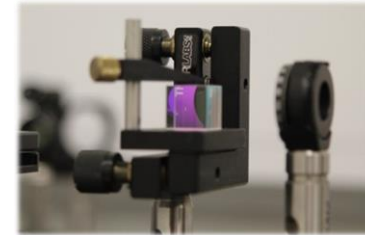


***ADVANCED DIAGNOSTICS FOR
CHARGED PARTICLE BEAMS***





D-Beam



Alexandra Alexandrova

*The University of Liverpool
Physics Department*

and

*The Cockcroft Institute
Sci -Tech Daresbury*



THE ROYAL
SOCIETY
OF EDINBURGH

ENTERPRISE
FELLOWSHIPS

RSE ENTERPRISE
FELLOWSHIP



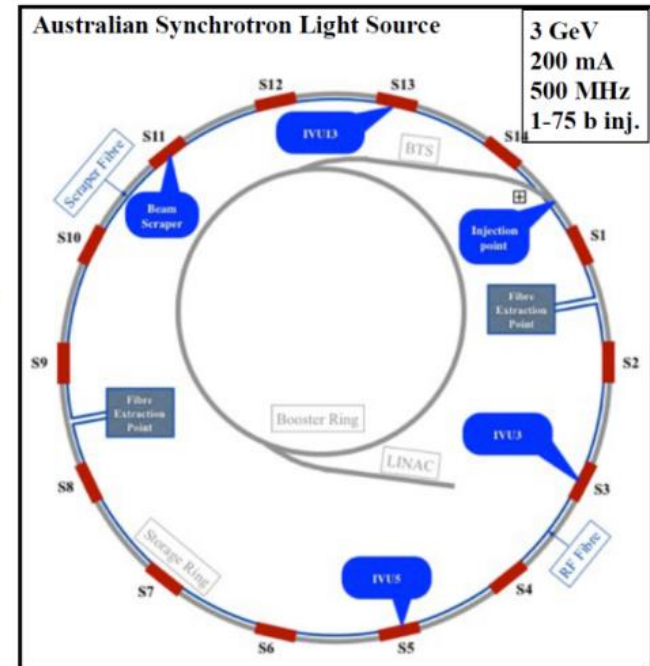
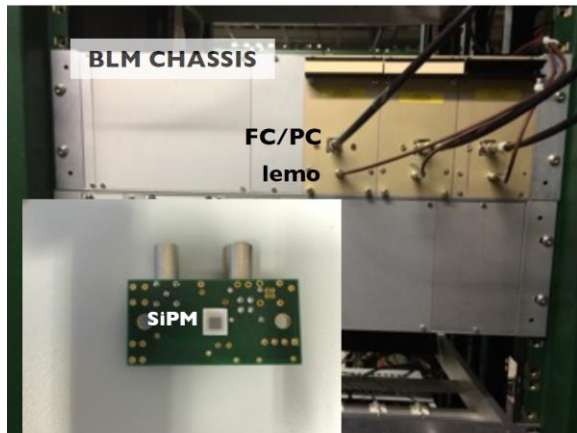
Optical Beam Loss
Monitors

Beam Intensity Monitors

Beam Profile Monitors

Technology Example

Optical Beam Loss Monitor



Superior time and spatial resolution
Save money and time

Find out more

- <http://www.d-beam.co.uk/>



Summary

- LA³NET R&D program gave an excellent start;
- Unique combination of research areas;
- Exciting new opportunities are about to start!
- Important to see the project as exciting and challenging task

Thanks for your attention !

Thank you

Questions?

www.la3net.eu



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Conference contributions

- Conferences 2012
 - IPAC stand
 - BIW, LAP, etc.
- Conferences 2013
 - FEL, IPAC, IBIC, HEA L&T, etc.
 - IBIC stand
- Conferences 2014
 - IPAC stand, ESOF
 - IBIC, IPAC
- Outreach Symposium 26 June 2015
- Own conference in 2015 – Mallorca



Beam Diagnostics R&D Within LA*NET
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Abstract
Lasers have become increasingly important for the successful operation and continuous optimisation of particle accelerators. For beam diagnostics laser provide the highest time and spatial resolution for transverse and longitudinal beam profile measurements. They also allow the detection of slowly developing particle losses with high dynamic range and permit measurements of very important machine parameters such as the non-linear composition factor and beam emittance. The development of these laser applications for accelerators is the focus of the LA*NET project funded by the UK and EU governments. The IFF Marie Curie Action Training Network is the only European training network for this field. This paper describes the network's activities from its inception in 2009 to the present. It will describe the project to date, work on detailed research projects at specific partner sites. In addition, the network will organise a number of international training events, seminars, an overview of the most relevant and training program to date with members of 17 research groups.

