CFEL SCIENCE SEMINAR

28th November 2018 - 2:00 p.m.

CFEL-bldg. 99, seminar room IV

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Modeling of the interaction of an X-ray free electron laser with bulk matter, atomic physics concerns and prospects concerning 1D photonic crystals in the X-ray range.

Phenomena driven by x-ray free-electron-laser (XFEL) pulses have been the subject of many investigations for a few years in order to evaluate all the important mechanisms involved when X-ray photons interact with molecules, clusters or solids. Concerning solids, the scenario of the interaction of an intense monochromatic X-ray pulse with a bulk sample is now clear. It depends strongly both on the energy of the incident photons and on the atomic number of the material, and involves a rich non-local thermodynamical equilibrium (NLTE) atomic physics. As a result of the interaction, all of the produced free electrons tend to thermalize (more or less locally) and to transfer some energy to the lattice which, depending on the XFEL intensity, may undergo solid-solid phase transition, or simply melts and expands, giving a more or less warm or hot plasma.

We will present here a theoretical study of the interaction of monochromatic X-ray photons with a bulk sample and of the subsequent evolution of the material according to the different regimes of intensity and from XUV to hard X-ray photons. We will focus specifically on the XFEL energy deposition which is modeled through a calculation of the radiation field in the material which in turn depends on the complex refractive index linked to a complex NLTE atomic physics. Will be discussed also, the transport of energetic photo-electrons, the electron-ion energy exchange and the possible elastoplastic behavior of the material. Last, we will present a prospective study concerning the diffraction of X-ray stimulated emission in a periodic structure (1D photonic crystals).

Host: Robin Santra – CFEL-DESY Theory Division