Electromagnetic Ion Cyclotron Waves in the Helium Branch Induced by Multiple Electromagnetic Ion Cyclotron Triggered Emissions

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Electromagnetic ion cyclotron (EMIC) triggered emissions with rising tones between the H^+ and He^+ cyclotron frequencies were found in the inner magnetosphere by the recent Cluster observations. Another type of EMIC wave with a constant frequency is occasionally observed below the He^+ cyclotron frequency after the multiple EMIC triggered emissions. We performed a self-consistent hybrid simulation with a one-dimensional cylindrical magnetic flux model approximating the dipole magnetic field of the Earth's inner magnetosphere. In the presence of energetic protons with a sufficient density and temperature anisotropy, multiple EMIC triggered emissions are reproduced due to the nonlinear wave growth mechanism of rising-tone chorus emissions, and a constant frequency wave in the He^+ EMIC branch is subsequently generated. Through interaction with the multiple EMIC rising-tone emissions, the velocity distribution function of the energetic protons is strongly modified. Because of the pitch angle scattering of the protons, the gradient of the distribution in velocity phase space is enhanced along the diffusion curve of the He^+ branch wave, resulting in the linear growth of the EMIC wave in the He^+ branch.