New research improves quality of free electron laser

June 2 2011

The free electron laser is the next step in the development of equipment to help us see the structure of materials. Nino Čutić at MAX-lab in Lund, Sweden, has done a PhD in further improving the test free electron laser at the laboratory.

As a member of a small team that works with the test free electron laser at MAX-lab, Nino Čutić has helped to make improvements to the technology. The long-term aim of the experiment is to help develop better full-scale free electron lasers than those in existence today.

A free electron laser can be very large – often several hundred metres long – and requires accelerators and magnet structures in order to function. Instead of using gas or crystals, like in a 'normal' laser, free, unattached electrons are used. When the electrons, which have gained high speed in an accelerator, lose energy in the magnet structures, they emit light. With the free electron laser technology, this light can gain the characteristics of a laser but at new wavelengths, and this light can be used to study materials. Among other things, greater understanding can be gained of molecular structures and chemical processes.

In MAX-lab's test free electron laser, MAX-lab's existing accelerator has been used in combination with a conventional laser. Nino Čutić's work attempts to synchronise the electron pulse from the accelerator with the laser pulse from the conventional laser in time and space – something which can be difficult. The electron pulse is around one third of a millimetre long and the laser pulse is around a tenth of a millimetre, and

both travel at the speed of light. Nino Čutić has built an electro-optic system and used it to improve the stability of the laser beam. The precision has increased – the overlap between the electron pulse and the laser pulse is now at around 0.3 picoseconds.

More information: Nino Čutić's thesis is entitled Timing Diagnostics and Coherent Harmonics from a Test-FEL.

Provided by MAX-lab