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Multidimensional high energy spectroscopy in X-rays/electron hybrid experiments

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We propose an experiment in which a beam of pulsed X-rays is combined to a pulsed electron beam in a Transmission Electron Microscope. Thanks to such an apparatus, X-ray chemically selective photo-doping of materials can be obtained while its effect can be investigated in diffraction, imaging or spectroscopy in a TEM. Recent development in pulsed electron sources allow a temporal resolution comparable to that achievable with light beams, and the combination of these tools can open fascinating new areas of investigation.

Summary

Recently, much attention has been devoted to the development of new pulsed sources of radiation for investigating matter with atomic scale temporal and spatial resolution. While much has been achieved thanks to modern ultrafast laser technology, the ultimate coherent light source, the X-Ray Free Electron Lasers (X-FEL), promises to deliver the highest X-ray photon flux in the shortest pulses at energies unreachable by conventional solid-state lasers. In parallel, other approaches that utilize electrons in table-top setups as a probe have been developed demonstrating the potential for a valid complement to X-ray based techniques. Here, we consider yet another possible avenue in which the technology of electron diffraction and imaging is pushed further; we estimate the interest and performances of a femtosecond High Energy electron microscope and propose a hybrid experiment with relativistic electrons as a probe and fs X-ray pulses as a pump taking advantage of both technologies.

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