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

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To support future space activities, it is very important to acquire space environmental data related to 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 ISS (International Space Station) to measure the space environment at 400-kilometer altitude.

Neutrons are very harmful radiation because of their strong permeability due to its electrical neutrality. 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 by using the relative response function of the 6 kinds of different polyethylene moderator’s thickness. FIB measures the tracks of recoil protons which caused by neutron in 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 the reactions of galactic cosmic ray or radiation belt particles with atmosphere
2. Local Neutrons
Produced by the reactions of galactic cosmic ray or radiation belt particle with spacecraft
3. Solar Neutrons
Produced by accelerated particles in solar flare
An accurate energy spectrum of the solar neutrons includes important information on the high energy particle generation mechanism in a solar flare, because a neutron does not receive the influence from the interplanetary magnetic fields. These data will become useful to forecast solar energetic particles in the future. Some candidate events of solar neutron were found as a result of analyzing the data of the solar flare of M>2 since September, 2009.

Moreover, it is important to measure the albedo neutrons because it is supposed that protons generated by neutron decays are an origin of the radiation belt. This theory is called as CRAND (Cosmic Ray Albedo Neutron Decay). Our observation result is consistent with the CRAND theory prediction in the case of low energy part. And also, the flux and angular distribution of local neutrons were estimated using nuclear simulation code "PHITS" to evaluate the influence of local neutrons from the structure of SEDA-AP and "Kibo".

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