COMPARISON OF NEUTRON ENVIRONMENT AND NEUTRON COMPONENT OF RADIATION DOZE FOR SPACE AROUND EARTH AND MARS FROM DATA OF INSTRUMENTS HEND/MARSODYSSEY AND BTN/ISS. V.I Tretyakov[1]; A. S. Kozyrev[1]; M.L. Litvak[1]; A. V. Malakhov[1]; I. G. Mitrofanov[1]; M.I. Mokrousov[1]; A.B. Sanin[1]; and A.A.Vostrukhin[1]; [1]Space Research Institute, RAS, Moscow, 117997, Russia, vladtr@mx.iki.rssi.ru.

Introduction: Neutron spectroscopy data from HEND/MO and BTN/ISS instruments have used for investigation of neutrons fluxes near Mars and Earth. During start of Mars Odyssey mission in May 2001 the HEND/MO accumulate huge volume of data that were successfully used for exploration of water ice distribution in Martian surface and carbon dioxide annual evolution in atmosphere [1-6]. BTN/ISS operates from February 2007 and data accumulated for this period are close to results of other neutron experiments [7, 8] and sufficient for preliminary comparision of neutron environment near Earth and Mars.

Instruments description: BTN/ISS and HEND/MO have similar set of neutron detectors on base of three ^{3}He proportional counters for epithermal neutrons (0.4 ev – 1 Mev) and plastic scintillator for fast neutrons (0.4 Mev – 10 Mev). The BTN/ISS have two unit: 1) electronics units for command and data handling placed inside Station; 2) detector unit presented in Figure 1 that is mounted on open surface of Russian Service Module "Zvezda" of ISS by means of special blacket. The total mass of units without cables is near 15 kg and the power consumption is near 18 W.

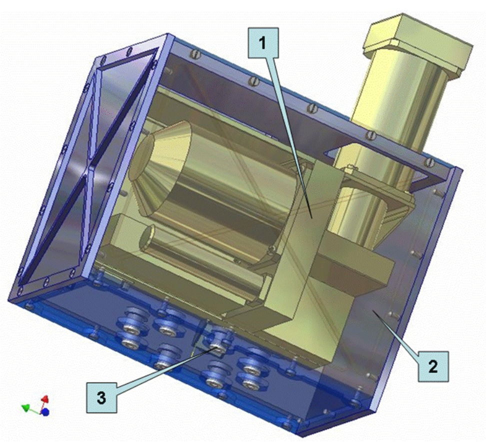

Fig. 1. Concept design of BTN/ISS detector unit [1- detector unit equal HEND/MO instrument; 2 – special frame for mechanical and thermal condition providing; 3 – montage holes for blacket]

Neutron in space: In both cases - for MO and for ISS neutrons produced mainly due to interaction of galactic and solar cosmic rays with the planet and the spacecraft materials. For the vicinity of Mars the "natural" source of neutrons is the Martian surface, whereas for the vicinity of Earth the "natural" source of particles is the upper layers of thick terrestrial atmosphere. The second technogenic component of neutron emission in both cases is produced by spacecrafts itself. In spite of differences in mass and structure of Mars Odyssey and Space Station the local fluxes of technogenic neutrons are determined by mass distribution in the local vicinity of the instruments. Third neutron source in space is acceleration processes on surface of Sun [9, 10] but detection of very high energy neutron from Sun is very difficult task and it is purpose for future stages of BTN space experiment.

Data analysis: Data obtained from two similar instruments – HEND/MO and BTN/ISS – gives very good opportunity to compare neutron radiation environment in the space near Mars and Earth. The technogenic component of neutron background may be estimated by analysis of data for different stages of flight. For Mars Odyssey this analysis is based on data for interplanetary flight and for elliptical orbit on stage of Mars Orbit Insertion. For Space Station, the data from different altitude may be used for estimation of technogenic neutrons environment at the vicinity of BTN. After evaluation of local background, the natural component of neutron radiation environment will be estimated for space around both planets. Using data from HEND/MO and BTN/ISS in 2007 - 2008, the neutron contribution to total doze is estimated in conditions of solar minimum both for near-Earth and near-Mars space. Map of dose rate distribution on ISS orbit for quiet Sun condition show on Figure 2.

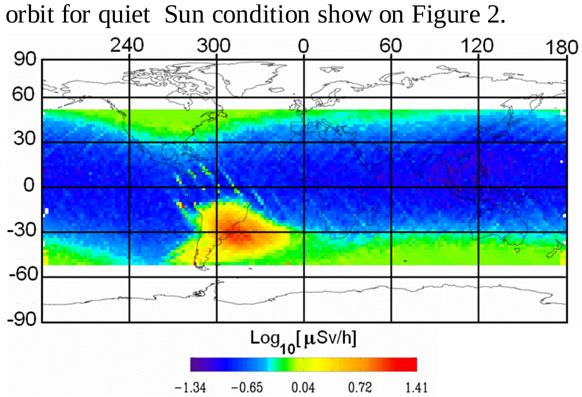

Fig. 2. Map of dose rate on base of data BTN/ISS accumulated from February 2007.

Preliminary estmations for neutron dose in space on ISS orbit are: 0.2 mZv/hour (equatorial areas); 0.8 mZv/hour (near polar areas); 5.0 mZv/hour (South Atlantic Anomale). Dose for Martian orbit varies in range 0.8 - 1.1 mZv/hour.

Conclusion: These estimations are converted easily into the doze rate for long interplanetary flight and for long stay at different regions on the Martian surface. In 2009 - 2010, when the rising phase of the next 24th solar cycle will be in progress, the data of measurements of HEND/MO and BTN/ISS will allow to model space environment for more complex conditions, when decreasing flux of galactic cosmic rays will be compensated by episodes of powerful solar particles events.

References:

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