Spontaneously Triggered Electromagnetic Ion Cyclotron Emissions Generated by Ion Temperature Anisotropy

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In the previous study, we reproduced electromagnetic ion cyclotron (EMIC) triggered emissions in the Earth's magnetosphere by hybrid simulations with cylindrical magnetic geometry. The triggered emissions were generated with energetic proton distribution function (stable for EMIC instability) and triggering waves generated by external current source at the equator. Instead of injecting the triggering wave, we have performed hybrid simulations with anisotropic energetic protons which are unstable for EMIC instability. We have obtained spontaneously triggered nonlinear EMIC waves with rising frequencies. The spontaneously triggered emissions (STE) are reproduced in both H^+ and He^+ band. The proton holes in the phase space are formed in the velocity phase space by resonant protons satisfying the second-order resonance condition. We have also derived the theoretical optimum wave amplitude for triggering the EMIC nonlinear wave growth and compare with the simulation results. Moreover, to reproduce a series of STEs lasting for a few minutes as observed by Cluster, we have implemented continuous injection of energetic protons.