Qeios

Peer Review

Review of: "Drift-Cyclotron Loss-Cone Instability in 3D Simulations of a Sloshing-Ion Simple Mirror"

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This paper presents a numerical study for kinetic drift-cyclotron loss-cone instability in a magnetic mirror confinement device. The initial condition for the main hybrid PIC-ion fluid-electron simulation is constructed using the collisional Fokker-Planck code to mimic the experimental condition. From the main simulation results, the concerned DCLC instability is identified, and quasilinear diffusion analysis is performed to explain the confinement performance of the device. Some effects (cool plasma populations, profiles, kinetic electrons) that may suppress DCLC, thus improving the device's performance, are discussed. Overall, the study is well-organized and comprehensive. The paper is well written.

I only have minor comments that may help improve the readability.

* Eq. (2.1)

It may be better to mention Pe=ne*Te with constant Te just after (2.1).

* sloshing ions

Please elaborate more on the sloshing ions.

Are ions sloshing along the magnetic field initially (t=0)?

What is the turning point and where is it?

If I understand correctly, the CQL3D-m results averaged along the field line define the profiles at z=0, and the same profiles are extended along the field lines. Therefore, the ion velocity should also be uniform along the field lines, ie. ions are not sloshing.

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If I'm wrong, please explain how to initialize the sloshing ion in Sec. 2.3.

* Initial conditions

Are temperatures uniform?

If not, how about showing the temperature profile in Figure 2?

* Page12, Line2

"Figure 3(f-i)" should be removed.

* Potential

It seems the electrostatic potential is an important ingredient in determining confinement. Isn't it necessary to discuss it? Is Figure 2(b) showing the so-called Yushmanov potential?

* Ion scattering zone

Is the scattering zone (discussed in the paragraph mentioning delta t) defined?

* Design concept

I wonder why the density gradient is so steep that it is comparable to the ion Larmor radius and the DCLC matters. Such a profile is chosen by intention in the WHAM design. While in the discussion, relaxing the spatial gradient (smaller epsilon) is considered. Maybe it is instructive to explain the design concept in the introduction.

Declarations

Potential competing interests: No potential competing interests to declare.