

R006-14

B会場：11/27 AM1 (9:15-10:45)

9:15～9:30:00

周波数上昇を伴った電磁イオンサイクロトロン放射波束の非線形発展過程

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Nonlinear Evolution of Wave Packets of EMIC Rising-tone Emissions

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Electromagnetic ion cyclotron (EMIC) waves with rising tone frequency are frequently observed in the inner magnetosphere. They play a critical role in the loss process of the radiation belt electrons. We performed a one-dimensional hybrid simulation in a dipole magnetic field in the presence of energetic protons with temperature anisotropy. Through interaction between the protons and thermal fluctuations of the transverse electromagnetic fields, a coherent wave gradually grows at the frequency and wavenumber with the maximum linear growth rate. The interaction between the coherent wave and the energetic protons in the presence of positive gradient of the dipole magnetic field results in formation of a proton hole in the velocity phase space, giving rise to the resonant current $J_E (<0)$ parallel to the wave electric field. As reported in our previous study [1], the wave amplitude and the J_E maximize at the same location. Along with the formation of J_E , the $J_B (>0)$ parallel to the wave magnetic field also formed which contributes to variation of the wave frequency and wave number through the nonlinear dispersion relation. As observed at a fixed position, the frequency and the wavenumber do not change in the growing phase of the wave packet. Both frequency and wavenumber start to change after the wave amplitude is maximized. The wave packet with the increased frequency and the wavenumber propagates slower than the foregoing wave packet with the original frequency, because the group velocity decreases with the increasing frequency. There arises a spatial gap between the original wave packet and the new wave packet with the increased frequency, resulting in formation of two distinct wave packets. The frequency increase and the separation process of the wave packet are repeated through space-time evolution of the wave packets, resulting in formation of several subpackets of an EMIC rising-tone emission. The wave growth with frequency increase is interpreted with the nonlinear wave growth theory [2, 3]

[1] Chen, H., Wang, X., Lin, Y., Zhao, H., et al. (2025). Nonlinear proton dynamics in the formation of rising - tone EMIC wave subpackets. *Geophysical Research Letters*, 52, e2025GL115834

[2] Omura, Y., J. Pickett, B. Grison, O. Santolik, et al. (2010), Theory and observation of electromagnetic ion cyclotron triggered emissions in the magnetosphere, *J. Geophys. Res.*, 115, A07234, doi:10.1029/2010JA015300

[3] Shoji, M., and Y. Omura (2013), Triggering process of electromagnetic ion cyclotron rising tone emissions in the inner magnetosphere, *J. Geophys. Res. Space Physics*, 118, 5553 – 5561, doi:10.1002/jgra.50523.