Quantitative Comparison Between Reduced-Description Particle-in-Cell (RPIC) and full PIC Simulations of Laser-Plasma Instabilities.

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RPIC is a reduced-description particle-in-cell code designed to investigate laser-plasma instabilities in physical systems with vastly-different time scales prevalent under Inertial Confinement Fusion (ICF) conditions [1]. Such time scales include the laser, Langmuir, and ion acoustic time scales. In past literature, laser-plasma instability phenomena involving these disparate scales have mostly been studied with the extended Zakharov model. Recently, comparisons between the extended Zakharov model and the RPIC model were presented in a series of papers, Ref. [2-4], in which quantitative agreement between these two models are obtained in the fluid and quasi-linear regime. However, in the kinetic regime where electron and/or ion trapping is important, significant differences were found. These findings enunciate the importance for accurate modeling of kinetic processes such as trapping.

The RPIC model itself has some limitations, such as, the frequency harmonics of Langmuir waves are neglected. Our goal is two fold in comparing RPIC with full PIC. First, the various advantages of RPIC over full PIC will be quantitatively assessed, e.g., number of particle/cell required for similar noise spectra. Second, it is expected that for sufficiently strong laser drives, RPIC may not capture laser-plasma instability physics accurately due to the lack of frequency harmonics in the Langmuir waves. We would like to establish the regime of validity for RPIC, and to assess quantitatively if the physical regimes where RPIC fails is of interest to the conventional ICF indirect drive implosion scheme. Our current study is confined to one spatial dimension.

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