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Ultrafast and ultracold electron source

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We are developing an ultrafast and ultracold electron source (UCES), based on near-threshold femtosecond photoionization of a laser-cooled cloud of rubidium gas, stored in a Magneto Optical Trap (MOT). The UCES is characterized by electron temperatures as low as ˜ 10 K, enabling a unique combination of ultra-low emittance ˜ 1 nm rad and relatively high bunch charges. Recently we have demonstrated the generation of sub-ps electron bunches, whose bunch length is fundamentally limited by the duration of the ionization process.

The UCES may find application in single-shot, ultrafast electron crystallography of proteins, but also as an injector for dielectric laser acceleration, and as an injector for highly coherent inverse Compton scattering X-ray sources. All three applications require electron energies of ˜100 keV. The present UCES, however, is based on DC acceleration in relatively low electric field strengths ˜ 1 MV/m, allowing electron bunch energies of maximally ˜10 keV. Recently, we have shown that the electron energy can be boosted by a separate 3 GHz TM-010 RF cavity to 30 keV with conservation of beam quality. A dedicated DC-RF UCES is under construction which will produce ultracold and ultrafast bunches at 100 keV and 1 kHz rep rate.

Progress, both in source development and towards first applications, will be reported.

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Footnotes

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Yes

Primary author: NIJHOF, Daniel (Technische Universiteit Eindhoven)

Co-authors: MUTSAERS, Peter (Technische Universiteit Eindhoven); DE RAADT, Tim (Technische Universiteit Eindhoven); LUITEN, Jom (Technische Universiteit Eindhoven)

Presenter: LUITEN, Jom (Technische Universiteit Eindhoven)

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