



Magnetosonic Mode Waves as a Source of Plasmaspheric EMIC waves; Arase observations

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We present the Arase satellite observations about Magnetosonic mode waves (MSWs) and plasmaspheric EMIC waves, and we discuss possible roles of MSW to generate plasmaspheric EMIC waves. Two different processes are presented; (i) EMIC waves are generated through the mode conversion from MSWs.[1] (ii) EMIC waves are generated through the formation of anisotropic ion distribution by MSWs.

For the first process, the Arase observations identified the branch splitting from the earthward propagating MSWs (R-mode waves) into MSWs, H⁺-band EMIC waves and M/Q=2 ion EMIC waves (L-mode waves). The presence of M/Q=2 ions (Deuteron and/or alpha particle) is essential to change the dispersion relation. From investigations of cut-off frequencies and cross-over frequencies using Arase/PWE MGF measurements, we can investigate the ion composition ratio of ambient plasma, and we identify the presence of M/Q=2 ions in the lower-L shell as well as the topside ionosphere. The maximum composition ratio of M/Q=2 ions is 10% in the low altitude, which is enough to modify the wave dispersion relation. The lower frequency part of MSWs changes to EMIC waves. Since MSWs propagate radially, the converted EMIC waves have large wave normal angles, i.e., oblique propagation. In the presentation, theoretical investigations about linear mode conversion from MSWs to EMIC waves [2], which contributes to generation of parallel propagated EMIC waves, will also be discussed.

For the second process, MSWs often contribute to the formation of the temperature anisotropy of ring current ions inner magnetosphere. The Arase/LEPi measurements identified strong temperature anisotropy of a few hundred to ~ keV protons associated with MSWs. Simultaneously, the Arase PWE/MGF identified the high-frequency EMIC waves. The results suggest that MSWs cause heating of low-energy protons in the inner magnetosphere, and the energized protons contribute to generation of EMIC waves, i.e., coupling between MSWs and EMIC waves takes place through interactions with ring current ions. Based on these observations, we discuss possible roles of MSWs to generate plasmaspheric EMIC waves.

References

[1] Y. Miyoshi, S. Matsuda, S. Kurita, *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.*, **46**, doi:10.1029/2019GL083024, 2019.

[2] R. Horne, and Y. Miyoshi, “Propagation and linear mode conversion of magnetosonic and electromagnetic ion cyclotron waves in the radiation belts”, *Geophys. Res. Lett.*, **43**, doi:10.1002/2016GL070216