

**HIGH-ALTITUDE COSMIC RAY NEUTRONS:
PROBABLE SOURCE FOR THE HIGH-ENERGY PROTONS OF
THE EARTH'S RADIATION BELTS**

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Several High-altitude cosmic-ray neutron measurements were performed by the NASA Ames Laboratory in the mid-to late-1970's using airplanes flying at about 13km altitude along constant geomagnetic latitudes of 20, 44 and 51 degrees north. Bonner spheres and manganese, gold and aluminium foils were used in the measurements. In addition, large moderated BF-3 counters served as normalizing instruments.

Data analyses performed at that time did not provide complete and unambiguous spectral information and field intensities. Recently, using our new unfolding methods and codes, and Bonner-sphere response function extensions for higher energies, "new" neutron spectral intensities were obtained, which show progressive hardening of neutron spectra as a function of increasing geomagnetic latitude, with substantial increases in the energy region from 10 MeV to 10 GeV.

For example, we found that the total neutron fluences at 20 and 51 degrees magnetic north are in the ratio of 1 to 5.2 and the 10 MeV to 10 GeV fluence ratio is 1 to 18.

The magnitude of these ratios is quite remarkable. From the new results, the derived absolute neutron energy distribution is of the correct strength and shape for the albedo neutrons to be the main source of the high-energy protons trapped in the Earth's inner radiation belt. In addition, the results, depending on the extrapolation scheme used, indicate that the neutron dose equivalent rate may be as high as 0.1 mSv/h near the geomagnetic north pole and thus a significant contributor to the radiation exposures of pilots, flight attendants and the general public.