

Slovak participation in the European X-Ray Laser Project (XFEL)

Ing. Karel Saksl, DrSc., prof. RNDr. Pavol Sovák CSc

The European XFEL - next-generation light source

Location

Hamburg, Germany

Start of commissioning

2014

Accelerator technology

superconducting

Number of light flashes per second

27 000

Minimum wavelength of the laser light

0.1 nanometres

Maximum electron energy

17.5 GeV

Length of the facility

3.4 Kilometer

Number of experiment stations

6, upgradeable to 10

Peak brilliance
[photons / s / mm² / mrad²/ 0.1% bandwidth]

$5 \cdot 10^{33}$

Average brilliance
[photons / s / mm² / mrad²/ 0.1% bandwidth]

$1.6 \cdot 10^{25}$



Access of the Slovak republic to the European XFEL

- December 2007, signature of the XFEL Memorandum of Understanding.
- 10th September 2008 - government of the Slovak republic agreed to accede the XFEL project.
- 30th November 2009 - signing of the international European XFEL convention.



Representation in the European XFEL Organs

Prof RNDr. Pavol Sovák CSc. - *Vice Chair of the European XFEL Council,
member of the Administrative and Finance Committee XFEL*

Ing. Karel Saksl, DrSc. - *member of the European XFEL Council,
member of The Scientific Advisory Committee XFEL*

Ing. Štefan MOLOKÁČ, CSc. - *member of the In-kind Review Committee XFEL*

Activities towards the European XFEL

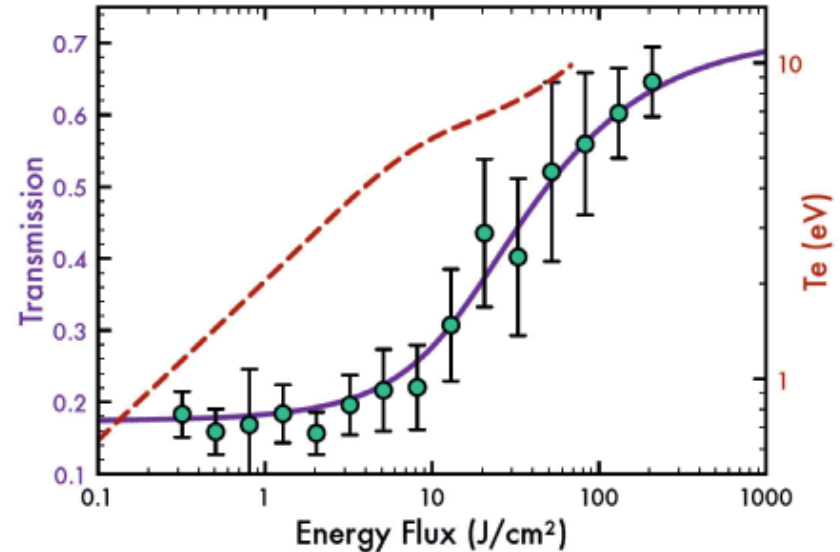
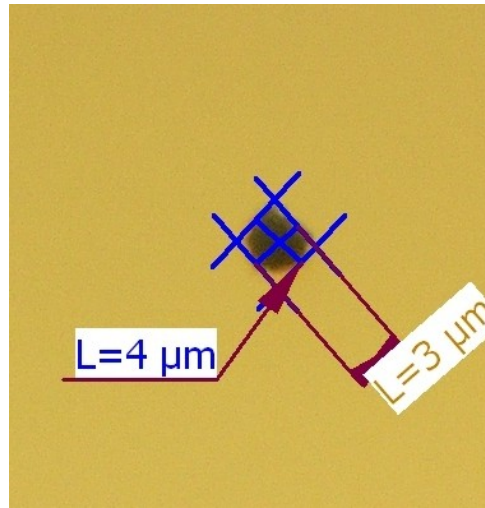
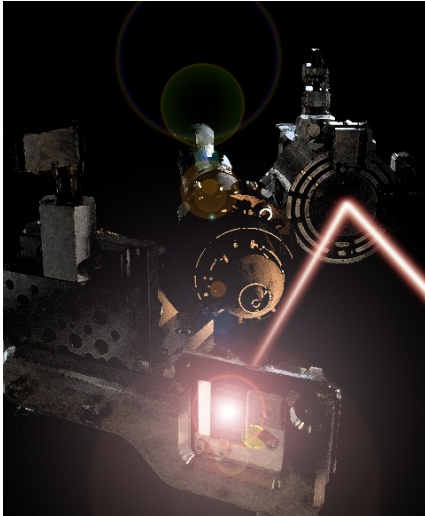
FEL science has only just started. Experiments have exploratory character and fields have to be established.

