



Recent Use of Advanced Radio Science Instrumentation

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Since the beginning of planetary probe exploration, radio communications have provided critical downlink from the exploring spacecraft to Earth-based receiving radio telescope antennas. In addition to providing valuable data downlink from onboard instruments, the radio link is also used as a science instrument itself referred to as Radio Science. Radio science investigations probe the atmosphere and ionosphere of celestial bodies with occultations, surface properties with bistatic scattering, and interior mass distribution by measurement of gravitational field parameters. Spacecraft navigators and radio scientists have advanced the precision, accuracy, and scope of investigations that utilize radio links. Recent planetary missions have utilized advanced radio science instrumentation. The Gravity Recovery and Interior Laboratory (GRAIL) mission to the moon utilized a spacecraft-to-spacecraft Ka-band link to measure the gravity field of the moon to the highest resolution of any planetary body. The recently concluded Cassini mission performed each type of radio science experiment described above at three bands: S-, X- and Ka-band to improve knowledge of gravitational fields, surface properties, and ring properties of the Saturnian system. The New Horizons Radio Science Experiment utilized a novel uplink-only radio science instrument with the spacecraft recording the received signal in an onboard open-loop recorder (REX) to determine the atmospheric and physical properties of Pluto and Charon. The Juno Gravity Science Experiment is the first mission to utilize dual and simultaneous X- and Ka-band up and down radio links between the spacecraft and antennas at Earth for geodesy. Due to its flexibility, science capabilities, and low cost, Radio Science as an instrument will continue to provide mission investigators high-quality planetary science data for many years to come.