R008-05
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11:45〜12:00

Study on Electric Field Sensor Impedance in Magnetized Plasma by PIC Simulation.

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A dipole antenna has been commonly used as electric-field sensors to observe plasma waves in space plasma. To calibrate electric field measurements, we have been using the assumption that wavelengths are much longer than antenna lengths. However, in the next generation of scientific satellite projects, it is possible that the wavelength is comparable to antenna length, and it significantly affects the interpretation of the observation results. Better understanding of electric field sensor responses to short-wavelength plasma waves is required for evaluating intensities and phases of targeted electrostatic waves.

In this research, we simulated the antenna impedances of electric field sensors in magnetized plasmas over electromagnetic waves with short or comparable wavelengths to the antenna. We conducted full Particle-In-Cell (PIC) simulations with electric field sensors as inner boundaries. The results were evaluated considering the linear dispersion relations in magnetized plasmas.

According to the calculation results, when the wave number of the antenna resonance is large enough, it is estimated that the resonances are seen at the frequencies of the electron cyclotron harmonics, which are frequently observed in the magnetized plasmas. The results show in some situations that at near the Upper Hybrid Resonance (UHR) frequency, one or two peaks of the antenna impedance was observed. When the wave number is small enough, the resonances frequencies are shifted to slightly high. The simulation results suggest that the frequencies at where the resonances were seen are determined by the relationship between the length of the antenna and the dispersion relation of the surrounding plasma.

In the present paper, we discuss the characteristics of electric field sensors in plasmas over plasma waves with short wavelengths that are comparable with lengths of electric field sensors.