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Laboratory in-situ experiments for plasma wave-particle interaction in linear magnetized plasma machine

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Wave-particle interactions are thought to play important roles to generate MeV electrons in the radiation belt. “ Wave-Particle Interaction Analyzer (WPIA) ” , which derives energy flaxes between wave and particle from simultaneous measurements of an electric field and particle velocity vector, has been developed to observe the interaction between wave and particle in space plasma. We have been conducting laboratory in-situ experiments of plasma wave-particle interaction.

We have carried out the laboratory simulation using the Q_T-Upgrade Machine in Tohoku University, which is linear magnetized plasma machine. The Q_T-Upgrade Machine consists of a vacuum chamber of 0.2 m in diameter and 4.5 m in length, and plasma sources, which generates high-temperature electrons using electron cyclotron resonance (ECR) and low-temperature thermal electrons. Thus, an electron temperature gradient (ETG) is formed in the apparatus by superimposing low temperature thermal electrons on the high temperature electrons of the ECR plasma. Moon et al. [Rev. Sci. Instrum., 2010] reported that low-frequency fluctuations of drift-wave mode with a frequency of 7 kHz were excited with ETG mode of 0.5 MHz. We focus on the low-frequency fluctuations and simultaneously measures an electric field vector (**E**) and current vector (**J**). Energy flaxes between wave and particle can be calculated from inner products of **E** and **J** vectors. For the simultaneous measurements, we have developed a combination probe, which is a combination of Mach probe for ion flow measurements and Twin probe for electric field measurements. Three-dimensional vector are measured by turning and moving the probe in the chamber.

In this presentation, we will report the performance of the combination probe, the phase relationship between the electric field fluctuation and the current fluctuation, and transient response of fluctuation growth in detail.