ABSTRACTS (MASTER THESIS)

A study on data processing for the Wave-Particle Interaction Analyzer onboard the Arase satellite

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The Arase satellite was launched in December 2016 for the purpose of understanding wave-particle interaction processes in the inner magnetosphere. Software-type Wave-Particle Interaction Analyzer (S-WPIA) is installed in the Arase satellite. In the S-WPIA, it is possible to identify a relative phase angle of an instantaneous plasma wave electric and magnetic field vectors and a velocity vector of each detected electron. Since energy exchanges between plasma waves and particles are represented by the inner product of electric field vectors and particle velocity vectors, the relative phase angle is essential in wave-particle interaction processes. The objective of the present thesis is to evaluate a method for calibrating electric and magnetic fields in the view point of the WPIA and data of the chorus emissions obtained by the S-WPIA onboard the Arase satellite.

We established the calibration processes of the amplitude and phase of electric and magnetic fields affected by sensors, filters and amplifiers of the receiver. We evaluated the precision of the calibrated data by comparing the observed values with the theoretical values of the refractive index and the amplitude ratios and phase differences between each component of electric and magnetic fields. Our analysis showed that the electric fields data was not accurate enough to perform the WPIA analysis due to the lack of the spin-axis electric field sensor. On the other hand, we succeeded in showing that the calibration of the magnetic fields data is precise.

Since the magnetic field observations are accurate, we evaluated the wave-particle interaction from the relative phase angle between the instantaneous magnetic field vector and the particle velocity vector. The result showed that it is necessary to correct the observability bias of the relative phase angle when the target waves propagate obliquely relative to the ambient magnetic field. We established the compensation method of this observation bias considering the configurations and specifications of the particle sensors.

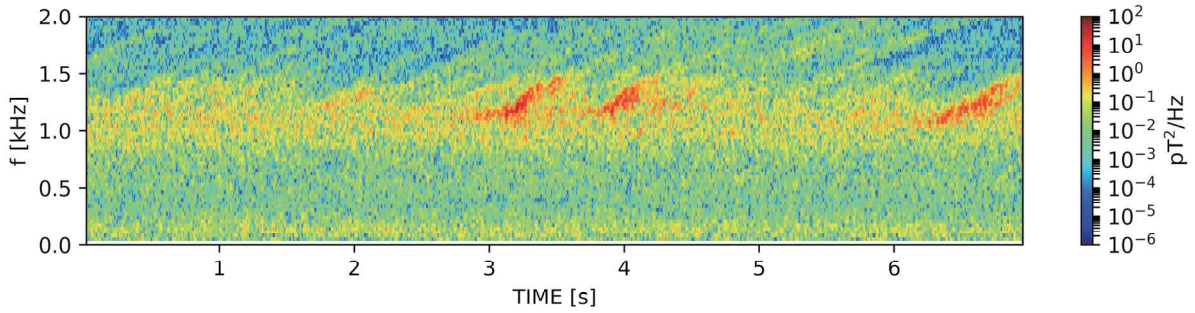

Figure 1. Frequency-spectrum diagram of chorus emissions observed by the Arase satellite. Chorus emissions is the main target of the S-WPIA.