Hybrid Vlasov simulation for Alfvén-cyclotron instability

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Hybrid-Vlasov simulations, in which electrons are treated as a massless charged fluid of constant temperature and ions are treated kinetically by following the temporal evolution of the distribution function on a fixed Eulerian-grid representation of the four dimensional phase-space (1D in space and 3D in velocity) are presented. In order to solve the Vlasov-Maxwell system in a consistent way, the splitting scheme [1] and the current advanced method (CAM) [2,3] are used. A high-order optimized finite-difference method for derivatives [4] are employed to convert the cubic spline interpolation scheme in an accurate and local scheme for parallel execution.

We use this hybrid-Vlasov code to study the properties of Alfvén-cyclotron waves propagating along a constant background magnetic field in a collisionless anisotropic electron-proton plasma with bi-Maxwellian proton velocity distribution functions, $T_{\perp p}/T_{\parallel p}>1$.

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