COSMIC RAYS IN THE HELIOSPHERE OVER THE SOLAR MINIMUM OF CYCLE 22

F. B. McDonald (1), A. C. Cummings (2), N. Lal (3), R. E. McGuire (3).
E. C. Stone (2)
(1) Institute for Physical Science and Technology, University of Maryland, College Park, MD 20742; 301-405-4861; fm27@umail.umd.edu
(2) California Institute of Technology, Pasadena, CA 91125
(3) NASA-Goddard Space Flight Center, Greenbelt, MD 20771

The combination of Voyager 1 and 2 in the distant heliosphere and IMP 8 at 1 AU provide cosmic ray observations over the solar minimum period of cycle 22 that extend beyond 70 AU. The cosmic ray intensity at 1 AU over the 1996-1997 time period exhibits the quasi-plateau like characteristic predicted for qA>0 epochs. The 1 AU energy spectra of 20-450 MeV/n He and 20-220 MeV H are essentially identical to those observed for 1976-1977 over a similar phase of the heliomagnetic cycle, strongly suggesting that modulation conditions at both times are very similar throughout the heliosphere. This similarity makes it possible to combine the Pioneer 10 and 11 data from 1977 with the Voyager 1 and 2 from 1997 to obtain a much more detailed measure of the distribution of cosmic rays in the heliosphere from 1 to > 70 AU near the ecliptic plane (?<35°). It is found that beyond ~12 AU the radial intensity gradients are very small; less than 0.15% AU for 265 MeV/n He. Such a small intensity gradient indicates that the intensity levels observed at V-1 for 7-18 MeV/n ACR 0^{+} and 265 MeV/n He are close to those expected at the termination shock at the V-1 heliolatitude of 39ºN. Furthermore the measured 1997 intensities of the GCR He and ACR 0^{+} at 70 AU are significantly less (x 6 smaller for ACR 0^{+}) than those observed at the 1987 solar minimum at 42 AU. For the ACR component such changes appear to be qualitatively consistent with Jokippi's diffusive shock drift acceleration model. For GCR He the difference may be further evidence for modulation in the region of the heliosheath combined with gradient and curvature drift effects over the two different phases of the heliomagnetic cyle.