R008-16
Zoom meeting D ：11/4 AM2 (10:45-12:30)
11:00-11:15

A fluid closure in wavenumber space to model cyclotron resonance of hot magnetized plasmas

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Physical models of plasmas can be roughly divided into two types: fluid models and kinetic models. Fluid models such as MHD describe large scale phenomena well and require relatively less computational resources in numerical simulations. However, usual fluid models do not describe wave-particle interactions of collisionless plasmas. Therefore, ad hoc resistivity terms are added in diffusion regions such as the vicinity of neutral sheet in magnetic reconnection. Kinetic simulation models, especially particle-in-cell methods are often used to model small scale phenomena but the slow convergence property and the grid size restriction make it difficult to apply to three-dimensional macroscopic simulations.
A fluid description that contains kinetic effects is not only convenient for numerical simulations but may also make theoretical discussions of the interaction of different scales easier because of the reduced degree of freedom.
A method to take into account Landau damping of electrostatic waves was developed by Hammett & Perkins [1]. They approximated the highest order velocity moment of Vlasov equation (the heat flux term when up to the second-order moment is taken) by a linear combination of lower order terms (number density, fluid velocity, and pressure) in the wavenumber space so that the resulting dispersion relation resembles the dispersion relation given by linear kinetic theory (the description with plasma Z-function). This cannot be achieved by local dissipation terms.
By following the same strategy, we have extended the model to take into account cyclotron resonance effect for electromagnetic waves propagating parallel to the ambient field. We solve the time evolution of the off-diagonal component of the pressure tensor by approximating the relevant component of the heat flux tensor. This model roughly reproduces the kinetic dispersion relation of hot magnetized plasmas. The theory and a couple of applications will be shown.
[1] G. W. Hammett and F. W. Perkins, Phys. Rev. Lett. 64, 3019 (1990).