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Real-time Measurements of the Low Energy Range Neutron Spectra

Bonner Ball Neutron Detector (BBND) is the first detector to be flown on the Space Shuttle for detecting and measuring the neutron activity. The BBND was first flown in 1992 on the Space Shuttle Mission, STS-28, and later on STS-31 and STS-36. The measurements from these experiments were not real-time but passive and cumulative radioactive measurements. We propose to enhance this capability and develop a real-time thermal neutron detection and measurement system.

Since the neutrons are particles without any charge, they have higher penetrating power. Because of this penetrating capability, low energy neutrons are likely to cause damage to the blood forming organs (BFO) that are deeper in the human body. In low Earth orbits, the contribution of the neutron component is estimated to be about 20% of the total radiation. For the Space Shuttle flights the total radiation contribution is expected to be higher than the International Space Station due to variations in the shielding component.

The BBND measures intra vehicular neutron radiation in the thermal range (0.025 eV - 10 MeV) using six of its independent ^3He counters. Thermal neutrons upon interaction with ^3He molecule generate the desired electrons. These electrons are collected at the anode and converted to amplified electrical signal for measurement. Four of the six ^3He counters are covered with varying thickness of the polyethylene material (spherical diameter of the polyethylene cover is in the range of 81Ø - 230Ø). One of the ^3He counters is covered with gadolinium (Gd) material, and one ^3He counter is not covered with any material and is considered to be naked. Data from these six different counters are normalized and the neutron activity is derived. The expected neutron flux of the SAA (South Atlantic Anomaly) is about 3×10^{-2} particles/cm²/sec.

The objectives of this study are to develop (a) an active thermal neutron detection system, (b) a real-time measurement capability of the thermal neutron activity, and (c) a system to analyze the energy spectrum of the thermal neutrons.