R009-05
Zoom meeting D ：11/1 AM1 (9:00-10:30)
10:00-10:15

Discrete rising tone elements of whistler-mode waves observed by ARTEMIS in the vicinity of the Moon

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Whistler-mode chorus emissions are narrow band electromagnetic emissions typically with rising tone elements in a frequency range of 0.2 - 0.8 f_{ce}, where f_{ce} is the electron cyclotron frequency. They are mostly observed in the Earth's inner magnetosphere, and also known to occur in the magnetospheres of Jupiter, Saturn and Mars. However, they have not yet been reported around airless bodies.
Although the Moon does not have a global, intrinsic magnetic field and a dense atmosphere, interaction of plasmas in the solar wind and in the Earth's magnetotail with the lunar surface and crustal magnetic fields causes various plasma phenomena. Whistler-mode waves can be excited in the vicinity of the Moon as a result of cyclotron resonance of waves traveling toward the Moon with upward electrons magnetically mirrored from the lunar surface. A free energy source for the wave excitation is provided by effective temperature anisotropy in electron velocity distribution functions resulting from the surface absorption of parallel electrons and magnetic reflection of perpendicular electrons. As these whistler-mode waves around the Moon can have as large amplitudes as those in the Earth's magnetosphere, they might possibly grow like chorus emissions.
We report the existence of discrete rising-tone elements of whistler-mode waves observed by ARTEMIS in the vicinity of the Moon along with results of two ways of analysis: two-point observations and data-theory comparison. To check if they are related to the Moon, we compare wave spectra, electron pitch angle distributions and magnetic connection to the lunar surface observed by one probe (foreground) with those observed by the other probe (background). These two-point observations demonstrate that the observed whistler mode waves are indeed moon-related as suggested by previous studies. Furthermore, we compare the frequency sweep rates of the observed rising-tone elements with those predicted by the nonlinear theory of chorus emissions by Omura et al. (2008). Based on the theory, relationship of sweep rates and wave amplitudes are estimated from the observed electron distributions and magnetic field strength. The predictions show a good agreement with the observations. These results imply that moon-related whistler-mode waves can grow nonlinearly into chorus-like emissions.