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Polarisation and CEP dependence of the transverse phase-space in laser driven accelerators

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We present experimental results, which show a laser polarization dependent contribution to electron beam pointing jitter in laser wakefield accelerators (LWFA). We develop a theoretical model for the polarization dependence in terms of the transverse dynamics of trapped electrons, resonantly driven by bubble centroid oscillations. The latter are generated by the carrier wave phase evolution at the self-steepened laser pulse front and are closely related to effects seen in few cycle pulses [1]. In the model, the polarization dependent jitter originates from shot-to-shot fluctuations of the laser carrier envelope phase. The model is verified by particle in cell simulations and suggests that CEP-stabilization of the driving lasers might be necessary to achieve ultimate electron pointing stability in LWFA.

References

[1] Julius Huijtsa), Igor A. Andriyash, Lucas Rovige, Aline Vernier, and Jérôme Faure, Physics of Plasmas 28, 043101 (2021)