ホイッスラーモード・コーラス放射の非線形成長と飽和過程

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Nonlinear wave growth and saturation of whistler-mode chorus emissions

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Chorus emissions are generated via nonlinear wave growth due to formation of an electromagnetic electron hole in the velocity phase space. The initial phase of the nonlinear wave growth is well described by a set of differential equations, which we call chorus equations [1]. Solutions of the chorus equations show exponential growth of the wave amplitude and rising tone frequency. The nonlinear wave growth theory indicates that the frequency sweep rate of a chorus element is proportional to the wave amplitude at the magnetic equator. Since chorus emissions often show a nearly constant frequency sweep rates, the wave amplitudes should be of the same order of magnitudes in the latter phase of the nonlinear wave growth, which indicates saturation of the wave growth. Our recent particle simulations of whistler-mode triggered emissions show formation of an electron bump in the higher pitch angle part of the velocity distribution function of the energetic electrons due to accumulation of trapped resonant electrons [2]. The electron bump causes wave damping, while the electron hole causes wave growth. The saturation of the nonlinear wave growth takes place due to balance of the two different nonlinear processes.

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