# Theory and Observation of Electromagnetic Ion Cyclotron Triggered Emissions in the Magnetosphere

YOSHIHARU OMURA,[1] JOLENE PICKETT,[2] BENJAMIN GRISON,[3] ONDREJ SANTOLIK,[3] IANNIS DANDOURAS,[4] MARK ENGEBRETSON,[5] PIERRETTE M.E. DECREAU,[6] ARNAUD MASSON[7]

[1]*Research Institute for Sustainable Humanosphere, Kyoto University, Kyoto Japan*
[2] *Department of Physics and Astronomy, The University of Iowa, Iowa, USA*
[3]*Institute of Atmospheric Physics AS CR, Czech Republic*
[4]*Universite de Toulouse, Centre d'Etude Spatiale des Rayonnements, Toulouse, France*
[5]*Department of Physics,Augsburg College, Minneapolis, USA*
[6]*LPC2E, CNRS, Orleans, France*
[7]*Science Operations Department, European Space Agency, Noordwijk, The Netherlands*

We develop a nonlinear wave growth theory of electromagnetic ion cyclotron (EMIC) triggered emissions observed in the inner magnetosphere. We first derive the basic wave equations from Maxwell's equations and the momentum equations for the electrons and ions. We then obtain equations that describe the nonlinear dynamics of resonant protons interacting with an EMIC wave. The frequency sweep rate of the wave plays an important role in forming the resonant current that controls the wave growth. Assuming an optimum condition for the maximum growth rate as an absolute instability at the magnetic equator and a self-sustaining growth condition for the wave propagating from the magnetic equator, we obtain a set of ordinary differential equations that describe the nonlinear evolution of a rising tone emission generated at the magnetic equator. Using the physical parameters inferred from the wave, particle, and magnetic field data measured by the Cluster spacecraft, we determine the dispersion relation for the EMIC waves. Integrating the differential equations numerically, we obtain a solution for the time variation of the amplitude and frequency of a rising tone emission at the equator. Assuming saturation of the wave amplitude, as is found in the observations, we find good agreement between the numerical solutions and the wave spectrum of the EMIC triggered emissions.

Keywords: EMIC; chorus; nonlinear wave growth; triggered emissions