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Accurate electron beam phase-space theory for ionization injection schemes

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After the introduction of high-quality electron beam generation methods as two-color [1] or the Resonant Multi Pulse Ionization injection (ReMPI) [2], the theory of thermal emittance by C. Schroeder et al. [3] has been used to predict the beam normalized emittance obtainable with those schemes. We [4] recast and extend such a theory, including both higher order terms in the polinomial laser field expansion and corrections due to the onset of saturation effects within a single cycle. Also, a very accurate model for predicting the cycle averaged distribution of the extracted electrons, including saturation and multi-process events, is proposed and tested. The accurate prediction of the beam phase-space can be implemented e.g. in laser-envelope or hybrid PIC/fluid codes, to correctly mimic the cycle-averaged momentum distribution without the need of resolving the intra-cycle dynamics. We introduce further spatial averaging, obtaining expressions for the whole-beam emittance fitting with simulations in a saturated regime, too.

References
[1] L. L. Yu et al., Phys. Rev. Lett. 112 125001 (2014)
[2] P. Tomassini et al., PoP 24 103120 (2017)
[3] CB Schroeder et al., PRAB, 17 101301, 2014
[4] P. Tomassini et al., HPLS 10 10.1017 (2022)

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