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Mars Advanced Radar for Subsurface Ionosphere Sounding: MARSIS

G. Picardi (1), D. Biccari (1) , M.Cartacci (1), A.Cicchetti (1), M.Iorio (1), R.Noschese (1), R. Seu (1) , A. Masdea (1), J. Plaut (2), R.L.Jordan (2), A.Safaenili (2), R. Orosei (3) P.T.Melacci (4)

(1)Infocom Dept.- "La Sapienza" University of Rome, Rome Italy via Eudossiana 18 00184 (2)Jet Propulsion Laboratory 4800 Oak Grove Drive Pasadena, CA-91109 USA (3)Dept. of Physics and Astronomy University of Iowa Iowa City, Iowa 52242 1447 USA (4) CNR/IAS Planetology Dept. Rome Italy via del Fosso di Cavaliere 00133 (4) Physics Dept. Universty of Perugia *picar@infocom.uniroma1.it

MARSIS (Mars Advanced Radar for Subsurface and Ionosphere Sounding) is a low-frequency nadir-looking pulse limited radar sounder and altimeter with ground penetration capabilities, which uses synthetic aperture techniques and a secondary receiving antenna (monopole) to isolate subsurface reflections. The MARSIS primary scientific objective is to map the distribution and depth of water, both liquid and solid, in the upper portions of the crust of Mars. Detection of such reservoirs of water will address key issues in the hydrologic, geologic, climatic and possible 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 for the MARSIS experiment: subsurface geologic probing, surface characterization, and ionosphere sounding. According to the previous scientific objectives, this paper describes the subsurface expected performance of the MARSIS. Three models, either dielectric and geometric, of the Martian crust have been worked out, being the related structure the results of many different processes, given the complex geological history of the planet. An exponential law model of the decline of porosity with depth due to the lithostatic pressure has been used. Three categories of rock material with different dielectric properties have been used to assess the performance of the radar sounder and detect the depth of the ice/water and dry/ice interface. The main feature of the MARSIS radar sounder and the expected subsurface sounding performance have been discussed, with respect to models of the martian crust omposition and topography as

revealed from the processing of MOLA data, using a fractal model. A mapping of the characteristics of the Mars surface are shown taking into account the statistical distribution of the fractal parameters. It has been also shown that, within the range of validity of the above mentioned models, MARSIS will be in principle able to detect subsurface water interfaces down to few Km beneath the surface.