

Ballooning perturbations in the inner magnetosphere of the Earth: spectrum, stability and eigenfunction analysis

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We present a theoretical study of extra low-frequency transversally small-scale perturbations. We investigate the influence of plasma beta, pressure profile, polarization of transversal (Alfvén) perturbations, ionospheric conductivity and McIlwain parameter on spectra, stability limit and eigenfunctions of ballooning perturbations of static plasma equilibrium provided by a dipolar geomagnetic field and a toroidal current. We use a previously derived set of dimensionless equations of small oscillations, derived from one-fluid ideal MHD equations in “warm” ($\beta < 1$) plasma approximation neglecting convection and influence of energetic particles. We derive an approximate analytical solution for longitudinal (slow magnetosonic) perturbations in the near-Earth layers of the magnetosphere. We perform a detailed analysis of aperiodic perturbations, including flute (interchange) and incompressible perturbations. We demonstrate that flute modes determine general MHD stability of magnetospheric plasmas. We discuss influence of nonlinear members in beta on stability limit and spectra of flute and incompressible modes and present a possible explanation for a global Alfvén resonance.

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