Research
Diagnostic systems are essential constituents of any accelerator. They need the properties of laser emission to measure and monitor beam quality. Without an appropriate set of diagnostic research, it is not always possible to measure and operate an accelerator at its maximum performance. The STRATE project has pioneered a new approach to researcher training in this field and the complete development of this approach has formed the basis of the LA*NET Initiative. A focused PhD program has formed the basis of the LA*NET Initiative. A focused PhD program has formed the basis of the LA*NET Initiative. A focused PhD program has formed the basis of the LA*NET Initiative.

Training
Training of all fellows will mostly be through research on dedicated individual projects related to the network's main activities with specific requirements to other partners for specialist techniques and/or accelerator expertise. In addition, the LA*NET structure will also organise a number of network-wide events that will open to the wider scientific community.

International Network
The network will be organised during the first and third year of LA*NET. The first network meeting will be held in October 2012 at CERN, France. The second will be held in March 2013 at DESY, Germany. The third will be held in June 2014 at SLAC, USA. The network will also organise a number of international training events and seminars, an overview of the most relevant and training program to date with members of 17 research groups.

Topical Workshops
The network will organise a series of Topical Workshops that will also be open to external participants. A topical workshop will bring together 20-30 experts in a given field. This includes:
1st LA*NET Topical Workshop: Particle Source, CERN, Switzerland, March 2013.
2nd LA*NET Topical Workshop: Laser Technology & Diagnostics, SLAC, USA, June 2013.
3rd LA*NET Topical Workshop: Laser Acceleration, DESY, Germany, March 2014.
4th LA*NET Topical Workshop: Accelerator Diagnostics, DESY, Germany, June 2014.
5th LA*NET Topical Workshop: Beam Diagnostics, Cockcroft Institute, UK, December 2014.

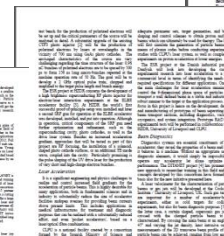
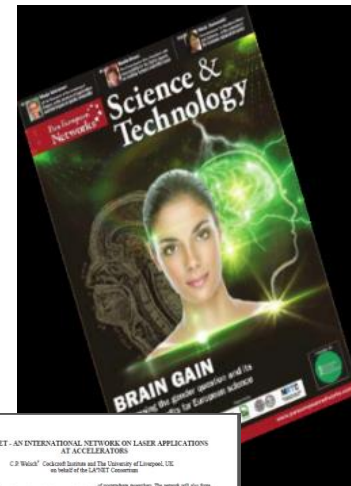
International Conference on Laser Applications
In the last year of LA*NET, a 3-day international conference on laser applications at accelerators will be organised, with a focus on the network developed within the network.

The consortium will award an annual LA*NET cash prize of 1,000 € for an outstanding young scientist in the field of laser applications at accelerators in the first five years of their professional career. Applications for the 2012 prize can be submitted until 15/12/2012. Full application details can be found on the LA*NET web site.

The network produces a quarterly newsletter – in order to submit the, simply send an email to the coordinator.

Publications

- IPAC 13: fellows publications
- Pan European Networks, Science and Technology 6 (2013)
- STFC's UK news from CERN 2013: Issue 14 on LA³NET
- Higher Education Academy's Annual Learning and Teaching Conference in Birmingham, UK
- LA³NET Brochure and Booklet



Outreach

- Conference – Symposium (26 June 2015)
- Fellows:
 - Webcasts about projects
 - Engagement with local schools
 - Specific opportunities
- Annual prize



Problem

- **Diagnostics for > 30,000 accelerators in use:**
 - Fundamental research;
 - Clinical facilities;
 - Light sources;
 - Reactors.
- **Beam profile, position, intensity at any moment of time**



- **D-Beam provides:**
 - ✓ Compact
 - ✓ Simpler-to-use
 - ✓ Enhanced performance
 - ✓ Robustness
 - ✓ Lower integral cost over the lifetime of the devices

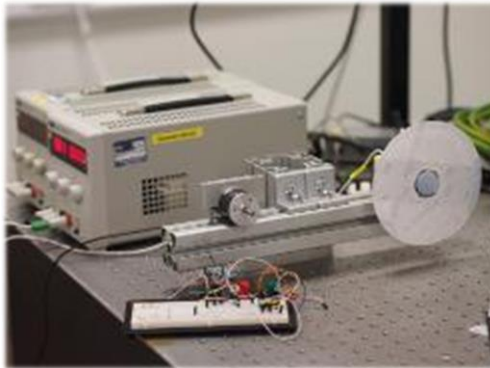
Laser Diode Velocimeter-monitor: trainings

