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3D Self-Consistent Full Wave –PIC Models for Investigating Space-Resolved ECR Plasma Properties

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Simulations are a powerful method to study the correlation between output beams and internal dynamics of ECR plasmas, which involve a complex interplay between injected power, RF frequency, gas type and pressure. Modelling the microscopic properties of such plasmas is essential not only for fundamental research into the operation of ECR ion sources but also for applications like the PANDORA facility which aims to utilise the stellar-like laboratory plasma to measure in-plasma β-decay rates.
We present here some details on a 3D full wave-PIC code suite originally developed to model electron dynamics self-consistently with EM field propagation in the plasma under the cold electron approximation, but now extended to include ion dynamics as well. The coupled PIC codes have been updated to include stepwise ionisation, self-generated potential dip, and atomic excitation and can now furnish space-resolved information on charge density, energy and charge state distribution (CSD).
The models are currently being upgraded to include thermal plasma effects through evaluation of the hot plasma dielectric tensor to first order in temperature, thus including collisionless wave damping mechanisms. Furthermore, efforts are also underway to include collisional excitation and spontaneous emission in ions to obtain atomic level distributions along with CSD. Preliminary runs of the simulation show an encouraging match on comparison with experimental data and offer several perspectives for future improvements.

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Yes

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