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Laser focusing trade-off in the multi-PW regime

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The development of laser technology will soon enable experiments focused on the interaction of laser pulses with power up to 10 PW with various types of plasma targets for purposes of electron acceleration. Amongst the others, the motivation is to reach the highest possible energies on distances shorter compared to conventional accelerators. We have recently shown using particle-in-cell framework OSIRIS that multi-PW lasers are capable of delivering electron bunches with energies of several GeV by the mechanism direct laser acceleration (DLA). The total accelerated charge can exceed the 100 nC limit which results in very high conversion efficiency of the laser energy into energetic electrons. Many applications such as gamma-ray radiation, neutron generation or seeding of electron-positron showers may strongly benefit from the DLA.

We show that the correct focusing and consequent guiding of the laser pulse is key to using the full potential of the DLA acceleration scheme. The correct focusing is necessary to accelerate electrons far from the axis. However, higher laser intensity enables electron acceleration further from the axis, which results in the nonlinear interplay for the optimal focusing strategy in order to achieve high intensity but using sufficiently wide laser pulse.

Available for oral presentation in a session

Yes

Primary author: BABJAK, Róbert (GoLP - Group for Lasers and Plasmas)

Co-authors: AREFIEV, Alexey V. (UC San-Diego); Prof. WILLINGALE, Louise; VRANIC, Marija (IST - Lisbon)

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