BALLOON OBSERVATIONS OF RELATIVISTIC ELECTRON PRECIPITATION AND THE BARREL EXPERIMENT

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Atmospheric losses of relativistic electrons play an important role in radiation belt dynamics; precipitation into the atmosphere may completely deplete the radiation belts during the main phase of some geomagnetic storms. Thus, quantifying losses and understanding loss processes is an important part of fully understanding radiation belt variability. Balloon-based observations provide a method for studying relativistic electron losses through the observation of bremsstrahlung X-rays produced as the electrons precipitate into the atmosphere. Since balloons measure precipitation directly, such observations allow us to separate the effects of acceleration and loss. In addition, balloons offer a nearly-stationary platform from which the spatial scale, duration, and temporal variations of precipitation can be measured.
In this talk, results from several balloon campaigns aimed at studying relativistic electron precipitation will be discussed. An overview of the BARREL experiment will be provided, including observations from a test flight conducted in January-February 2009. BARREL is the first Living with a Star Geospace Mission of Opportunity, and will support NASA's Radiation Belt Storm Probes mission. BARREL will consist of two Antarctic balloon campaigns conducted in Austral summers of 2012 and 2013. During each campaign, a total of 20 small (~25 kg) balloon payloads will be launched to an altitude of 30-35 km to maintain an array of 5-8 payloads extending across up to 8 hours of magnetic local time for 40 days. Each balloon will carry a NaI scintillator to measure the bremsstrahlung X-rays produced by precipitating relativistic electrons as they collide with neutrals in Earth’s atmosphere.

radiation belts, precipitation, wave-particle interactions

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