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THE MARS EXPRESS RADIO SCIENCE EXPERIMENT (MARS)

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The Mars Express Orbiter Radio Science experiment (MaRS) (a) will sound the neutral Martian atmosphere (occultation experiment) to derive vertical density, pressure and temperature profiles as a function of height (height resolution better than 100 meter), (b) will sound the ionosphere (occultation experiment) to derive vertical ionospheric electron density profiles and a description of the Martian ionosphere through its diurnal and seasonal variations depending also on solar wind conditions, (c) will determine the dielectric and scattering properties of the Martian surface in specific target areas by a bistatic radar experiment, (d) will determine gravity anomalies for the investigation of the structure and evolution of the Martian crust and lithosphere in conjunction with HRSC observations as a base for three dimensional (3D) topography, and (e) will sound the solar corona during the superior conjunction of the planet Mars with the Sun. The radio carrier links of the spacecraft Telemetry, Tracking and Command (TTC) subsystem between the orbiter and the Earth will be used for these investigations. A simultaneous and coherent dual-frequency downlink at X-band (8.4 GHz) and S-band (2.3 GHz) via the High Gain Antenna (HGA) will separate the contributions from the classical Doppler shift and the dispersive media effects caused by the motion of the spacecraft with respect to the Earth and the propagation of the signals through the dispersive media, respectively. The experiment relies on the observation of the phase, amplitude, polarization and propagation times of radio signals transmitted from the spacecraft and received with ground station antennas on Earth. The radio signals are affected by the medium through which the signals propagate (atmospheres, ionospheres, interplanetary medium, solar corona), by the gravitational influence of the planet on the spacecraft and finally by the performance of the various systems involved both on the spacecraft and on ground.