

A DIRECT MEASUREMENT OF THE QUIET-TIME GEOMAGNETIC CUTOFF FOR COSMIC RAYS AT SPACE STATION LATITUDES

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We report new measurements of the vertical geomagnetic cutoff for cosmic rays in the rigidity range from ~500 to 1700 MV. The measurements were made using data from the MAST instrument on the polar-orbiting SAMPEX satellite at an average altitude of ~600 km during solar and geomagnetically-quiet periods from July, 1992 to February 1995. The MAST instrument measures the nuclear charge, mass, and kinetic energy of individual cosmic ray nuclei from ~20 to ~200 MeV/nucleon. From these data and the satellite location the particle's rigidity (momentum/charge) and invariant latitude can be calculated. A total of almost 10,000 nuclei were used to measure the latitude cutoff in nineteen separate rigidity intervals. These results show that cosmic rays and solar particles can penetrate several degrees lower in latitude than would be estimated from commonly used relations for the geomagnetic cutoff, which has implications for the radiation exposure expected on the Space Station. We find that an excellent fit to our measured cutoffs is given by the relation $R_c = 15.062 \cos^4(\lambda) - 0.363$ GV, where R_c is the geomagnetic cutoff in rigidity, and λ is the invariant latitude. We suggest that this relation is useful over invariant latitudes from $\lambda = 0^\circ$ to 65° , above which particles with rigidities >100 MV generally have free access to SAMPEX altitudes. In general, our results show that the cutoff at a given latitude is lower than is given by estimates based on particle tracing techniques.