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Compact collinear staging of laser wakefield acceleration

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Designs for linear colliders based on laser wakefield acceleration (LWFA) must address dephasing, which occurs when trapped particles outpace the accelerating phase of the wakefield. To address dephasing, current designs employ many stages, each operating at a low plasma density, which limits the acceleration gradient and elongates both the individual stages and total collider length. Here, we explore the possibility of a compact, continuously staged bubble-regime LWFA in high-density plasma by utilizing arbitrarily structed laser (ASTRL) pulses. By chaining together discrete pulses with controlled delays, powers, spot sizes, durations, polarizations, or focal positions, ASTRL pulses allow for the formation of a highly tunable flying focus that moves at the vacuum speed of light in plasma. In addition, the use of periodic density gaps mitigates distortion of the accelerating structure by dispelling depleted, red-shifted laser light. We present preliminary simulations using the OSIRIS-validated quasistatic particle-in-cell code QPAD for 800nm laser light at a plasma density of 3e18 cm^{-3}.

Working group

WG1 : Laser-driven plasma wakefield acceleration

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