Radar Sounder Observation of Phobos. A. Safaeinili[1], A. Cicchetti[3], C. Nenna[4], D. Calabrese[2], R. Jordan[1], T. Duxbury[1], J. Plaut, G. Piccardi[3], E. Flamini[6] [1]Jet Propulsion Laboratory, California Inst. of Technology, M/S 300-319, 4800 Oak Grove Dr., Pasadena, CA, [2]InfoCom Dept. University of Rome, La Sapienza, Rome, Italy, [2]Alcatel Alenia Space, Rome, Italy, [2]Alcatel-Alenia Spazio, Roma, Italy, [3]Infocom Department, "La Sapienza" University of Rome, Rome, Italy, [4]Info Solution, Milan, Italy, [5]Technische Universitaet Dreseden, Dreseden, Germany, [6]Italian Space Agency (ASI)

Introduction: Since 2004, Mars Express has been orbiting planet Mars. Due to its elliptica orbit, Mars Express spacecraft can provide its instruments a unique opportunity to observe phobos from a relatively close distance of few hundred kilometers. The latest flyby on October 2, 2007 will bring Mars Express instruments to a distance of ~130 km. This is close enough for the radar sounder on board to acquire echoes from the surface and possibly subsurface of Phobos.

Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) is a 1.3-5.5 MHz subsurface sounder that has been probing Mars to a depth ~3.7 km from orbit. Although originally MARSIS was not designed to probe Phobos, we have been able to use this radar sounder to investigate phobos at decameter wavelengths for the first time.

Radar Observation of Phobos: The first MARSIS opportunity to observe phobos was on November 4th, 2005. MARSIS came within 215 km of the Phobos surface. During this flyby, MARSIS collected data over a period of ~ 5 minutes from a distance of 460 km to 215 km and then out to 430 km. A total of 45 frames was collected with raw echoes stored in instrument on-board memory. During this fly a total of ~ 16000 raw echoes were collected. In spite of the relatively small size of Phobos and large wavelength of the radar, we observed signal to noise ratio (SNR) of ~ 25 db. This sensitivity was adequate to resolve features that could not be explained using the high-resolution shape models that are available today [1].

The Phobos flyby of October 2, 2007 will bring MARSIS to a close range of 125 km with the ground track crossing over the Stickney crater. This will be the closest flyby and observation of a phobos by a radar sounder.

Relevance to Future Asteroid Missions: Recently, Near-Earth asteroids have been considered as important exploration targets since they provide clues to the evolution of the solar system. The techniques exercised by MARSIS during the measurement of Phobos are very relevant to the type of data that one would expect to get from an radar orbiting around an asteroid. However, unlike the current Phobos flybys where the range is more than 100 km, the asteroid missions will enjoy much higher sensitivity due their relatively close distance of 5-10 km. A factor of 10 in range can increase the SNR by approximately 30 db.

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References:[1] R. Gaskell, private communication. 2007, [2] Safaeinili et al., 2006, First Radar Observation of Phobos, EGU conference.