PIC Simulation on nonlinear development of lower-hybrid instabilities driven by energetic ions.

*Tsubasa Kotani[1], Mieko Toida[2], Toseo Moritaka[2], Satoshi Taguchi[1]

1. Graduate School of Science, Kyoto University, 2. National Insititute for Fusion Science

Instabilities driven by energetic ions are important issues both for space plasmas and magnetic fusion plasmas. Radio Frequency (RF) waves in the range from the ion cyclotron frequency to the lower hybrid resonance frequency are often observed during the period of neutral beam injection (NBI) in Large Helical Device (LHD) plasmas. The experimental results showed that the peak frequency in the Lower Hybrid Wave (LHW) region has a positive correlation with the electron density and the ion cyclotron emissions (ICEs) have much larger amplitudes than LHW. These waves can be excited by instabilities due to energetic ions generated by the NBI perpendicular to the magnetic field.

Using a one-dimensional, electromagnetic, Particle-In-Cell (PIC) code, we study instabilities driven by energetic ions assuming that the energetic ions have a non-Maxwellian ring-like distribution in the velocity space perpendicular to the magnetic field. This PIC code enables us to self-consistently simulate full dynamics of electrons and ions and evolution of electromagnetic fields, using the full Maxwell's equations and the equations of motion of particles. We focus on the nonlinear evolution of LHW and ICEs caused by continuous energetic-ion injection into a plasma.

The simulation results are as follows. After the rapid growth of the LHW in the early stage, the ICEs gradually become intense. Finally, the ICEs have larger amplitudes than LHW.

Keywords: lower-hybrid instabilities, ion-cyclotron emissions, non-linear development, Particle-In-Cell simulation