1. Development of the conception –
 technique how to measure; ← Secondment:
 University of
 Bari, Italy
2. Set-up for the preliminary experiments –
 possibility to measure; ←
3. Mathematical model of the method and study
 of theoretical limits; ←
4. Monitor design concept and installation in the
 gas jet setup; ←
5. Studying into the characterisation; ←
6. Investigation into alternative application of the
 monitor; ←

Solution: IP



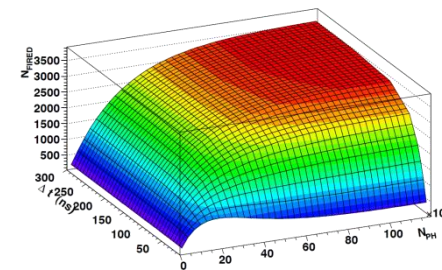
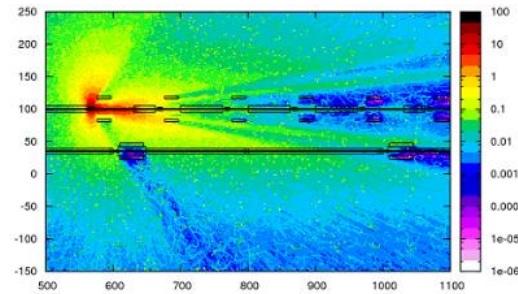
Laser self-mixing sensors for position, vibration and velocity measurements



Optical fibre-based light transport systems

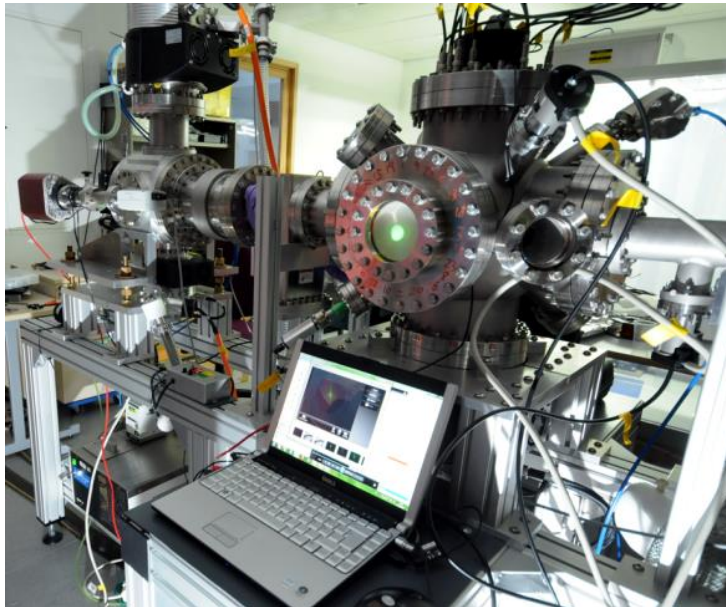


Advanced modelling tools

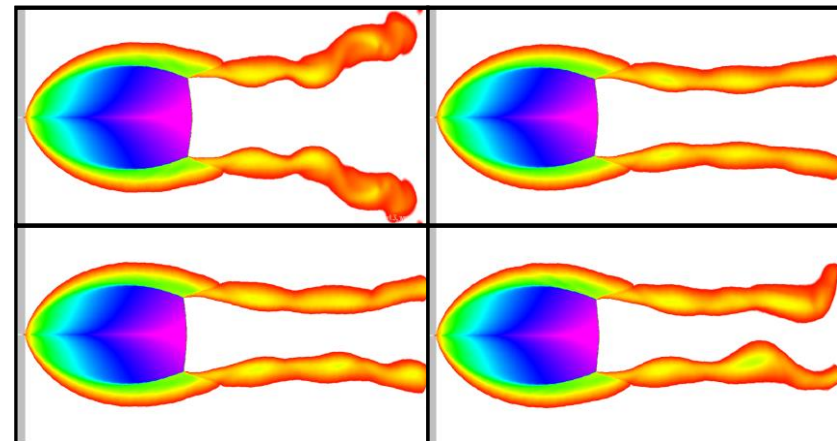


Laser Diode Velocimeter-monitor Based on Self-mixing Technique

Task: in-detail characterization of the gas jet,
 Gas: Ar, N₂, He; Velocities: 100-2000 m/s; Density: $10^{10} - 10^{15}$ mol/m³ ;
 - compact and cheap device



Distribution of velocities in gas jet:



Other possible measuring techniques
Mechanical, Acoustic, Optical

Experiment – plans and first results

1. Studying different regimes for operation;
2. Variation of velocity and distance;
3. Variation of objects
 - mirror (99% reflectivity) ✓;
 - white paper (scattering) ✓;
 - rotating disc ✓;
 - fluids;
 - gas;

Self-Mixing