Our intentions are:

- to join leading international research groups, be part of the collaborations, propose and perform experiments at the XFEL.
- transfer of the FEL knowledge and technologies to Slovak scientific groups at universities and research institutions with aim to involve them to different areas of R&D needed for this technology. Be involved in User consortia shaping the end experimental stations of the XFEL.
- educate young generation of Slovak scientists in FEL technologies (in form of joined study programs) and prepare them for future research at XFEL.
- continue in activities for contract award connected to the XFEL project.

Experiments at free electron laser with Slovak participation

Creating transparent aluminum - Saturable absorption by ultra-intense and ultra-short soft X-ray photoionization, 13-25.4.2008

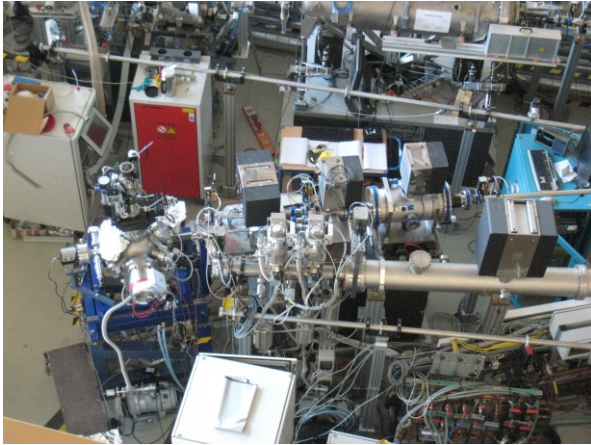


When focused to micrometre spot sizes, the free-electron laser FLASH reaches record intensities over $10^{16} \text{ W}/\text{cm}^2$ in the soft X-ray wavelength regime. With these extreme intensities it was possible to saturate the absorption of an L-shell transition in aluminum at 13.5 nm (92 eV photon energy): The samples become transparent for soft X-rays. This has never been observed before and is an ideal method to create homogenous warm dense matter, which is highly relevant to planetary science, astrophysics and inertial confinement fusion.

“Turning solid aluminium transparent by intense soft X-ray photoionization”,
Nature Physics 5, 693 (2009).

Experiments at free electron laser with Slovak participation

Material damage experiment, 5th -11th May 2011



Aim:

Investigate damage of materials used for optical components by high intensive soft X-rays.

Goals of the experiments were:

- extend the determination of the single shot damage to higher photon energy and different incidence angle above and below the critical angle
- explore the damage mechanism in multishot regime and the influence of repetition rate which may influence thermal effects.
- online monitoring of damage

Results from the experiment are now under evaluation.

Teaching/training activities

31.1 - 4.2.2011: *Winter School of Synchrotron Radiation 2011, Liptovský Ján*, with one day devoted to FEL principles and applications and in particular to The European XFEL supported by Ministry of Education, Science, Research and Sport of the Slovak Republic.

106 participants from 9 countries.



2010: Lecture series about construction and utilization of modern X-ray sources given to young students (~30) at Faculty of Science, Pavol Jozef Šafárik University in Košice. (Saksl, Sovak, Michalik)

24.9.2010: popularization lecture “Lasers based on free electrons” (K. Saksl) during the Researchers’ night organized by EU in Kosice (~40 participants).

27.11.2008: popularization lecture “Fourth generation of light sources – windows to nanoworlds” given by prof. Sovak at National centre for popularization of science and research in Bratislava.