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POZVÁNKA

na 224. seminář ÚTEF ČVUT
pod záštitou Československé sekce NPSS IEEE

Picosecond X-ray Spectroscopy and Phase Sensitive Imaging

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Ultrafast x-ray absorption experiments have been carried out at the Advanced Photon Source, Argonne National Laboratory, 7ID-C. While the x-ray pulses length produced by the synchrotron is about 100 ps, a temporal resolution of 2 ps has been achieved by detecting the x-radiation transmitted though the sample with a streak camera. The iron K-edge shift of a sample of $Fe(CO)_5$ solvated in ethanol was measured at a repetition rate of 1 kHz. The experimental arrangement is described. It consists of x-ray and pump light optics, the laser triggered streak camera, and a liquid sample beam apparatus that permits studying chemical reactions under protective atmosphere. The apparatus contains x-ray and laser beam diagnostic for x-ray and laser beam profile and overlap measurements as well as pump-probe timing measurements with sub-ps accuracy. The results demonstrate that single picosecond temporal resolution can be achieved at a synchrotron beam line.

In a related project x-ray imaging modalities are studied. The first method, called Propagation-based Differential Phase Contrast Imaging measures the Laplacian of the real part of the index of refraction of the material. No x-ray interferometers are used. The sensitivity to of the measurements to density variations is up to 1000 times larger than that of conventional x-ray absorption based imaging methods. The second method, called Spatial Harmonic Imaging, uses the x-radiation scattered off the sample for image formation. Both modalities do not require any x-ray optics between the sample and the x-ray source. As a consequence, they are suitable for ultrafast time-resolved imaging in a setup very similar to those used in conventional x-ray backlighting. The principles of both modalities are discussed along with applications to nano-structured samples and the time-resolved measurements of their dynamics.

Seminář se bude konat v úterý 18. ledna 2010 ve 14 hodin
v zasedací místnosti ÚTEF ČVUT, Praha 2 - Albertov, Horská 3a/22

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