Ultra-stable Optical Timing Distribution for Accelerator Applications.

"La3Net" Marie Curie Vacancy

(September 2012 – September 2015)

STFC Daresbury National Laboratory
and
University of Manchester Photon Science Institute

The next generation of accelerators, both light source and particle physics linear colliders, require unprecedented stability and precision in the timing systems, with clocks with few femtosecond stability. The leading technological to providing such stability is based on mode locked laser optical clocks, and actively length stabilised optical fibre distribution. The requirement of ~1 femtosecond stability on distributed RF timing signals over distances of >100metres requires an in-depth knowledge and understanding of the physics of the of the optical transport and detection processes. This project will focus on the distribution systems, examining the physics of sources optical timing error which are encountered in accelerator environments, and the fundamental limitations arising from distribution optical physics. The project will also seek to develop optical beam arrival monitors based on the distribution systems and with femtosecond level capability.

The successful candidate will

- Examine Stimulated Raman in the optical fibre transport and the consequences for the one-way and round-trip optical pulse transit time in the distribution fibres.
- Investigate the detrimental effects of optical pulse (group) transit stabilisation on the interferometric carrier stabilisation; examine schemes for simultaneous carrier and envelope stabilisation in distribution fibres, and their potential for breaking into the regime of sub-optical-cycle pulsed mode-locked timing distribution.
- Develop a particle-bunch arrival time monitor using the optical timing distribution with "in-beamline" pickup of the bunch via the electro-optic effect; in doing so this will extend the bandwidth of beam arrival monitors from 10's GHz into the few THz regime.

The project will be a mixture of theoretical and experimental activities, requiring the student to understand linear and non-linear optics and the physics of mode-locked lasers, and to apply this understanding to practical experimental tests.

The successful candidate will be based at STFC Daresbury National Laboratory; they will be enrolled for a PhD at the near-by University of Manchester, and the project will form the basis of their thesis. This position is provided through the "La3Net" Marie Curie Network, a European wide collaboration in laser and accelerator research. These prestigious studentships come with a very generous salary and support package; as required by the EU scheme rules:

- The successful candidate will be directly employed by STFC for the duration of the project, and will therefore need to be eligible for employment in the UK.
- The successful candidate must have resided *outside* of the UK for the majority of the previous three years.
- Notwithstanding the above, the position is open to candidates of all nationalities, including those outside the EU.

STFC Supervisor Background:

Dr Jamison works in the Accelerator Science and Technology Centre (ASTeC) at STFC Daresbury National Laborarory, undertaking research activities in ultrafast laser physics and its application to next generation particle accelerators and free-electron lasers. He has had a leading role in the development of electro-optic techniques for relativistic particle bunch temporal diagnostics, including the development and demonstration of "Temporal Decoding" and "Spectral-upconversion" concepts. He is responsible for a range of projects undertaken in the ALICE and Cockcroft institute laser laboratories at Daresbury, and with collaborators at European accelerator laboratories. The ALICE (Accelerator and Lasers in Combined Experiments) facility is used as a test bed for laser based accelerator diagnostics, and for laser-electron interaction experiments. Dr Jamison has long standing collaborations with researchers at the University of Dundee and the Free-electron laser facility in the Netherlands (FELIX), and is also engaged in research activities with CERN, Liverpool University and the University of Manchester.

Dr Jamison is a member of the Cockcroft Institute of accelerator science and technology, and an associate of the University of Manchester Photon Science Institute.

If you require further information on this project, Dr. Jamison can be contacted directly at steven.jamison@stfc.ac.uk. An overview of the research carried out by ASTeC can be found on its website, http://www.stfc.ac.uk/ASTeC