# Accurate electron beam phase-space theory for ionisation 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 normalised 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 non polinomial corrections due to the onset of saturation effects on 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.

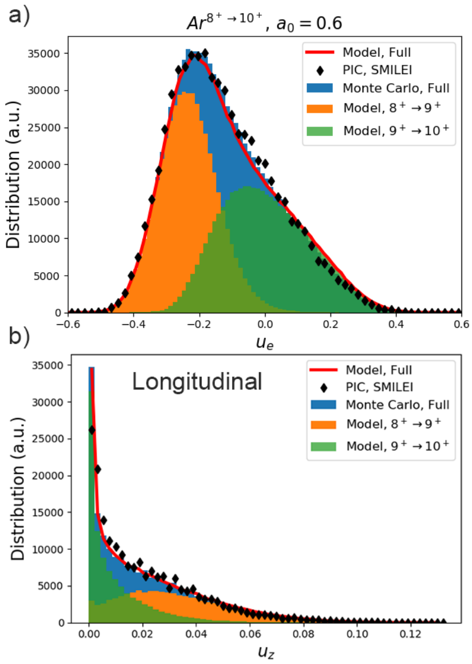


Figure 1: 3D distribution of the residual momentum for the channels $Ar^{8+\to9^+}$ and $Ar^{9+\to10+}$ in the deep saturation regime, single pulse cycle with a0 $= 0.6$ and $\lambda = 0.4\,\mu m$, accurately reproduced by the model.

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## References

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