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Nearly collinear optical injection of electrons into wakefield accelerators

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We show the recent results of electron injection into the laser wakefield accelerators by interfering two intense, nearly colinear laser pulses in underdense plasma [1, 2]. In the experiment, electrons could be injected into either laser wakefields, or both, depending on the relative delay between two laser pulses' arrival time to the interference point. Particle-in-cell simulations revealed that the interference ponderomotively drives a relativistic
plasma grating and triggers the delay-dependent injection. Such injection occurs in later acceleration buckets other than the leading ones and can potentially be combined with optimal plasma tapering, and the dephasing limit of such unprecedented electron beams could be potentially increased by an order of magnitude. Other injection phenomenon like electron beam splitting and ring electrons are also discussed.

[1] Q. Chen, D. Maslarova, J. Wang, S. X. Lee, V. Horný, and D. Umstadter, Transient Relativistic Plasma Grating to Tailor High-Power Laser Fields, Wakefield Plasma Waves, and Electron Injection, Phys. Rev. Lett. 128, 164801 (2022).
[2] Q. Chen, D. Maslarova, J. Wang, S. X. Lee, and D. Umstadter, Injection of electron beams into two laser wakefields and generation of electron rings, Phys. Rev. E. (Accepted).

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Primary author: CHEN, Qiang (Lawrence Berkeley National Laboratory)

Co-authors: MASLAROVA, Dominika (Institute of Plasma Physics of CAS; Czech Technical University); WANG, Junzhi (University of Nebraska-Lincoln); LEE, Shao Xian (University of Nebraska-Lincoln); HORNY, Vojtech (Chalmers University of Technology; LULI-CNRS); Prof. UMSTADTER, Donald (University of Nebraska–Lincoln)

Presenter: CHEN, Qiang (Lawrence Berkeley National Laboratory)

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