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Measurement result of the neutron monitor onboard the Space Environment Data Acquisition Equipment(SEDA-AP)

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To support future space activities, it is crucial to acquire space environmental data related to the space-radiation degradation of space parts and materials, and spacecraft anomalies. Such data are useful for spacecraft design and manned space activity.
SEDA-AP was mounted on ”Kibo” of the ISS (International Space Station) to measure the space environment at a 400-kilometer altitude.

Neutrons are very harmful radiation, with electrical neutrality that makes them strongly permeable. SEDA-AP measures the energy of neutrons from thermal to 100 MeV in real time using a Bonner Ball Detector (BBND) and a Scintillation Fiber Detector (FIB). BBND detects neutrons using He-3 counters, which have high sensitivity to thermal neutrons. Neutron energy is derived using the relative response function of polyethylene moderators of 6 different thicknesses. FIB measures the tracks of recoil protons caused by neutrons within a cubic arrayed sensor of 512 scintillation fibers. The charged particles are excluded using an anti-scintillator which surrounds the cube sensor, and the neutron energy is obtained from the track length of a recoil proton.

There are three sources of neutrons in space;
1. Albedo Neutrons
Produced by reactions of galactic cosmic rays or radiation belt particles with the atmosphere
2. Local Neutrons
Produced by the reactions of galactic cosmic rays or radiation belt particles with spacecraft
3. Solar Neutrons
Produced by accelerated particles in solar flares
An accurate energy spectrum of the solar neutrons includes important information on high-energy particle generation mechanism in a solar flare, because neutrons are unaffected by interplanetary magnetic fields. These data will become useful to forecast solar energetic particles in future. Some candidate events involving solar neutrons were found as a result of analyzing data of the solar flare of M>2 since September 2009.

Moreover, it is important to measure albedo neutrons, since protons generated by neutron decays are thought to originate from the radiation belt. This theory is called CRAND (Cosmic Ray Albedo Neutron Decay). Our observation result is consistent with the CRAND theory prediction in the case of low-energy parts. Moreover, the flux and angular distribution of local neutrons were estimated using the nuclear simulation code ”PHITS” to evaluate the influence of local neutrons on the structure of SEDA-AP and ”Kibo”.

The results of our analyses on solar and albedo neutrons are reported in this paper.