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Space experiment BTN-NEUTRON on INTERNATIONAL SPACE STATION – CURRENT STATUS and future stages

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Space experiment BTN (Board Telescope of Neutrons) was suggested in 1997 for the Russian segment of International Space Station. The first stage of this experiment was started in February 2007 with instrumentation BTN-M1, which contain two separate units: 1) the electronics unit for commanding and data handling, which is installed inside the Station; 2) the detector unit, which is installed at the outer surface of Russian Service Module "Zvezda". The total mass of this instrument without cables is about 15 kg and total power consumption is about 18 Watts. Detector unit of BTN-M1 has the set of four neutron detectors: three proportional counters of epithermal neutrons with 3He covered by cadmium shields and polyethylene moderators with different thickness and stylbene scintillator for fast neutrons at the energy range 0.4 Mev – 10 Mev.

There are three sources of neutrons in the near-Earth space. Permanent flux of neutrons is produced due to interaction of energetic particles of galactic and solar cosmic rays with the upper atmosphere of the Earth ("natural neutrons") and with the body of the spacecraft ("technogenic neutrons"). The third transient sources of neutrons are active regions of the Sun, which may sporadically emit energetic neutrons during strong flares. Some of these particles have sufficiently high energy to neutrons cover the distance to the Earth before decay

Data from BTN-M1 after 2 years of space operations is sufficient for preliminary estimation of neutron component of radiation environment in the near-Earth space. BTN-M1 detector unit is equal to the Russian instrument HEND, which also operates now onboard NASA's Mars Odyssey orbiter since May 2001. Simultaneous measurements of neutron radiation on orbits around Mars and Earth give the unique opportunity to compare neutron radiation environment around two planets. The technogenic component of neutron background may be estimated by analysis of data for different stages of flight. After evaluation of local background, the natural components of neutron radiation environment around two planets are deconvolved from the data of two instruments. Using the data from HEND/MO and BTN/ISS for 2007 – 2008 years time interval, the neutron contribution to the total radiation doze is estimated in conditions of solar minimum both for near-Earth and near-Mars space. 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.

Presently instrumentation BTN-M2 for the 2nd stage of space experiment BTN-Neutron is designed, which will allow to study the neutron fluxes in different places inside of Station. This data will allow to compare neutrons outside and inside Station at different conditions of orbital flight. Detector unit of BTN-M2 will be surrounded by different shielding materials, which are known as good neutron moderators and absorbers. Measurements with shielded and open detectors will provide the experimental data for designing future spacecraft for long space flights in the interplanetary space.