EUROPEAN NETWORK FOR NOVEL ACCELERATORS

EuroNNAc4

NPACT supported by EU via I-FAST

Contribution ID: **160** Type: **Invited talk**

Free-electrons manipulation with light in an RF-cavity-based Ultrafast Transmission Electron Microscope

Friday, 23 September 2022 17:10 (20 minutes)

Developing new methods for tailoring the phase-space distribution of electron beams is a challenging and essential task in next-generation particle accelerators, compact x-rays sources, and ultrafast electron microscopy. RF-cavities are routinely employed in accelerator science to manipulate the electrons'phase-space. This contribution shows the use of a miniaturized RF-cavity to chop the continuous beam of a conventional transmission electron microscope into ultrashort pulses. We developed an RF-cavity-based ultrafast transmission electron microscope (UTEM) generating few-100-fs pulses with GHz-MHz repetition rate, which preserves the low emittance and energy spread of the TEM Schottky field emission gun.
Beyond time-resolved investigation of specimens, UTEMs entitle novel free-electron quantum optics. We devise techniques to control and shape the electron wavefunction amplitude and phase for coherent detection methods and distinct phase-contrast imaging. A laser oscillator is integrated into the RF-cavity-based UTEM setup, thus allowing the observation of the synchronized interaction between free-electrons and fs-laser pulses.
We propose to exploit this interaction to coherently shape the electron wavefunction in photon-induced near-field electron microscopy and light-based Zernike phase plate imaging. We present experimental results and a theoretical model of the ponderomotive interaction between free-electrons and laser pulses, which opens the path to the phase-manipulation of high-relativistic electron beams.

Primary authors: BORRELLI, Simona (TU/Eindhoven); Mr KEMPERS, S. T. (TU/Eindhoven); Dr KIEFT, E. (ThermoFisher Scientific); Dr MUTSAERS, P.H.A. (TU/Eindhoven); Prof. VAN LEEUWEN, K.A.H. (TU/Eindhoven); Prof. LUITEN, O.J. (TU/Eindhoven)

Presenter: BORRELLI, Simona (TU/Eindhoven)

Session Classification: Special Topic