THE MARS MICROPHONE 2016 EXPERIMENT

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The Mars Microphone is a very simple and exciting experiment proposed in the frame of the ExoMars 2016 EDM Payload. Its primary objective is to achieve a world premiere during the short life of the ExoMars EDL payload: retrieve sounds from Mars. While built in Europe, with students involvement, the Mars Microphone will also strongly rely on the heritage of the previous Mars Microphone experiments, led by Berkeley SSL and the Planetary Society for the Phoenix, Mars Polar lander and NetLander missions. This experiment will therefore feature a unique combination of outreach, educational initiative and scientific objectives, particularly suited for the EDM payload context.

**Experiment configurations and scientific objectives**

The stringent resource constraints lead us to propose 3 possible configurations for the Microphone which will eventually depend on the possible on–board resources allocation.

| **Option** | **Configuration** | **Science objectives** | **Remarks** |
|---|---|---|---|
| Baseline | Electronic box + 1 microphone | First Sounds from Mars + Core Science | About 50 grams |
| Option #2 | Electronic box + 2 microphones (stereo) | First Sounds from Mars + Extended Science | Adds 5 g to the mass (additional microphone and wire) – Allows stereo recording |
| Option #3 | Electronic box + 3 (TBD) microphones + synergy with EDL sensors | First Sounds from Mars + Extended Science + Descent Science | To enable descent science, the microphone shall be powered ON during the descent (this implies an implementation in the EDL engineering system) |

**Sound environment on the Martian surface**

A thorough synthesis of the expected sound environment for the Mars microphone was given by (William, 2001) for the Mars Polar Lander Microphone. Sound behaviour at the Martian surface is expected to be very similar to the Earth stratosphere, with an average atmospheric pressure between 6 and 8 mbar and a mean temperature about 240 K. In absence of in-situ measurement, main expected attenuation sources are classical and molecular absorption, but also the effect of the carbon dioxide viscosity. As a consequence of this, a strong attenuation is foreseen: most sounds in the human ear sensitivity window will not propagate over more than some dozen of meters. However, the situation improves in the lower frequencies, and infrasounds, either related to dust devils or to other sources are expected to propagate over kilometre ranges.

**Expected signals**

Therefore, expected signals are due to the interaction between the lander structure and the Martian wind. Aeolian tones will be related to the main size of the lander and to the size of the lander elements exposed to wind (Curle, 1955). Noise level will be mainly related to atmospheric turbulence next to the lander (William, 2001). As we expect a sandy environment in the vicinity of the lander, the noise of the particles against the lander structure or directly against the microphone (depending on the wind direction) could also be monitored. A random activation of the microphone will therefore most likely bring back wind and saltation related noises. In addition, several less probable phenomena could also be witnessed, especially if the EDM operational scenario allows operating an automatic "switch on" triggered by a event of some intensity: dust devils, thunderstorms, asteroid impacts. Dust devils are known to generate both infrasounds (detectable over long ranges) and high frequency sounds (short ranges) Arnold et al (1976) reported dust devil activity in the audible range [2000 Hz] for Earth dust devils. The microphone has therefore a good chance of capturing such sounds, and, in its stereo version, to provide data on its trajectory. Melnik and Parrot (1998), as well as Mills (1977) also stated that dust storms could lead to lightning through cloud dust charging: an acoustic counterpart (thunder) may be detectable.

**Experiment description and Heritage**

The design is on-purpose very simple, and following the previous design, relies primarily on a COTS component. It offers the required functionality together with the required low power consumption (150 mW), and a sufficient reliability for short life duration. In its baseline configuration, the Mars Microphone weights 50 g, and is composed of an electronics board enclosed in a 50x50x20 mm aluminium box. The microphone component is accommodated "outside". A simple serial bus interfaces with the internal payload unit. The proposed design has its heritage in previous Mars Microphone implementations, first on-board Mars polar Lander, and then on-board Phoenix: same microphone elements, same class of COTS components.

**Preliminary Team description , Student Involvement – Outreach**

The Mars Microphone 2016 team includes a wide panel of scientists and engineers, interested in both science and outreach. Outreach will be coordinated with the Planetary Society and Europlanet..

Following the successful example of Cassini-Huygens, we will put a large emphasis on outreach activities. The strong design heritage of previous versions will also allow us to have a student involvement in the development and in the tests of the Mars Microphone 2016.


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