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## **Highlights of sounding of the plasmasphere and low altitude polar regions by the Radio Plasma Imager on the IMAGE satellite**

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The Radio Plasma Instrument (RPI) on the IMAGE satellite (Bodo Reinisch of U.Mass. Lowell, P.I.) was operated from March 2000 to December 2005 in a polar orbit with apogee at  $\sim 7$  RE. This brief review is the result of contributions from many members of the RPI team. One study showed that the plasmopause is a ‘rough’ target for sounding at free-space-mode frequencies. In conjunction with other work, that study indicated that the outer plasmasphere is regularly permeated by field-aligned irregularities with scale widths  $\sim 80$  m to 10 km. A propagation ‘cavity’ for Z-mode waves, evident in previous passive wave measurements, was explored, showing that a sounder operating near 3500 km altitude can probe the distribution of plasma along geomagnetic field lines in the upward as well as the downward direction. Echoes at whistler-mode frequencies observed at several thousand km altitude were found to reflect in two ways, depending upon the initial wave normal angle of the wave. In some cases the waves “specularly” reflected from the steep density gradients at the bottom side of the ionosphere, while in a narrow range of frequencies below  $\sim 12$  kHz, they underwent “magnetospheric reflections” at locations below the satellite where the wave frequency matched the local lower hybrid resonance (LHR) frequency. New evidence, relevant to earlier observations from the ISIS and Alouette topside sounders, was found of the manner in which proton cyclotron echoes can be stimulated at frequencies in the whistler and Z-mode domains, as well as at frequencies above the electron gyrofrequency in a nominally non-electromagnetically propagating domain. In the latter domain, a new resonance, apparently not present below  $\sim 10,000$  km altitude, was found at frequencies  $\sim 15\%$  above the electron gyrofrequency.