Particle simulations about generation mechanism of low frequency waves excited from beam instabilities

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According to our PIC simulations, ESW(Electrostatic Solitary Wave) is generated from electron beam instabilities. We know ESW is composing the upper frequency part of BEN(Broadband Electrostatic noise) which is frequently observed in space plasma. The generation mechanism of the lower frequency part of BEN, however, is still unexplained. To clarify whether such low frequency waves are generated by electron beam instabilities, we have to perform a series of long-term simulations of beam instabilities with different parameters, and observe time evolutions of these beam instabilities.In order to investigate time evolutions of beam instabilities, we are performing two-dimensional electrostatic computer experiments of electron beam instabilities, and demonstrate nonlinear evolutions of electron beam instabilities, in time as well as in space.

In this study, we investigated parameter dependence on formation mechanism of ESW and excitation conditions of low-frequency electrostatic waves after long-time evolution of electron beam instabilities. We performed a series of simulations with different parameters, electron cyclotron frequencies and drift velocities of the electron beam, and then confirmed that low-frequency waves are excited with relatively strong magnetic field. These low-frequency waves are polarized in the perpendicular direction to the ambient mangetic field, and have harmonics with lower-hybrid frequency, which indicates that they are affected by electron-ion hybrid cyclotron dynamics. We are going to perform more detailed simulations with various parameters in order to analyze excitation mechanism of these low-frequency waves.