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Scaling relativistic laser-solid interaction using 30fs laser pulses[1]

JINPU LIN, THOMAS BATSON, JOHN NEES, ALEC THOMAS, KARL KRUSHELNICK, University of Michigan, CENTER FOR ULTRAFAST OPTICAL SCIENCE TEAM — There has been growing interest in relativistic laser-solid interaction as a compact source of relativistic electron beams and hard x-rays. Femtosecond hard x-ray pulses have important applications such as probing time-resolved x-ray absorption and diffraction. Relativistic electrons from solid targets have superior properties in beam charge and divergence than those from wakefield acceleration in underdense plasmas, and can find applications in warm dense matter creation, electron radiography, seed of wakefield accelerators and fast ignition researches. In this work, the 30fs laser pulses are focused down to near diffraction-limit spot size to achieve relativistic intensity (a_0>1) and ablate into a thick (˜mm) glass target. We investigate the scaling laws of this interaction in terms of laser wavelength (0.8m, 1.3m and 2m), laser energy (millijoule to joule level), angle of incidence (grazing, 45and normal) and preplasma scale length (0.1λ to 5λ). Particle-In-Cell simulation (PIC) and particle tracking shows that the incident half and reflected half of the laser pulse form a standing wave to accelerate electrons to relativistic (MeV) energy.

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