SPATIAL PROFILES OF RELATIVISTIC ELECTRON PHASE SPACE DENSITY: SCATHA OBSERVATIONS AT CONSTANT FIRST AND SECOND ADIABATIC INVARIANT

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Radial profiles of the energetic electron phase space density (PSD) measured by the SCATHA satellite during several geomagnetic storm events show various features associated with radial diffusion, acceleration, and losses. The profiles are analyzed as functions of the three adiabatic invariants of electron motion: the magnetic moment M, the bounce invariant K, and the radial coordinate L*. This formalism removes adiabatic fluctuations in the phase space density due to variations in the magnetic field during the storm. The radial profiles reveal the effect of radial diffusion: a positive gradient implies inward diffusion, and a negative gradient shows outward diffusion. A locally growing (shrinking) peak could be evidence of acceleration (losses) via plasma waves. The storms studied show a wide variety of signatures in the PSD. For example, the recovery phase of the storm an May 6-7, 1986 exhibited a locally-growing peak in phase space density at L* ~ 6. The peak occurred for large values of the second invariant K, but not for small K. As the storm recovery phase evolved, the peak gradually shifted to higher L*. This is consistent with a supposed outward shift in L* of the wave-induced pitch angle diffusion due to the expansion of the plasmasphere during the recovery phase. Other storms such as the event on September 12, 1986 exhibit only a monotonically declining PSD with increasing L*. This may be the outward edge of a peak in PSD centered below the radiation coverage of SCATHA, or the radial profile may be negative throughout the outer zone. In both of these events, no clear evidence of the causative wave activity was observed by the SCATHA wave experiment. These results are compared with several other storms with implications for radiation belt models.

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