



Measurements of crustal magnetic fields at Mars using the electron echo technique

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In an unexpected development, the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) instrument on the Mars Express spacecraft can be used to make very accurate measurements of the local magnetic field. The technique relies on the detection of electron echoes, which are series of echoes equally spaced in time at the electron cyclotron period. The echoes are believed to be caused by the periodic return to the antenna of electrons that are accelerated during the sounder pulse by strong electric fields near the antenna. From the period of the echo, the magnetic field strength in the vicinity of the spacecraft can be computed, averaged over a spatial scale on the order of the electron Larmor radius, which is typically a fraction of a kilometer to several kilometers. These scalar measurements are highly complementary to those obtained by the Mars Global Surveyor Magnetic Field Experiment (MAG/ER). In addition to providing accurate local magnetic field data for other Mars Express investigations, they will extend the existing spatial coverage at low altitudes. This will make possible the development of more accurate models of the Martian field and contribute to the study of the Mars-solar wind interaction.