Testing the SHARAD experiment of Mars Reconnaissance Orbiter with a flight balloon over polar regions.

G. G. Ori[1], E. Flamini[2], R. Seu[3], L. Marinangeli[1], [1]IRSPS (Universita' d'Annunzio, Viale Pindaro 42, 65127 Pescara Italy, ggori@irsps.unich.it), [2]Agenzia Spaziale Italiana (ASI, Solar System Exploration, Via di Villa Grazioli, 00100 Roma Iatly, enrico.flamini@asi.it), [3] INFOCOM (Universita' La Sapienza, Via Eudossiana, 00100 Roma Italy, robeto.seu@uniroma1.it)

Introduction: SHARAD is a subsurface penetrating radar that will be onboard the Mars Reconnaissance Orbiter (MRO) NASA mission. SHARAD [1] is a facility instrument provided by Agenzia Spaziale Italiana for a NASA mission and the PI is R. Seu (INFOCOM Dept., Univ. Roma "La Sapienza). SHARAD is the direct evolution of MARSIS [2, 3], the subsurface penetrating radar on board the European mission Mars Express. MARSIS has a strong penetration power (a few kilometers) and lower vertical resolution, whereas SHARAD will penetrate only several 100s meters but its data will have high-resolution range. This is achieved with the use of different hardware and different frequencies. One of the goals of MARSIS and SHARAD data is to understand the nature of the signal and compare it with the geological nature of the subsurface.

The two instruments have been not tested yet in flying conditions on Earth. The Agenzia Spaziale Italiana has set up a test campaign in order to evaluate and validate the operation and data of the SHARAD experiment. The Agenzia Spaziale Italiana is planning a test programme in order to evaluate and validate the operation and data of the SHARAD experiment. Possibly, two experiments are envisaged one in Antarctica and the other in the Artic. At present, only one flight will be performed. According to the results of the first test a decision to carry out another test will be taken. The first experiment is scheduled in 2004.

Rationale and operations: Testing a subsurface sounder orbiting radar on Earth is a difficult challenge. The most difficult problem is the presence of interstitial water that, even in small concentration, will strongly attenuate the signal. The consequence is to not have reliable data from most part of the planet. However, the polar areas are good candidates for this kind of test due to the presence of thick cover of ice, as well as the extensive presence of permafrost. A stratospheric balloon flaying at about 35 km above sea level will carry the experiment. The balloon will carry a model of SHARAD with some capability and electronics scaled to the experiment parameters. Both polar regions (the Arctic and Antarctica) are under considerations. The Arctic experiment will be launched from Svalbard where the facility of the Italian base will be used. Simulations of the balloon trajectory show a circular shape with a landing area within 100 km from the launch pad. During the flight the balloon will get data from northern Greenland the Canadian Archipelago and part of northern Siberia and adjoining islands. The experiment will be able to investigate thick ice sheets, permafrost areas, seasonally snow covered zones and sea ice. The Antarctica experiment will flight from the US McMurdo base and the Italian base at Terra Nova Bay will provide the support. Even in this case the trajectory will be circular with the landing near the launch location. In this experiment the balloon will chiefly flight over the thick Antarctic ice sheet.

