In situ atomic physics for PIC

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Standard modelling techniques for atomic process in PIC simulation are not sufficient for non-thermal relativistic plasmas, since they either neglect excited states, are not self-consistent with 3d plasma simulations or assume quasi-thermal plasma conditions.

To remedy this, we are developing a new extension for our ParticleInCell simulation framework PIConGPU to allow us to model atomic states self consistently with the PIC-simulation, in transient plasmas and without assuming temperatures.

This extension is based on a reduced atomic state model, which is directly coupled to the existing PIC-simulation and for which the atomic rate equation is solved explicitly in time.

This allows us to model excitation and deexcitation of ions in transient plasma conditions, as typically encountered in laser generated plasmas.

This new approach to atomic physics modelling will be very useful in plasma emission prediction, plasma condition probing with XFEL and better understanding of isochoric heating processes, since all of these rely on an accurate prediction of atomic state populations inside transient plasmas.