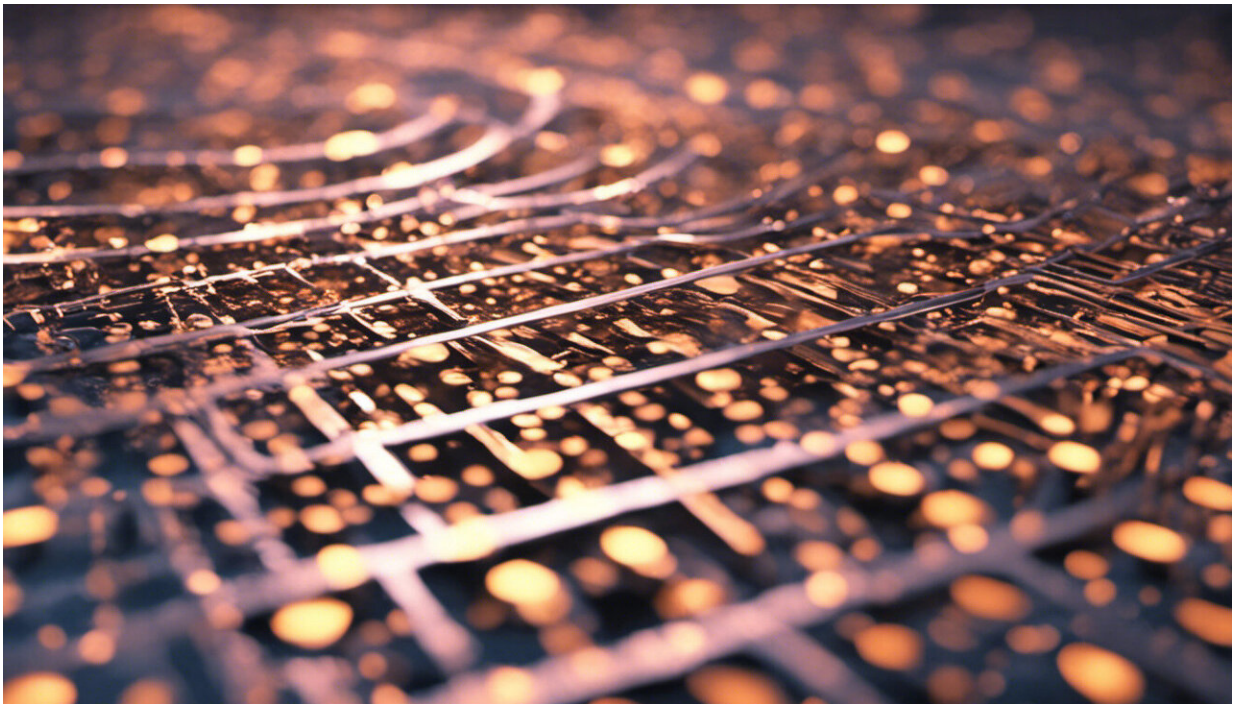


A new rapid X-ray technique using ultra-short electron beams

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Credit: AI-generated image ([disclaimer](#))

EU-funded researchers have developed a new ultrafast X-ray technique which could revolutionise our understanding of structure and function at the atomic and molecular level.

A research team based in Germany are using a new compact hard X-ray

source to shine new light on important questions in structural biology.

Until now ultra short electron beams, which have many uses in scientific imaging, could only be produced by expensive, power-hungry equipment which took up roughly the space of a car. A team at Deutsches Elektronen-Synchrotron (DESY), the German Synchrotron, and the Massachusetts Institute of Technology (MIT) in the United States, has produced a device the size of a matchbox which could open up a whole range of applications for academics and industry alike.

As part of the EU-funded AXSIS (Attosecond X-ray Science: Imaging and Spectroscopy) project, the DESY team, together with the University of Hamburg, is now using this device as a photo injector for a new Attosecond table-top free-electron laser. With this, they are recording short sequences of chemical, physical and, above all, biological processes.

Life is never static and many of the most important reactions in chemistry and biology are light-induced and occur on ultrafast timescales, according to the researchers. These reactions have been studied with high time resolution primarily by ultrafast laser spectroscopy, but this reduces the vast complexity of the process to just a few reaction coordinates.

Revolutionising our understanding

The AXSIS team, led by Franz Kaertner, Professor of Physics at the University of Hamburg, has developed attosecond serial crystallography and spectroscopy which can give a full description of ultrafast processes atomically resolved in real space and on the electronic energy landscape. They believe this new technique will turn our understanding of structure and function at the atomic and [molecular level](#) on its head and help unravel fundamental processes in chemistry and biology.

The technique involves applying a fully coherent attosecond X-ray source based on coherent inverse Compton scattering off a free-electron crystal, developed by the project, to outrun radiation damage effects caused by the high X-ray irradiance needed to capture diffraction signals.

Optimising instrumentation

The team is also using this advance to optimise the entire instrumentation towards fundamental measurements of light absorption and excitation energy transfer. This includes X-ray pulse parameters, in tandem with sample delivery and crystal size as well as advanced X-ray detectors.

The final aim will be to apply the new capabilities to some of the fundamental problems in biology, such as studying the dynamics of light reactions, electron transfer and protein structure in photosynthesis.

The AXSIS team published their findings recently in the journal *Optica*. The project has received nearly EUR 14 million in EU funding and is due to continue until July 2020.

More information: Project page:
cordis.europa.eu/project/rcn/191291_en.html

Provided by CORDIS

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