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Radiation Reaction in Laser Wakefield Accelerators

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Recent results showed that laser wakefield accelerators can provide all-optical configurations to study classical radiation reaction with present-day laser technology. In this all optical configuration self-injected electron bunches with energies on the order of 1 GeV, which have been reported by several laboratories, leave the plasma and collide head-on with an intense laser (for example I~10^21 W/cm2, tfwhm~30fs), therefore maximizing the radiation reaction impact on the electron bunch. While interacting with the laser in this configuration, 1 GeV electrons can lose up to 40% of their initial energy. This is a strong and easily measurable signature. We present a numerical and analytical study covering parameters that can be achieved with current and near-future laser systems in this configuration, employing full-scale ab-initio 3-dimensional particle-in-cell simulations. Higher laser intensities soon to come online (> 10^22 W/cm2) will provide even stronger radiation reaction on LWFA produced electron bunches, and also the possibility to enter the QED regime. The impact of radiation reaction on bunch parameters such as emittance and divergence is also addressed.

Primary author: Ms VRANIC, Marija (GoLP/IPFN - Instituto Superior Tecnico)

Co-authors: Ms MARTINS, Joana (GoLP/IPFN - Instituto Superior Tecnico); Dr VIEIRA, Jorge (Instituto Superior Tecnico); Prof. SILVA, Luis (GoLP/IPFN - Instituto Superior Tecnico); Prof. FONSECA, Ricardo (DCTI/ISCTE - Lisbon University Institute)

Presenter: Ms VRANIC, Marija (GoLP/IPFN - Instituto Superior Tecnico)

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