Spatial resolution dependence of ion-scale waves in a global-hybrid Vlasov simulation

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Plasma waves are ubiquitous in the Earth’s magnetosheath. The most observed waves arise from instabilities generated by temperature anisotropy on the ions and electrons, such as the mirror and proton cyclotron instabilities. Along with observations, space physics is increasingly relying on the support of numerical simulations to understand these waves and instabilities. However, numerical simulations come with resolution limitations. We investigate here the spatial resolution dependence of the mirror and proton cyclotron instabilities in a global-hybrid Vlasov simulation with the use of the Vlasiator model. We compare the proton velocity distribution functions, power spectrum and growth rate of the instabilities in a simulation with three different spatial resolutions. We find that the proton cyclotron instability is absent at the lowest resolution and that the mirror instability is dominating, increasing the overall temperature anisotropy of the simulation. We also conducted a test at higher resolution and found out that this does not improve the description of the proton cyclotron instability significantly enough to justify this increase in resolution at the cost of numerical resources in future simulations. These results will be used for a future sub-grid model in order to mimic the energy dissipation processes at work at smaller scales without increasing the resolution of the simulation.