

The 7th Dvořák Lecture

By Professor Janos Hajdu, Laboratory of Molecular Biophysics, Uppsala University, Sweden & the European XFEL GmbH, Hamburg, Germany

X-ray lasers and the challenges facing structural sciences

May 27th, 2015 at 3:00 pm

Institute of Physics of the AS CR, v. v. i., Na Slovance 2, CZ-182 21 Praha 8, Czech Republic

Annotation

Theory predicts that with an ultra-short and extremely bright coherent X-ray pulse, a single diffraction pattern may be recorded from a large macromolecule, a virus, or a cell before the sample explodes and turns into a plasma. The over-sampled diffraction pattern permits phase retrieval and hence structure determination. X-ray lasers capable to deliver ultra bright and very short X-ray pulses for such experiments have recently started operations. Free-electron lasers are the most brilliant sources of X-rays to date, exceeding the peak brilliance of conventional synchrotrons by a factor of

10 billion, and improving. In the duration of a single flash, the beam focused to a micron-sized spot has the same power density as all the sunlight hitting the Earth, focused to a millimetre square. The interaction of an intense X-ray pulse with matter is profoundly different from that of an optical pulse. Our aim in biology is to step beyond conventional damage limits and develop the science and technology required to enable high-resolution imaging of biological objects. The talk will summarise imaging results from the Linac Coherent Light Source, including studies on live cyanobacteria.



Credit: Glenn Roberts Jr., SLAC

Janos Hajdu

Born in 1948 in Budapest, Hungary. He earned his Diploma in Chemistry in 1973 at the Eötvös Lorand University, Budapest. In 1980 he finished his Ph.D. in Biology and in 1994 he earned the D.Sc. in Physics/Biology from the Hungarian Academy of Sciences. His postdoctoral work was done at the University of Bern in Switzerland and at the Laboratory of Molecular Biophysics, Oxford University, U.K. Presently he is Professor of Molecular Biophysics at Uppsala University,

Sweden, Prof. of Photon Sciences at Stanford University, USA, and Scientific Advisor of the Institute of Enzymology of the Hungarian Academy of Sciences. Prof. Hajdu is also a member of the International Scientific Advisory Committee of ELI Beamlines, Prague and of DESY, Hamburg.

Prof. Janos Hajdu is highly recognized for his exceptional work in structural sciences. He pioneered the work of diffractive imaging using short high intensity X-ray pulses from X-ray lasers. This has led to numerous new discoveries in field of structural Biology and Chemistry as proven by highly cited articles in leading scientific journals. To characterize the recent achievements of his research one could say it is the idea of diffraction before destruction using strong short X-ray pulses. This technique enables now to reconstruct the 3D structure of complex micro- and nano-objects.

In a recent interview with EurekAlert science portal Prof. J. Hajdu mentioned the following: *"Biologists have long dreamed of being able to capture the image of viruses, single-cell organisms, and bacteria without having to section, freeze, or mark them with metals, as is necessary in electron microscopy. Our studies show that it is really possible to create images with the aid of extremely intensive and ultra-short x-ray pulses that would otherwise destroy everything in their path."*



Vladimír Dvořák

(1934–2007)

Solid state physicist, the most prominent Czech scientist in the theory of ferroelectricity and structural phase transitions, for the whole productive life affiliated with the Institute of Physics, Acad. Sci. Czech Rep. in Prague, its director in 1993–2001, member of the Learned Society since 1995. The main protagonist of the revolutionary reforms in the Institute of Physics after 1989.

His personality has strongly influenced the scientific program and development in the Department of Dielectrics of the Institute since the late sixties up to present. Brilliant lecturer and most respected director of the Institute.

To commemorate his work and personality, the Institute of Physics of the Academy of Sciences of the Czech Republic decided to organize an annual festive Dvořák lecture, given by prominent internationally renowned scientists in the field related to the research pursued at the Institute of Physics.



Fyzikální ústav
Akademie věd ČR, v. v. i.