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Seminar Room V, CFEL (Bldg. 99, 01.109)

CFEL SCIENCE

Max Planck Research Department for Structural Dynamics

SEMINAR

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Ultrafast acoustic and magnetism using table-top femtosecond lasers: applications in biology and ferromagnetism

Imaging specific elements, sub-elements and their interactions in space and time is essential to improve our understanding of matter and of the fundamental interactions in matter. This implies developing new imaging techniques effective from nanometer to micrometer scales and from femtoseconds to nanoseconds. I will present in my talk two optical methods to realize such experiments on lab-scale facilities.

In the first part of my talk, I will present the first applications of picosecond ultrasonics in a single biological cell. Picosecond ultrasonics uses femtosecond IR laser pulses to generate and to detect acoustic pulses of nanometric characteristic space scale. I will show that the technique can be used to realize the echography of a single cell [1] and to locally measure its viscoelastic properties. [2]

In the second part, I will talk about experiments that combine nanometric lateral resolutions and femtosecond time resolution using new-generation table-top soft X-ray laser sources. The soft X-ray radiation is obtained from High Harmonic Generation and provides 20fs pulses of 1010 photons in the sub 100 eV range. Our source is used to 1) image micrometric samples with a lateral resolution of 78 nm using a single fs pulse [3] and 2) investigate magnetic properties of a [Co/Pd] sample. Its spectroscopic (resolution of 1.5 eV) and dynamics (resolution of 40 fs) properties have been characterized at the nanometer scales (resolution under 100 nm). [4-6] I will also present some future experimental challenges, already under investigation.

[1] Rossignol & al. Appl. Phys. Lett. (2008)
[2] Ducousso & al., Eur. Phys. J. Appl. Phys. (2013)
[3] Ge & al., Opt. Exp. (accepted)
[4] Ducousso & al., Phys. Rev. B. Rapid. Comm. (submitted)
[5] Ge & al., J. Mod. Opt. (submitted)
[6] Vodungbo & al., Nat. Comm. (2012)

Host: Andrea Cavalleri, MPSD-CFEL