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Development of a kHz laser plasma accelerator for ultrafast electron diffraction

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We will present the status of the FEMTOELEC project (ERC starting grant) whose goal is to develop a kHz, laser-plasma accelerator generating femtosecond electron bunches for applications to ultrafast electron diffraction. Simulations of the interaction of few millijoule, few cycle laser pulses with an underdense plasma have been performed and show that high-quality sub-fs electron bunches at the MeV level can be generated from this interaction [1]. Such ultrashort bunches are suitable for probing ultrafast structural changes in condensed matter via ultrafast electron diffraction. We will then show the results of first proof of principle experiments performed using a 8 mJ, kHz laser interacting with a 100 micron underdense plasma. Electron beams at 100 keV and with kHz repetition rates have been obtained [2]. High quality diffraction patterns on single crystal Gold samples have been measured, showing the potential of laser-plasma accelerators for electron diffraction applications [3].

References:
[1] A. Lifschitz et al., New J. Phys. 14 053045 (2012).
[2] Z.-He et al., New J. Phys. accepted for publication
[3] Z.-H. He et al., Appl. Phys. Lett. 102, 064104 (2013).

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