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Arase observations of wave-particle interactions in the inner magnetosphere

Y. Miyoshi* (1), Y. Kasahara(2), H. Kojima(3) , S. Kasahara(4) , K. Asamura (5), Y. Kazama (6) , I. Shinohara (5) , S. Matsuda (2) , S. Yokota(7) , T. Mitani (5) , N. Higashio (5) , A. Matsuoka (3) , T. Takashima (5) , S. Kurita (3) , S. Saito (8) , Y. Katoh(9), M. Shoji (1) , and S. Nakamura (1)
(1) Nagoya University, Japan; e-mail: miyoshi@isee.nagoya-u.ac.jp
(2) Kanazawa University, Japan, (3) Kyoto University, Japan, (4) University of Tokyo, Japan, (5) JAXA, Japan, (6) ASIAA, Taiwan, (7) Osaka University, Japan, (8) NICT, Japan, (9) Tohoku University, Japan

In geospace, there are characteristic plasma distributions in a wide energy hierarchy from eV to several MeV. Geospace is a collisionless plasma system, and wave-particle interactions play an important role in the dynamics of plasma distributions. To understand how wave-particle interactions work for the cross-energy couplings and the dynamical evolutions of the plasma environment; acceleration, transportation, and loss of charged particles, the Geospace Exploration Satellite "Arase" was launched in 2016 [1]. The Arase satellite has instruments for plasma/particle observations (electrons: tens of eV to a few MeV, ions: 10 eV/q to 180 keV/q with mass discriminations) and electromagnetic waves (electric field: DC-10 MHz, magnetic field: DC-100 kHz), and the Arase satellite has continued the observations in geospace. The observations of the Arase satellite provide new insights of wave-particle interactions in the geospace, especially for significant role for the accelerations and loss of energetic electrons and wave generation process through cross-energy coupling.
In this presentation, we will introduce the highlights of the scientific achievements of the Arase satellite: 1) direct detection of electron acceleration and scattering by whistler mode chorus waves [2][3], 2) scattering and heating of ambient ions by electromagnetic ion cyclotron (EMIC) waves and magnetosonic waves (MSWs), and new generation mechanisms of plasmaspheric EMIC waves through interactions with MSWs[4][5]. For the first topic, we introduce the electron acceleration by non-linear wave-particle interactions with whistler mode chorus waves, as well as the scattering of electrons and the resultant pulsating auroral emission caused by the scattering of electrons. For the second topic, we will introduce the direct observation of the energy exchange process between ambient ions, EMIC waves and MSWs, and the mode conversion between MSWs and EMIC waves. In addition, we show that MeV electron flux in the radiation belt decrease through the pitch angle scattering with EMIC waves. Finally, we discuss the multiple roles of plasma waves in the different frequency bands for the dynamics of the inner magnetosphere.

1. Y. Miyoshi et al., Geospace Exploration Project ERG, *Earth Planets and Space*, **70**, doi:10.1186/s40623-018-0862-0, 2018..

2. S. Kurita et al., Deformation of electron pitch angle distributions caused by upper-band chorus observed by the Arase satellite, *Geophys. Res. Lett.*, doi:10.1029/2018GL079104, 2018.

3. S. Kasahara et al., Pulsating aurora from electron scattering by chorus waves, *Nature,* 554, doi:10.1038/nature25505, 2018.

4. Y. Miyoshi et al., EMIC waves converted from equatorial noise due to M/Q=2 ions in the plasmasphere: Observations from Van Allen Probes and Arase, *Geophys. Res. Lett.*, doi:10.1029/2019GL083024, 2019.

5. K. Asamura et al., Cross-energy coupling from magnetosonic waves to electromagnetic ion cyclotron waves through cold ion heating inside the plasmasphere, *Phys. Rev. Lett.*, 127, doi:10.1103/PhysRevLett.127.245101, 2021.