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Toroidal Electromagnetic Particle-in-Cell Code with Gyro-kinetic Election and Fully-kinetic ion

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Current drive and auxiliary heating is critical for fusion plasmas. A kinetic simulation model has been developed using gyro-kinetic electron and fully-kinetic ion by removing fast gyro motion of electrons using the Lie-transform perturbation theory. A particle-in-cell kinetic code is developed based on this model in general magnetic flux coordinate systems, which is particularly suitable for simulations of toroidally confined plasma. Single particle motion and field solver are successfully verified respectively. Integral Electrostatic benchmark, for example the lower-hybrid wave (LHW) and ion Bernstein wave (IBW), shows a good agreement with theoretical results. Preliminary electromagnetic benchmark of fast wave at lower hybrid frequency range is also presented. This code could be a first-principal tool to investigate high frequency nonlinear phenomenon, such as parametric decay instability, during lower-hybrid current drive (LHCD) and ion cyclotron radio frequency heating (ICRF) with complex geometry effect included.

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