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Stable and tunable laser-wakefield acceleration and x-ray generation

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We report on several experimental campaigns on laser-wakefield electron acceleration and radiation generation from laser-driven free electrons. Using a 60 TW-Ti:Sapphire laser, we routinely obtain stable electron beams with energies of up to 0.5 GeV, beam charge of 30-300 pC and bunch durations around 5fs. After passing a miniature undulator, a first all-laser driven X-ray undulator source with photon energies in the water window (300eV) could be demonstrated. Furthermore, the betatron emission from the wiggling motion of the electrons in the plasma wave was characterized, revealing 10^8 photons/shot with typical mean photon energies of 5 keV from a 2 μm source and 10 mrad divergence. This photon beam was used to obtain the first 3-D phase-contrast tomogram of a fly from a laser-driven free-electron source. Finally, we will report on the first tunable, quasi-monochromatic Thomson X-ray source in the energy range from 5 to 35 keV, obtained by colliding tunable 15-50 MeV electron beams off a short laser pulse.

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