

The miniaturised Moessbauer spectrometer MIMOS II: future developments.

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In January 2004, the first in situ extraterrestrial Mössbauer spectrum was received from the Martian surface. At the present time (May 2007) two Miniaturized Mössbauer Spectrometers (MIMOS II) on board of the two Mars Exploration Rovers “Spirit” and “Opportunity” continue to collect valuable scientific data [1-3]. Both spectrometers are operational after more than 3 years of work. Originally, the mission was expected to last for 90 days. To date more than 600 spectra were obtained with a total integration time for both rovers exceeding 260 days.

The MER mission has proven that Mössbauer spectroscopy is a valuable technique for the in situ exploration of extraterrestrial bodies and the study of Fe-bearing samples. The Mössbauer team at the University of Mainz has accumulated a lot of experience and learned many lessons during last three years. All that makes MIMOS II a feasible choice for the future missions to Mars and other targets. Currently MIMOS II is on the scientific payload of two missions: Phobos Grunt (Russian Space Agency) and ExoMars (European Space Agency).

Phobos Grunt is scheduled to launch in 2009. The main goals of the mission are: a) Phobos regolith sample return, b) Phobos in situ study, c) Mars and Phobos remote sensing. MIMOS II will be installed on the arm of a landing module. Currently, we are manufacturing an engineering model for testing purposes.

The ESA “ExoMars” mission involves the development of a MER-like rover with more complex scientific payload (Pasteur exobiology instruments, including a drilling

system). Its aim is to further characterise the biological environment in preparation for robotic missions and eventually human exploration. Data from the mission will provide invaluable input to the field of exobiology - the study of the origin, the evolution and distribution of life in the universe. The launch date is scheduled for 2013. Like on MER, the MIMOS II instrument will be mounted on a robotic arm.

Advanced and improved version of MIMOS II instrument is under development for those and other future missions. The new design includes additional mass reduction (total mass is planned to be ~ 320 g). The dimensions of the electronic-board will be minimized by using state of the art digital electronics. A new ring-detector system (Si-Drift detectors) will be used, thus greatly improving energy resolution. We expect an energy resolution of around 140-160 eV for temperatures lower than 250 K. This will increase the signal to noise ratio by a factor of 10 and, therefore, integration times will be reduced significantly. In addition to the Mössbauer data, simultaneous acquisition of an X-ray fluorescence spectrum will be possible, thus providing data on a sample's elemental composition. New firmware will be developed to optimize the instrument's performance.

References:

- [1] Klingelhöfer et al., «*Two years of Mössbauer studies of the surface of Mars with MIMOS II*», Hyp. Int. 170 (2006)
- [2] Morris, Klingelhöfer et al., «*Moessbauer mineralogy of rock, soil, and dust at Gusev crater, Mars : Spirit's journey through weakly altered olivine basalt on the plains and pervasively altered basalt in the Columbia Hills*», J. Geophys. Res. 111 (2006)
- [3] Morris, Klingelhöfer et al., «*Moessbauer mineralogy of rock, soil, and dust at Meridiani Planum, Mars: Opportunity's journey across sulfate-rich outcrop, basaltic sand and dust, and hematite lag deposits*», J. Geophys. Res. 111 (2006)