CASSINI RADIO AND PLASMA WAVE OBSERVATIONS AT SATURN

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Abstract

An overview is given of the radio and plasma waves detected by the Cassini Radio and Plasma Wave Science (RPWS) instrument during the approach and first few orbits around Saturn.

Many of the radio and plasma wave phenomena detected by Cassini are similar to those previously observed by Voyagers 1 and 2 in 1980–81, and some are not. Previously observed phenomena that are now being studied include Saturn Kilometric Radiation (SKR), Saturn Electrostatic Discharges (SEDs), upper-hybrid resonance emissions, electrostatic electron cyclotron waves, whistler-mode chorus emissions and dust impacts. The great improvements in the resolution and sensitivity of the RPWS and the advanced capabilities of Cassini now allow us to study these phenomena in ways that were never previously possible. For example, comparison with images of Saturn have now revealed storm systems in Saturn's atmosphere that are believed to produce the lightning responsible for the SEDs, comparison with auroral images have shown that SKR has a clear association with Saturn's aurora, and high-resolution spectrograms of SKR reveal complex frequency-time structures that are very similar to terrestrial kilometric radiation. Also, high-resolution spectrums of upper-hybrid emissions and Langmuir probe measurements have produced very detailed electron density and temperature profiles through the inner region of Saturn's magnetosphere and through the ionosphere of Titan.

Many unexpected phenomena have also been discovered. These include many short nearly monochromatic plasma wave emissions associated with the rings, apparently caused by meteoroid impacts on the rings; whistler-mode emissions similar to terrestrial auroral hiss, apparently caused by an electrodynamic interaction between the co-rotating magnetospheric plasma and the rings; whistling signals (whistlers), apparently produced by lightning; and a variety of unusual plasma and plasma wave phenomena that remain to be explained.

In addition to these early results, the long-term observations that Cassini can provide are expected to answer several difficult questions that have arisen since the early Voyager observations. Foremost among these are the unusual time variability of the SKR rotational modulation, and the possible control of SKR by Saturn's moon, Dione.

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