

THE MEASUREMENTS OF NEUTRON RADIATION DOSE DURING MARS ODYSSEY CRUISE TO MARS.

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Introduction: In 2001 Mars Odyssey mission was launched and travelled to Mars. It carried High Energy Neutron Detector (HEND) instrument which was operating during transit to Mars to measure solar activity and variations of ambient neutron background induced in space craft body by Galactic Cosmic Rays (GCR) [1,2], see Figure 1. HEND/Odyssey was originally designed to measure martian neutron albedo and to search for martian subsurface water/water ice but its measurements are also applicable to evaluate neutron radiation doses [1,2]. The biological impact of neutron component of the radiation background during cruise to Mars, orbital and surface operations should be understood to plan future manned missions to Mars. We analyzed HEND measurement and modeled spacecraft neutron spectral (see Figure 2) to estimate equivalent neutron dose rates during Odyssey cruise phase, which corresponds to the solar maxim period (23th solar cycle), see Figure 2.

Results. It was found that Odyssey ambient neutron environment during May - September 2001 produces 10.6 ± 2.0 mSv per day in energy range 0-15 MeV or about 29 mSv per day if extrapolated to 0-1000 MeV energy range for sun quiet intervals. These estimations were also extrapolated to the different periods of solar cycle and it was found that neutron equivalent rate during cruise to Mars could be as high as 40 mSv per day. These values are in good agreement with results reported for a similar measurement made with an instrument aboard the Mars Science Laboratory during its cruise to Mars in 2011-2012.

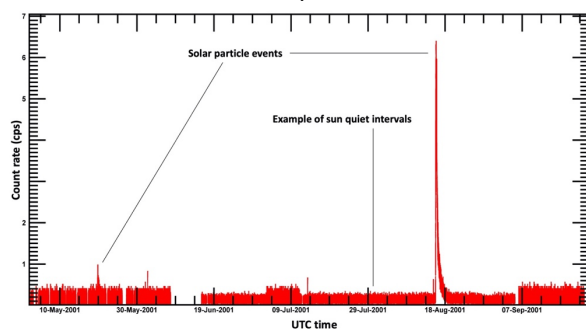


Figure 4. The HEND/Odyssey observations during cruise to Mars.

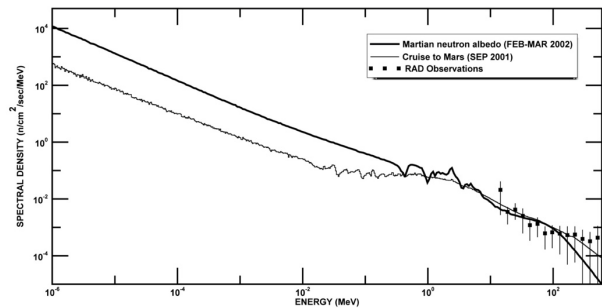


Figure 2. The modeled neutron spectra fitting the HEND/Odyssey measurements during cruise to Mars (thin line), HEND/Odyssey measurements of Martian neutron albedo during initial phase of mapping (February – March of 2002) and RAD/MSL observations during cruise to Mars (November 2011 – August 2012), data taken from [3]).

References:

- [1] Boynton W.V. et al. (2004), Space Science Reviews, 110, 37-83.
- [2] Mitrofanov I.G. et al. (2003), Solar System Research, 37, 366-377.
- [3] Köhler J. et al. (2015), Life Sci. Space Res. 5 (0), 6–12.