Particle accelerator for the X-ray laser in Hamburg is operating

In 2016, more than HUF 3 billion (EUR 10.5 million) was allocated by the NRDI Office to cover the costs of participation in large research infrastructures, including the investment of EUR 2.2 million for the ongoing project of the European X-Ray Free-Electron Laser Facility (European XFEL). Two Hungarian research teams at the Wigner Research Centre for Physics, Hungarian Academy of Sciences are eager to become one of the first users of the facility.

The construction of the European XFEL in Hamburg, one of the most significant European research infrastructures has reached an important milestone: the 2.1 km long underground electron accelerator of the large facility has become operational. It consists of 98 resonators arranged serially along a distance of 1.7 km that, for the time being, accelerate electrons to an energy of 12 GeV (12 billion electron volts), a figure to be increased to 17.5 GeV during the next few months. The resonators are made of the metal niobium and are operating at -271 °C, close to the absolute zero temperature where niobium becomes a superconductor, i.e. it completely loses its electric resistivity. This is presently the world's longest superconducting linear particle accelerator.

The accelerated electrons will enter an about 200 m long series of magnets of special arrangement, the so-called undulators in which 27000 ultrashort X-ray flashes per second will be created. The properties of the flashes will be similar to those of laser light and will have a brilliance that is a billion times higher than that of conventional X-ray sources; such facilities are called 'free-electron lasers'. Scientists will perform experiments with these flashes of about 10 keV (i.e. hard X-ray) photons at the experimental stations being constructed at the end of the altogether 3.4 km long X-ray laser. Atomic details of viruses will be mapped, the molecular composition of cells will be deciphered, three-dimensional 'photos' of the nanoworld will be taken, fast chemical reactions will be 'filmed', processes such as those occurring deep inside planets will be studied, and the list could be continued long. The first user experiment will take place in the fall of this year.

Planning of the European XFEL started twenty years ago. The construction needed more than seven years, however the extension will go on also in the operational phase. The construction of the X-ray laser was taken over by 11 countries including Denmark, France, Germany, Hungary, Italy, Poland, Russia, Slovakia, Spain, Sweden and Switzerland. Germany and Russia contribute 58% and27 % of the total costs (at 2005 price levels), respectively. Hungary, as a full member bears 1% of the costs. Measurements and experiments can be performed by concerned researchers to the extent of the beam time provided by the share of the given partnering country

Hungarian scientists have been using accelerator-based X-ray sources for analytical and materials investigations since the eighties; most of their experience stems from the largest European synchrotron, the ESRF in Grenoble. Therefore it can be expected that, after completed construction of the experimental stations, they will also prove to be successful users of the European XFEL. Presently, two Hungarian research teams at the Wigner Research Centre for Physics, Hungarian Academy of Sciences are planning to become one of the first users of the facility. New achievements may also be expected from other researchers in the fields of molecular biology, genomics, medical diagnostics and treatment applications, nanotechnology and relating material sciences etc.

Photo by Heiner Müller-Elsner / European XFEL

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