Dependence of Nonlinear Wave Growth of Hiss Emissions on Plasma Simulation Parameters

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A recent electromagnetic particle simulation has successfully generated plasmaspheric hiss-like emissions with fine structures, showing preliminary agreements with nonlinear wave growth theory. In this study, using one-dimensional KEMPO code, we vary key parameters in a series of simulations and check their correspondences with theoretical results, further examining the applicability of nonlinear wave growth theory to the generation of hiss. As the gradient of background magnetic field increases from a homogeneous condition, we find that wave amplitude generated will decrease correspondingly, showing a relatively good match with nonlinear wave growth theory, that is the overlap between optimum and threshold amplitude diminishes and disappears at certain situation. We provide discussions on the value Q which represents depth of electron hole, indicating that its magnitude and symbol may result in obvious differences between simulation and theoretical results. We also vary the hot electron density to various levels. The wave amplitude evidently reduces for a small hot electron density case, which is consistent with the rapidly disappearing overlap between optimum and threshold amplitude in theory. We propose a self-consistent analysis that a low hot electron density leads to a small linear growth rate, thus a small initial wave amplitude. The inhomogeneity factor S which is closely related to wave amplitude may turns to a rather large value, representing the nonexistence of nonlinear process.

Keywords: Generation of Plasmaspheric Hiss, Nonlinear wave growth theory, Particle Simulation