

UV CLIMATE AT MARS SURFACE: A PROPOSED SENSOR FOR BOTH ORBIT AND GROUND STATIONS. D.Gillotay¹, C. Depiesse¹, F.Daerden¹, N. This² and C. Muller², ¹Belgian Institute for Space Aeronomy, (avenue Circularize, 3, B-1180 Brussels, Belgium, Didier.Gillotay@aeronomie.be), ²B.USOC (Belgian User Support and Operation Centre, Christian.Muller@busoc.be)

Introduction: One of the concerns for the future manned exploration of Mars centers around protecting the human body from high energy UV radiation. Similar methods of suit protection to that used on the manned Apollo missions to the Moon would be required for any extra vehicular activity on Mars. A long-term study of the UV environment is thus required, to understand fully any changes or trends in the irradiation patterns from which any human explorers would require protection. [3] [4]

The UV conditions on the surface of Mars are thus of paramount importance, when considering the human exploration of Mars, both directly through severe damage to human tissue and indirectly through the sustainability of a viable ecosystem and long term materials.

Also, as the Mars inclination parameter is not stabilized by a heavy satellite as the earth's moon, Mars radiative conditions may be chaotic and a comprehensive study of Mars UV climate is required before any human flight.

The UV climate is also related to an other main environment parameter which is Martian dust, it is far from being characterized and several indications exist that it could act as a UV filter, leading to a radiative role. The characterization of Martian dust relates evidently to its own toxicity (grain size, metallic content), its UV spectrum might be one of the best way to identify it and study its variations in density and composition.

UV-visible monitoring is also an effective technique to measure Martian ozone and other trace gases related to volcanic or biological sources.

Mission architecture: We propose to measure spectrally the solar direct UV and visible radiations absorbed through Mars atmosphere as well as the diffuse UV and visible radiations from both Mars orbit and ground stations with light functionally identical instruments. The surface stations could be fixed or mobile but must be well characterized in position and attitude. This payload would ideally complement a network science mission covering specific regions of the planet. Spectral measurements present the advantage of enabling a link between orbital measurements and surface observations..

The most efficient use of orbital measurement would be the near simultaneous observation of limb and nadir leading to both columns and vertical distribu-

tion determinations. Of course, solar occultation when possible would lead to high accuracy observations of the vertical distribution and would enable to determine values or upper limits for very minor species as hydrogen peroxide, nitrogen dioxide, sulfur dioxide or even formaldehyde.

Instrument example: Commercial spectrometers of shirt pocket size can now address the above scientific objectives.

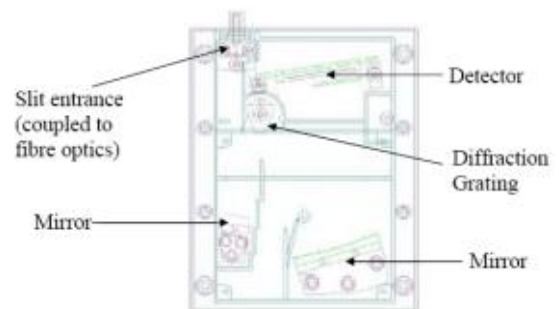


Fig. 1: schematics and drawing of the spectrometer (symmetric Czerny Turner layout).

The example shown (<300 g and <100 mW respectively) provides an ideal candidate for any Martian science payload, giving a very significant science return in the form of a spectrum covering the UV and visible spectrum (200 to 650nm) at medium resolution (1 nm).

The ambient light is input to the optics via an optical fiber, which is focused onto a diffraction grating via a collimating mirror. The dispersed light is then focused onto a 1024 element linear photodiode array, where the intensity as a function of wavelength is measured and processed through the front-end electronics. The flight instrument would probably gain if the linear array were replaced by a state of the art CCD bidimensional detector. These kind of modifications will certainly be studied if the concept were selected.

A flat base plate forms the basis of the instrument, upon which the optical components and cover are mounted. The key optical components (in light path order) are of the fiber optic input slit, a collimating

mirror, a diffraction grating, a second collimating mirror and the detector.

Previous results of the team: The Belgian Institute for Space Aeronomy is involved in Mars observations since the 1989 Mars-Phobos mission where one of the Franco-Russian optical packages used concepts developed for a Belgian national instrument on the never flown ESA Kepler mission to Mars. The analysis provided the first publication on a layer around the altitude of 17 km which presented spectral features similar to formaldehyde. (Korablev et al, 1993[1]), this observation got a new actuality when Martian absorptions corresponding to methane were observed.

The Belgian Institute for Space Aeronomy was then the lead in the construction of the SPICAM instrument on Mars 96 which was partly reused in the SPICAM Mars Express design which is now measuring in an extended mission [2, 4, and 5] as well as its Venusian version SPICAV-SOIR, also built at the Belgian Institute for Space Aeronomy. [6]

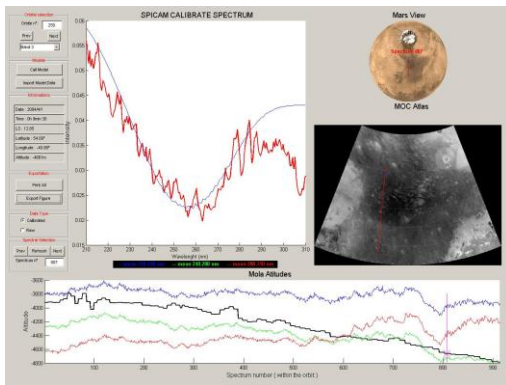


Fig. 2: Graphical interface for Martian ozone determination from SPICAM designed at BISA. [5]

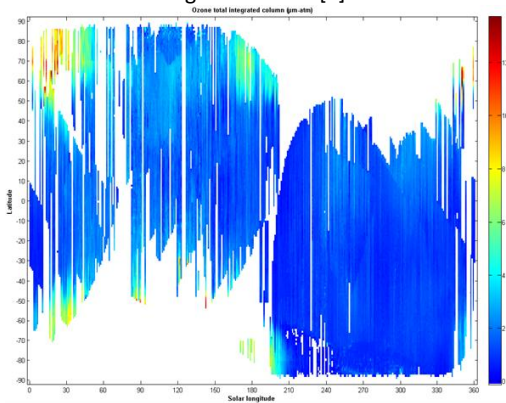


Fig. 3: Ozone map corresponding to the second Martian year of SPICAM on Mars Express. [5]

Current activities of B.USOC The Belgian User Support and Operation Centre as the other members of the European USOC network supports experiments on the International Space Station, in this respect, B.USOC is “Facility Responsible Centre” for the SOLAR package, a set of three solar monitor covering the far UV to the middle infrared. B.USOC has a 24h/24h, 7d/7d capability and could if requested support a Martian mission or network. B.USOC has also coordination mandates including an action on assessing the amplitude of solar forcing on earth climate variations.

One of the current operations managed by B.USOC on the ISS deals with METERON, a robotic technology concept developed in common by NASA and ESA as a tool for future planetary manned exploration.

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