PITCH ANGLE DISTRIBUTIONS OF SOLAR ENERGETIC PARTICLES AND THE LOCAL SCATTERING PROPERTIES OF THE INTERPLANETARY MAGNETIC FIELD

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ABSTRACT

We discuss an approximate solution of the Fokker-Planck equation containing pitch angle scattering and adiabatic focusing. For modest focusing effects the omnidirectional density obeys an ordinary diffusion equation with a modified diffusion coefficient. The anisotropic part of the distribution function is properly normalized and split into an even and an odd part. The even part is determined by the ratio between the scattering mean free path and the focusing length and by the degree of polarisation of the magnetic field fluctuations. The odd part is determined by the deviation of the pitch angle scattering from isotropic scattering $\varkappa(\mu) \sim (1 - \mu^2)$. The method supplies a powerful tool to obtain the local characteristics of pitch angle scattering. It is insensitive to long-lasting solar injections and to moderate radial variations of the mean free path. The method is applied to solar particle events observed on Helios-1 and -2. We find marked differences from one event to the other. Results are presented for the solar particle events of March 28, 1976; Nov 22, 1977; April 8, 1978; April 11, 1978. In general, the pitch angle coefficient has a pronounced minimum for pitch angles near 90°. The first three events are characterized by a small local degree of scattering, with the mean free path ranging from 0.5 to 1.0 AU, whereas the April 11, 1978, event is of a more diffusive nature with $\lambda \approx 0.12$ AU.