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Stabilization approach for an explicit hybrid particle-in-cell method for bridging multiple time-scales RINAT KHAZIEV, SHANE KENILEY, DAVIDE CURRELI, Univ of Illinois - Urbana — Fully-kinetic Particle-in-Cell (PiC) simulations of magnetized plasma sheaths including electrons, plasma ions, and heavy material impurities remain a big challenge because of the large discrepancy between the mass of the light species and that of the heavy species. The time-scales required for such simulations span over multiple orders of magnitude, from picoseconds for the electron dynamics, to microseconds for heavy-ion transport across the sheath. In this work, we analyze a numerical approach applicable to explicit PiC schemes that iterates between a fully-kinetic representation of the electrons and a reduced electron model; the method allows to capture fully-kinetic effects at time scales relevant to heavy-ion transport. A frequency analysis of the approach reveals the strategy required for stable operation of the method and prevent unstable drift-like behavior in the phase space. The method has been applied to plasma sheath simulations with oblique magnetic fields. In order to highlight the benefits of the method, the moments of the distribution function are compared to both long-time fully-kinetic PiC simulations, and to PiC simulations with only a reduced electron model. Finally, comparisons with a continuum Boltzmann-Poisson code solving the same problem are reported.

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