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MARSIS: Subsurface sounding performances

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The Mars Express mission, MARSIS (Mars Advanced Radar Subsurface and Ionosphere Sounding) has as a *primary scientific objective* to *map the distribution of water, both liquid and solid, in the upper portions of the crust of Mars*. Detection of such reservoirs will address key issues in the hydrologic, geologic, climatic and possibly biologic evolution of Mars, including the current and past global inventory of water, mechanisms of transport and storage of water. Three *secondary objectives* are defined as: *subsurface geologic probing, surface characterization* and *ionosphere sounding*.

This paper describes expected performance, based on Mars Orbital Laser Altimeter (MOLA) data. The analysis of MOLA data, from the current Mars Global Surveyor Mission, have shown indeed that Mars surface follows a pseudo fractal behavior. In this paper the results of the analysis of MOLA data, by mean also a mapping and a statistical distribution of the fractal parameters performed all over the surface of Mars, are shown. Then an analytical model for the surface correlation function will be introduced. Time domain analysis of the strong surface return, eventually after multi-look non-coherent integration, will allow estimation of surface roughness, reflectivity and mean distance, just as in classical pulse-limited surface radar altimeters. The presence of weaker signals after the first strong surface return will enable the detection of subsurface interfaces, while the estimation of their time delay from the first surface signal will allow the measurement of the depth of the detected interfaces.

The detection of these subsurface echoes is limited by the surface echoes (especially if surfaces are rough). For this reason, three methods are implemented: Doppler Beam Sharpening, Secondary Monopole Antenna and Dual Frequency Processing. The performance of these methods depend on surface models, the MARSIS frequency-agile design allowing to tune the sounding parameters, in response to changes in sun illumination condition, latitude etc., and global coverage to be achieved within the currently accepted Mars Express baseline orbit and mission duration.

Hence, considering the variation of surface parameters and instrument wavelengths, radar backscattering from the surface will be evaluated according to the Kirchoff approximation; in order also to predict the strength of the clutter signal and then of the penetration depth that is possible to reach with MARSIS instrument. The MEX available results and analytical evaluation obtained with the previous model will be compared.

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Mössbauer spectroscopy on Mars and its potential contribution in the search for extraterrestrial life

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For the first time in history a Mössbauer spectrometer was placed on the surface of another planet. The minaturized Mössbauer spectrometer MIMOS II, set up in backscattering geometry, is part of the payload of NASA's twin Mars Exploration Rovers (MER) "Spirit" and "Opportunity". They have measured the Fe-bearing mineralogy of several rocks and soil spots on two distinctly different landing sites, Gusev Crater and Meridiani Planum, spaced halfway across the planet. From orbital observations both landing sites have been associated with ancient water activity and are thus prime sites for the search for possible past or present life on Mars.

In this presentation we will compare several Mössbauer spectra obtained on the Martian surface with Mössbauer measurements performed in laboratories on Earth, using a copy of the flight instrument as well as conventional transmission Mössbauer spectrometer setups. Samples measured on Earth comprise in particular the SNC meteorites, including ALH84001.

We will explain what these data tell us about the evidence for the presence of water on both landing sites and evaluate the potential contribution of Mösbauer spectroscopy to the search for extraterrestrial life.