

Overview of Cassini radio Science at Saturn, Titan, and the icy satellites

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The Cassini spacecraft, which has been in orbit about Saturn for over two years, is the first Radio Science platform to provide three downlink frequencies. In addition to the X-band telemetry link (3.56 cm w.l.), two other frequencies, S-band (13.04 cm), and Ka-band (0.94 cm) are available. This, plus the high SNR (>50 dBHz at X-band) afforded by the 4 m diameter s/c high gain antenna in, combination with the excellent low noise receivers of the DSN, as well as overall system stabilities of 1 part in 10^{13} when referenced to the on-board ultra-stable oscillator (USO) in one-way operation, and 1 part in 10^{15} for a two-way link, make Cassini an unprecedented instrument of radio science.

The orbital tour phase of the mission has the following main radio science objectives:

- a) determination of the masses and gravity fields of Saturn's icy satellites, Titan, and Saturn through two-way tracking during fly-bys. To date, the masses of Phoebe, Iapetus, Dione, Enceladus, Rhea, and Titan have been measured, and will be reported here.
- b) Measurement of the structure and other properties of Saturn's rings through three-band occultation. Seven near-diametric occultations at a high ring opening angle have been completed, and the results will be presented here.
- c) Measurement of the vertical structure of the atmosphere and ionosphere of Saturn. The same series of occultations have provided nearly equatorial observations of the atmosphere structure and the ionosphere, and the results will be described here.
- d) Measurement of the vertical structure of the atmosphere and ionosphere of Titan. Two radio occultations of Titan have been observed to date, and the results on the atmosphere and ionosphere structure will be presented here

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