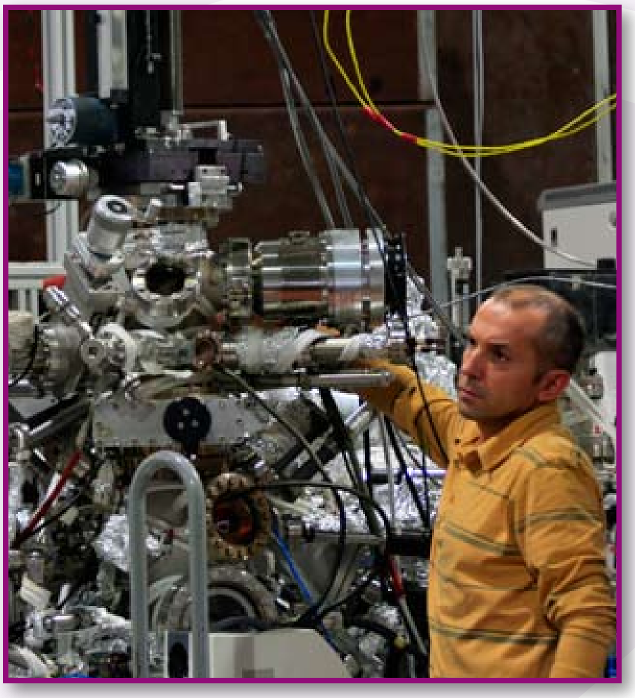
ELISA: European Light Sources Activities – Synchrotrons and Free Electron Lasers

Europe holds a leading position in the scientific and technological exploitation of the very bright light sources based on by modern particle accelerators, with emphasis on multidisciplinary integration. Synchrotron and free electron laser (FEL) light sources are very useful tools in physics, material sciences, chemistry, biology, imaging and microfabrication, as well as archaeology and cultural heritage. Building on the solid success of the IA-SFS project, ELISA aims to opens up the extensive network of existing facilities to the entire European user community through a package of transnational access, networking and joint research activities.

LIGHT, BUT NOT AS WE KNOW IT

Synchrotrons are rings, measuring several hundred meters in circumference, in which high-energy electrons orbit at close to the speed of light. As they are deflected by magnetic fields, they emit radiation. This radiation can be very useful for various purposes, because it can be channelled into narrow, intense beams with precisely controlled wavelengths ranging from the far infrared to the hard X-rays. Each wavelength range allows for different microscopic techniques permitting the analysis and control of matter at nano-scale level. For example, synchrotron radiation in the form of X-rays can be used to map the positions of atoms exploiting the technique known as X-ray diffraction. Synchrotron X-rays and short-wave ultraviolet light are also used to make computer chips, while terahertz waves can be used also in medical diagnoses and security screening.

The same principle of radiation generation lies behind another type of device – the free electron laser (FEL). Starting with a linear beam of electrons accelerated to a speed close to that of light, the FEL uses a series of magnets to drive the electrons into a sinusoidal path. The resulting rapid changes in direction force the electrons to emit light flashes more intense and shorter than those obtained in synchrotrons, and whose wavelength can be easily tuned. FELs can produce waves from terahertz to hard X-rays, which are valuable in measuring microscopic dynamic properties down to the very short time scale of femtoseconds. A femtosecond (10-15 sec) is such a small time interval that, at the speed of light, it takes 3 000 of them to cover a distance of 1 millimetre.



Using synchrotrons and FEL light sources, scientists can explore the nature of chemical bonds in a new compound, investigate the bonding of molecules absorbed onto a solid surface, probe the arrangement of atoms in a biological macromolecule, provide three-dimensional images of tissue samples and etch nanometric patterns for a variety of industrial applications.

PROMOTING ACCESS, DEVELOPING FACILITIES

ELISA has three basic strategic objectives: it provides resources for concrete transnational access independently of the financial situation of the concerned users. Simply put, 'transnational access' means freeing up resources for scientists to perform experiments in top-level facilities located in other countries. European synchrotron radiation and FEL laboratories already have a good record of opening their doors to researchers from abroad, and the transnational access activities of ELISA are building on this foundation.

Secondly, it is supporting joint research activities to develop new instrumentation and techniques, with the aim of enhancing existing research infrastructures' effectiveness in serving its users. This should help make European synchrotrons and FELs even more competitive with respect to the USA, Japan and others.

In addition, the project's networking activities – such as schools, virtual data centres and public dissemination – are boosting cooperation in the network and its positive effects in Europe and beyond, benefiting some 10 000 scientists in Europe. The aim of such activities is to stimulate new ideas for transnational collaboration and preparing new generations of users.

Europe already has the world's most advanced network of synchrotron and FEL sources. EU funding is allowing ELISA to coordinate and improve access to these facilities, with consequent benefits for the European science base.

Project acronym: ELISA

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