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Rapid radiation belt losses occurring during high speed solar wind stream driven storms: loss mechanisms

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Despite being discovered at the dawn of the space age, there are still fundamental questions concerning the acceleration and loss of highly energetic electrons; Energetic electron fluxes can increase or decrease by several orders of magnitude on time scales of less than a day.The coupling of the Van Allen radiation belts to the Earth's atmosphere through precipitating particles is an area of intense scientific interest, principally due to two differing research activities: 1) radiation belt physics and 2) the response of the atmosphere to precipitating particles.

Recently, more evidence has been found for the highly dynamic nature of the outer radiation belt electron fluxes. Studies undertaken by Steve Morley and coauthors combined observations from as many as 9 particle detectors flying onboard GPS spacecraft to show a rapid losses of energetic ($>$230 keV) electrons from the outer radiation belt ($4<L*<6$). These electron flux "dropout" were associated with a geomagnetic storm triggered by the arrival of a high speed solar wind stream interface which separates the leading slow solar wind and trailing fast solar wind. A superposed epoch analysis was undertaken of this data around the arrival of 67 solar wind stream interfaces (SWSIs), showing a strong repeatable "signal" of a rapid electron flux dropout. While the SWSI triggered geomagnetic storms, these are comparatively small (Dst =-40 nT, Kp=4) showing that even small geomagnetic disturbances can lead to major radiation belt changes. Candidate causes for the dropouts which have been put forward are losses through the magnetopause (by either magnetopause shadowing or outward diffusion) and energetic electron precipitation (EEP) into the atmosphere due to wave-particle interactions.

In this talk we will test the potential dropout causes by examining observations from multiple low-Earth orbit spacecraft, as well as ground-based instruments which are part of the AARDDVARK network.

Keywords: radiation belt, geomagnetic storms, solar wind interactions, energetic electron precipitation