有限振幅ホイッスラー波動の非線形発展によるプラズマ加熱

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Plasma heating through nonlinear development of finite-amplitude whistler wave

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Large-amplitude, circular polarized Alfven waves are unstable to a decay process in low-beta plasma. Terasawa et al. (JGR 1986) numerically demonstrated that the large-amplitude right-handed polarized Alfven waves transfer their wave energy to two daughter Alfven-like waves and sound like wave. The hybrid simulations, which ignore the electron kinetic effects, for the decay process were also studied, and showed that ions were heated in both parallel and perpendicular direction through the nonlinear development of the finite-amplitude Alfven wave.

Here we focus on the plasma heating by the finite amplitude whistler waves which include both electron and ion kinetic effects. By using particle-in-cell simulation working on GPU, nonlinear development of finite-amplitude whistler wave is studied in low beta plasma. The wavelength scale is shorter than in the work by Terasawa et al., which is of the order of the ion inertial scale. Our simulation results show that the finite-amplitude whistler wave is modulated in amplitude leading the energy transfer from the parent wave to the daughter waves. We will discuss both electron and ion heating associated with the nonlinear development of the finite-amplitude whistler waves.