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MARSIS: Latest Phobos Flyby. Data Processing Results and Advanced Radar Configuration Design

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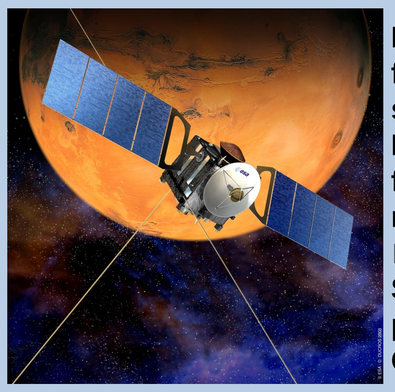
Mars Express Mission



MARSIS is a synthetic-aperture, orbital sounding radar, carried by ESA's Mars Express spacecraft. It works by transmitting a low-frequency radar pulse that is capable of penetrating below the surface, and is reflected by any dielectric discontinuity present in the subsurface.

MARSIS is capable of transmitting at four different bands between 1.3 MHz and 5.5 MHz, with a 1 MHz bandwidth. MARSIS is optimized for deep penetration, having detected echoes down to a depth of 3.7 km over the South Polar Layered Deposits. It has a vertical resolution of 150 m or less, depending on the dielectric constant of the material being sounded, and an horizontal resolution of 5-10 Km 10-20 Km, depending on the observation geometry.

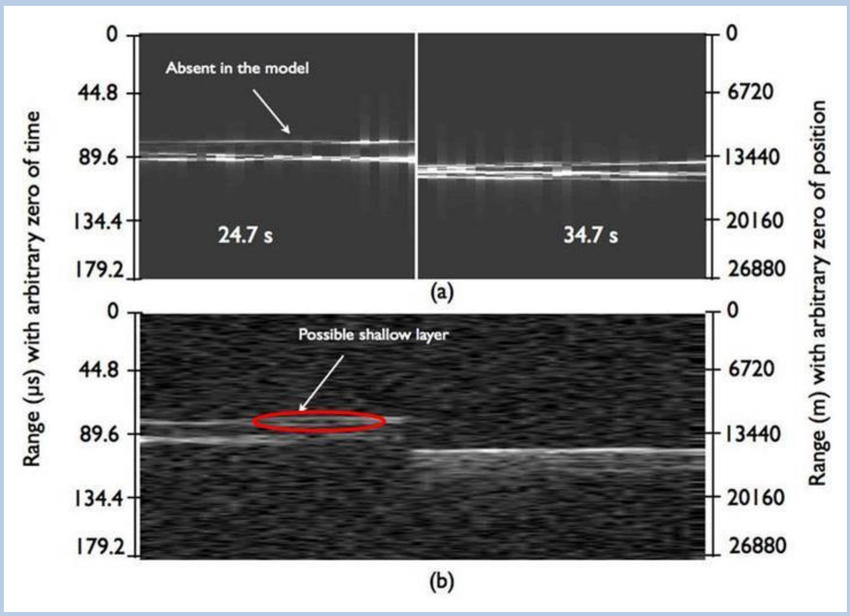
Since 2004, Mars Express has been orbiting planet Mars. Due to its highly elliptical orbit, the Mars Express spacecraft occasionally provides its instruments opportunities to observe Phobos from a distance of a few hundred kilometers. For safety reasons, the MARSIS CPU was designed to forbid all instrument operations when the designated target is closer than ~240 Km

Phobos Flyby 7 October 2007. Orbit 4814

Echoes from the surface were simulated through a code based on the Method of Moments.

Comparisons between Data and simulations shows features that are not present in the simulation results.

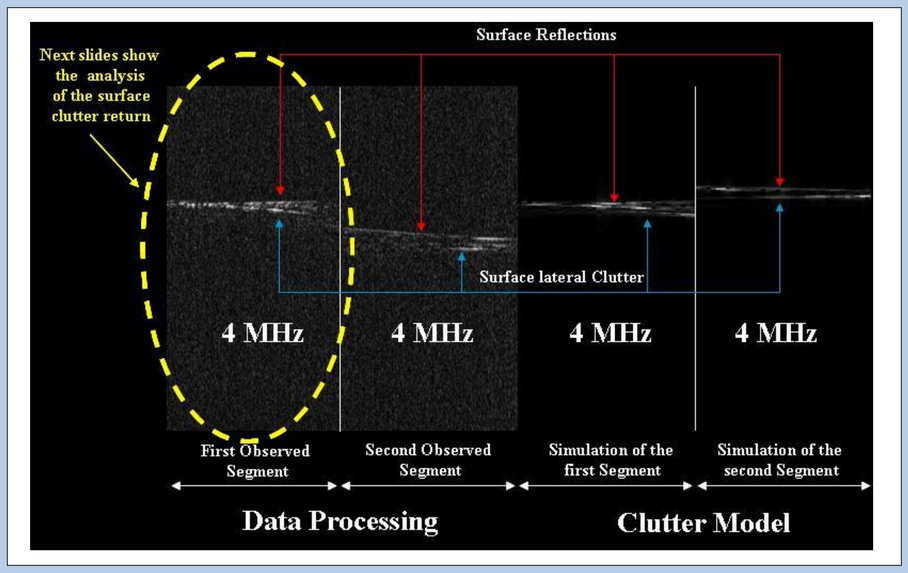
The explanation of this divergence between simulation and processing Could be caused by the presence of shallow Layers.



Phobos Flyby 7 March 2010. Orbit 7915

The simulation shows an evident correspondence between the science processing of the real data and the results of the simulator.

The secondary reflection has been generated by the lateral surface clutter.



Phobos Flyby 9 January 2011. Orbit 8974 " Latest MEX Flyby"

The Mars Express spacecraft flew by the Martian moon Phobos Sunday, January 9, 2011, at a distance of only 111 km from its centre. This is the closest of a number of flybys that took place between December 20, 2010 and 16 January 2011 and is the third closest in the entire mission.

Of the seven remote sensing instruments on board the spacecraft, six operated during the flyby to acquire high-resolution data. These new data will help solving the mystery surrounding the origin of the Martian moons, and will be used to help the Russian sample return mission, Phobos-Grunt, expected to be launched later this year.

The multi-frequency sounding radar MARSIS succeeded in recording echoes from Phobos during the flyby. MARSIS collected two segments of data containing 6000 individual echoes in 50 seconds of operations at a frequency of 4 MHz. The distance between Mars Express and Phobos during data acquisition ranged from 180 to 230 km.

The radar observed areas not explored during previous flybys, using a new setting of the on board software to boost the signal-to-noise ratio of measurements. Although this pushed the instrument to the limit of its original design capabilities, performance was flawless.