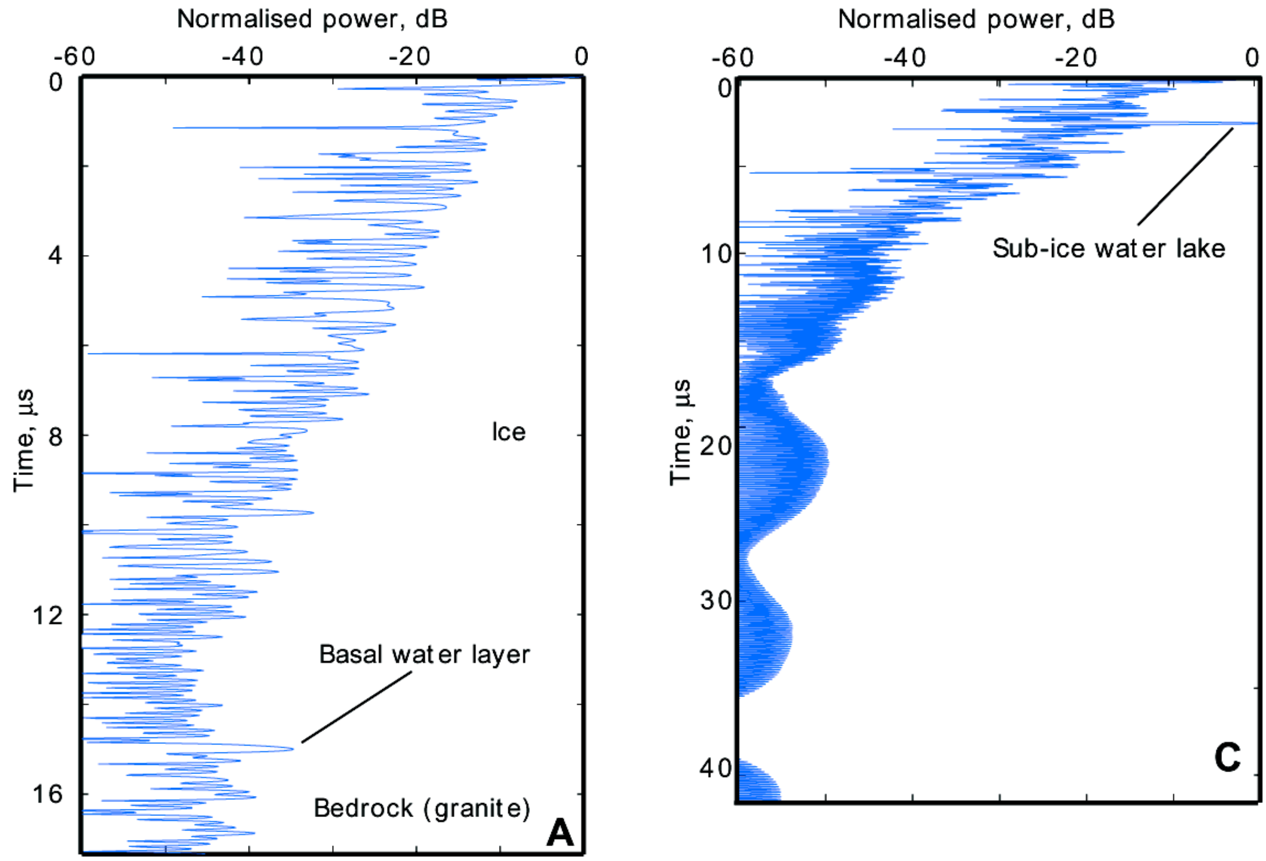
Preliminary work and data: The selection and timing of the experiment is still under consideration. A preliminary scenario suggests the Arctic flight in summer 2004 with a possible second experiment in winter (Austral summer) 2004.

Fieldwork will be carried out in order to analyse the surface properties along with the gathering of previous data. The ground penetrating radar data already obtained from the surface in the past years by several institutions are of particular interest, because they will be used to control the SHARAD signal when operating on Mars.

Several simulations of the radar signal have been performed in order to model the response of the SHARAD model to the polar environment. Some examples are provided in Figure 1. The ice has been modeled as a layered unit composed of strata of pure ice and ice with silicoclastic detritus. The layer thickness varied according to the simulation experiment ranging from a few tens of cm to a few meters. When a basal layer of melt water is present the bedrock is not recorded. Possible lakes of liquid water will produce, as expected, the same effect with the disappearance of the signal below the water layer.

Conclusion: The experiment with a model of the SHARAD radar on earth will provide useful clues in understanding the signal behaviour and will give some know-how about the geological and glaciological interpretation of the data. This experiment will support the analysis of the SHARAD data and will provide some clues on the use of a similar instrument on the icy satellites.

References: [1] Seu R. et al. (2003) *PSS, in press*. [2] Picardi et al. (1999) *INFOCOM Tech. Rep., n.*007/005/99 [3] Biccari et al. (2003) *PSS., in press*.



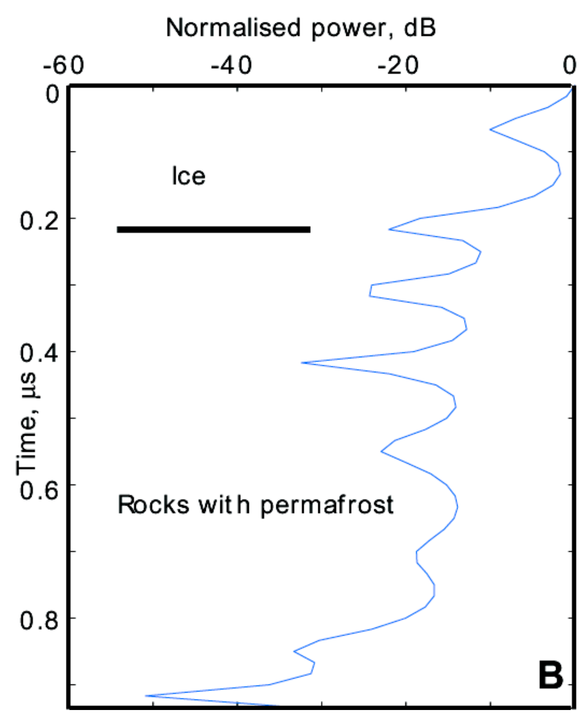


Figure 1. Simulations of the radar response of the balloon experiment for different polar scenarios.

A: simulation of a thick ice cover. The ice thickness is about 750 metres with a basal layer of meltwater 1 metre thick. Below the water layer a bedrock of about 100 metres of granite is present.

B: simulation of 10 metres of ice underlain by a 50 metres of permafrost in soft sediment.

C: simulation of about 850 metres of ice with a layer of water (sub-ice lake) at about 180 metres of depth. The water layer is 100 metres thick.