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Gravity Fields of the Saturnian Satellites

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Important objectives of the Cassini mission are to establish the densities of the Saturnian satellites, to determine the gravity field of Rhea, Enceladus, Titan, and Saturn, and to determine the dynamic Love number of degree 2 of Titan. The Cassini Radio Science team is responsible for the gravity investigations of Saturn and its satellites.

Prior to Cassini, our knowledge of the gravity of the bodies of the Saturnian system was fragmentary. Taking advantage of orbit-orbit resonances, the masses of Mimas and Tethys on one hand, and of Enceladus and Dione on the other hand were determined from ground-based astrometric data (Harper D. and D.B. Taylor 1993: *A&A* **268**, 236; Dourneau G., and S. Baratchart 1999: *A&A* **350**, 680). However, the dynamics of these resonances is imperfectly understood, making direct determinations highly desirable. Furthermore the small amplitude of Dione's libration results in a determination of Enceladus' mass with a large error of 22%. Radio tracking of the Pioneer and Voyager tracking data were analyzed to provide the masses of Tethys, Rhea, Titan, and Iapetus (Campbell J.K. and J.D. Anderson 1989: *Astron. J.* **97**, 1485). The masses of Hyperion and Phoebe were unknown.

The Cassini Radio Science Team has analyzed radio tracking data of Enceladus, Dione, Rhea, Hyperion, and Iapetus, and determined the masses of these satellites as well as the gravity harmonic coefficients of Rhea. The determination of Enceladus' quadrupole field will be made during the Extended Mission. At the time of the EGU meeting, we will also have acquired gravity science data during one Titan flyby.

Our technique consists of using X-band and Ka-band coherent, two-way radio links to collect Doppler measurements in short data arcs. The Doppler data are fitted using a

dynamical model that includes the gravitational accelerations from all Saturn system bodies, as well as non-gravitational accelerations from the spacecraft RTGs and from solar radiation pressure. Calibrations of the noise introduced by the Earth troposphere and charged particles in the solar corona and the Earth ionosphere are applied.

The talk will present our results as well as some geophysical interpretation.