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Testing the Stability Criteria of Low-Frequency Waves in the Saturnian Magnetosphere

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Cassini plasma and magnetic field observations indicate that the centrifugal/interchange instability plays a critical role in radial plasma transport in the rapidly rotating magnetosphere of Saturn. The signatures of this instability are observed in a broad region extending from R=5 Rs to R=11 Rs, together with signatures of the mirror instability. These observations stimulate our interest in understanding the development of these low-frequency instabilities in the Saturnian magnetosphere. We describe in the present paper a first attempt to apply our theoretical findings to the Saturnian inner plasma torus, based on the best observational data from the Cassini mission available to date. This application is very similar to the ones done for the Io torus at Jupiter and the Earth's plasmasphere. We test our stability criteria against the mirror and interchange instabilities using various radial profiles for the magnetic and plasma distributions in the equatorial plane and we locate the unstable regions of the torus. We discuss in particular the implications of hot plasma pressure gradient and temperature anisotropies for their stability.