Nonlinear Dynamics of the Electromagnetic Ion Cyclotron Structures in the Inner Magnetosphere

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Electromagnetic ion cyclotron waves, called EMICs, are widely observed in the inner magnetosphere and can be excited through various plasma mechanisms, such as ion temperature anisotropy and directly by phenomena like magnetopause pulsations. These waves interact with magnetospheric particles, which they can scatter into the loss cone. We investigate how nonlinearities in the ion fluid equations governing the electromagnetic ion cyclotron waves can cause large-amplitude EMIC waves to evolve into coherent nonlinear structures. Both planar soliton structures and also two-dimensional vortex-like nonlinear structures are found to develop out of these nonlinearities. In addition to the nonlinear evolution of the EMIC waves, we consider the relationship between EMIC waves and seismic phenomena. In particular, we suggest that the presence of EMIC waves with certain properties might prove to be a tool for forecasting probable conditions for earthquakes [1].

[1] N. L. Tsintsadze, T. D. Kaladze, J. W. Van Dam, W. Horton, X. R. Fu, and T. W. Garner, "Nonlinear dynamics of the electromagnetic ion cyclotron structures in the inner magnetosphere," submitted to J. Geophysical Res. (2009).