R008-P07
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ホイッスラーモード・ヒス放射の非線形波成長のパラメータ依存性

#殷 振興 [1,2], 大村 善治 [2], 謝 怡凱 [3]
([1] 京都大学海老原研究室, ([2] 京大・生存圏, ([3] 京大生存研

Parametric dependence of nonlinear wave growth of whistler-mode hiss emissions

#ZHENXING YIN[1,2], Yoshiharu Omura[2], Yikai Hsieh[3]
([1]Ebihara laboratory, Kyoto University, ([2]Research Institute for Sustainable Humanosphere, Kyoto University, ([3]Research Institute for Sustainable Humanosphere, Kyoto University

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Zhen-Xing Yin, Yi-Kai Hsieh, and Yoshiharu Omura
Research Institute for Sustainable Humanosphere, Kyoto University

We conduct a series of electromagnetic particle simulations in magnetospheric plasma to analyze the nonlinear wave growth of hiss emissions. In our previous investigation into the effects of the background magnetic field gradient on nonlinear growth of hiss emissions, we confirmed the existence of an optimal gradient that maximizes wave amplitude growth. We also found that in a homogeneous background magnetic field, the wave amplitude is minimized compared to other magnetic field gradient scenarios. Thus, in this study, we focus on the nonlinear growth of hiss in the homogeneous background magnetic field by setting the gradient coefficient to zero and adjusting the initial temperature anisotropy by varying the thermal velocities $V_{\perp}$ and $V_{\parallel}$. We then calculate wave growth rates in simulations and the theoretical nonlinear wave growth rates for both temperature anisotropy and isotropy cases.

The results show that even in the temperature isotropy case, some wave packets with small amplitudes are generated, and we observe a remarkable growth rate in the wave generation process at the system's boundary. To verify whether the wave amplitude exhibits linear or nonlinear growth, or if it displays nonphysical behavior during the process, we select wave packets with falling-tone and raising-tone characteristics across different wavenumber ranges. We then calculate the frequency variation, trapping period, and the inhomogeneity factor S for each case. In the case of temperature isotropy within a homogeneous setting, we find that, despite the small wave amplitudes, wave packets are still generated, accompanied by frequency variations and inhomogeneity values $|S|$less than 2. This indicates significant nonlinear effects in some ranges compared to the temperature anisotropy case. Even under the temperature isotropy conditions, the system may still exhibit certain nonlinear effects. These effects can cause the originally linearly stable system to develop wave packets, which may arise due to nonlinear interactions.

References:

[1] Hikishima, M., Omura, Y., Summers, D. (2020), Particle simulation of the generation of plasmaspheric hiss. Journal of Geophysical Research: Space Physics, 125, e2020JA027973,
[2] Liu, Y., Omura, Y., Hikishima, M. (2021), Simulation study on parametric dependence of whistler - mode hiss generation in the plasmasphere, Earth, Planets and Space 73, 230.
[3] Liu, Y., & Omura, Y. (2022). Nonlinear wave growth of whistler-mode hiss emissions in a uniform magnetic field. Journal of Geophysical Research: Space Physics, 127, e2022JA030428.