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Wakefield Excitation in a Metallic-Density Electron Plasma by X-ray Laser Pulses

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Using newly available compact laser technology [1] one can produce 100 PW-class laser pulses with a single-cycle duration on the femtosecond timescale. With a fs intense laser one can produce a coherent X-ray pulse that is also compressed, well into the hard X-ray regime. Prof. T.Tajima suggested [2, 3] utilizing these coherent X-rays to drive the acceleration of particles. Such X-rays are focusable far beyond the diffraction limit of the original laser wavelength and when injected into a crystal it interacts with a metallic-density electron plasma ideally suited for laser wakefield acceleration [2, 3]. Also in [4-11] it has shown that at certain conditions in blowout regime (see [12-16]) the laser wakefield acceleration by plasma wakefield with time is replaced by a combined joint LPWA acceleration and selfinjected-beam-plasma wakefield acceleration. In this paper X-ray laser wakefield acceleration in a plasma of metallic density, the maximum accelerating gradient (approximately 10TV/m) in such a new medium, the transition to the regime of joint X-ray laser wakefield acceleration and selfinjected-beam-plasma wakefield acceleration are investigated by numerical simulation by code UMKA [17].

Primary authors: BONDAR, Denys (Karazin Kharkiv National University); Prof. MASLOV, Vasyl (NSC Kharkov Institute of Physics & Technology); Mrs LEVCHUK, Irina (NSC Kharkov Institute of Physics & Technology); Dr ONISHCHENKO, Ivan (NSC Kharkov Institute of Physics & Technology)

Presenter: BONDAR, Denys (Karazin Kharkiv National University)

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