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# Instantaneous Frequency Analysis on Nonlinear EMIC Emissions: Arase Observation

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The electromagnetic ion cyclotron (EMIC) waves are generated by the temperature anisotropy of protons. Especially, the nonlinear wave particle interaction [1,2] between the EMIC waves and protons causes the rising or falling frequencies and drastic proton scattering in the equatorial region[3]. Frequency sweep rate of the EMIC wave is a key parameter to analyze the affection on the ion scattering, however the estimation of the sweep rate is difficult from the Fourier dynamic spectrum due to the limitation between the frequency and temporal resolutions.

Arase spacecraft observed nonlinear EMIC emissions in the inner magnetosphere. The wave growth with sub-packet structures is found by waveform data from PWE/EFD instrument. The evolution of the instantaneous frequency of the electric field of the EMIC rising tone emission is analyzed by Hilbert-Huang transform (HHT). The intrinsic mode functions derived from HHT is compared between in the self-consistent ion hybrid simulation and Arase data. The EMIC waves are decomposed into the wave in growing phase and that in the nonlinear growth phase by HHT. Both waveforms are compared with the linear and nonlinear theories and showing good agreements. The intrinsic mode function explaining nonlinear wave shows rising frequency with the strong wave growth. The instantaneous frequency change of the falling tone emission is also discussed.

References:

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