Population Kinetics for Laser Plasma Interactions

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Standard atomic physics models in Particle-In-Cell(PIC) simulations either neglect excited states, predict atomic state populations in post processing only, or assume quasi-thermal plasma conditions.

This is no longer sufficient for high-intensity laser plasma interactions such as direct-drive ICF and laser plasma accelerators, due to their non-equilibrium, transient and non-thermal plasma conditions, which are now accessible in XFEL experiments at HIBEF (EuropeanXFEL), SACLA (Japan) or at MEC (LCLS/SLAC).

To remedy this, we have developed FLYonPIC, a extension of the PIC code PIConGPU, to self-consistently and time-dependent model atomic population kinetics inline in PIC-Simulations, in transient plasmas and without assuming equilibrium or steady state temperatures.

This new approach to atomic physics modeling will be useful in predicting plasma emission prediction, plasma condition probing with XFELs and better understanding of isochoric heating processes, all relying on an accurate prediction of atomic state populations inside transient plasmas.

I will show comparisons of FLYonPIC-PIConGPU, SCFLY, and ground state only PIC simulations for different plasma conditions relevant to ICF and laser plasma accelerators.

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