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Numerical analysis of ballooning modes in Earth’s magnetosphere and their connections with MHD oscillation branches

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The report examines the condition for thee development of balloon instability in the Earth's dipole magnetosphere. It is shown that the instability lies on the same dispersion branch as the slow magnetosonic resonance. A necessary condition for instability is the plasma pressure fall with increasing distance from the Earth. The instability threshold is determined depending on the β parameter and the pressure gradient. On a given magnetic shell, at a given β value, a lorge pressure gradient favors the instability, and vice versa, at a given pressure gradient, a large β favors the instability. This situation is typical for the magnetic storms times, when strong ring current develops in the magnetosphere. It is found that the instability growth rate depends on the ratio of the radial and azimuthal wave vector components. The maximum growth rate value is reached if this ratio is zero. The magnetic field of an unstable ballooning mode is localized near the equator, and its localization grows as the mode approaches the maximum growth rate. It is shown that in the unstable mode the compressional magnetic field component has a phase shift with respect to the radial component. This can be used to detect unstable ballooning modes during observations in the Earth's magnetosphere. This study is supported by the Russian Science Foundation under grant 22-77-10032.