J O U R N A L C L U B

Auroral Precipitation and Quasi-Trapped Electrons

by

Dan Swift
Geophysical Institute

ABSTRACT

The visual auroral takes on a bewildering variety of forms ranging from the discrete, highly structured to the diffuse glow. There is a similarly large variety of electron spectra associated with the aurora, ranging from the field-aligned monoeneretic to the broad spectrum, nearly isotropic. An enormous conceptual simplification can be obtained by assuming that the auroral electrons are accelerated as spatially narrow, field-aligned beams, which are immediately scattered. The scattering leaves the bulk of electrons in quasi-trapped orbits. The trapped electrons are subject to rapid pitch-angle scattering that maintains pitch-angle isotropy and continued auroral luminosity after the acceleration event has passed. Differential gradient and curvature drift of electrons acts to spatially diffuse forms.

A radiation transport code is used to test this hypothesis. Auroral imagery from the Polar Satellite is used to define an initial radiation distribution, assuming pitch-angle isotropy. The radiation transport code is used to compute subsequent precipitation patterns assuming rapid pitch angle diffusion between a prescribed set of altitudes. These precipitation patterns can be compared with subsequent Polar images. It is found for a particular isolated substorm event that the luminosity decay time of twelve minutes to nearly an hour can be accounted for with the radiation transport code, assuming rapid pitch angle scattering occurs within the altitude range between 4,000 km to the equatorial plane. Eventually, the trapped electron population will fall to the point that it will no longer sustain the instability responsible for rapid pitch-angle diffusion, leaving a residual population more permanently trapped. The residual trapped intensities at geosynchronous orbit are found comparable to observed intensities. This suggests that the aurora is a source of the trapped electron radiation.

Friday, January 31
Elvey Bldg. Globe Room
3:45 pm