D SCIENCE INVESTIGATION

D.1 Scientific Goals and Objectives

D.1.a Science Objectives

The proposed investigation will address the RBSP goal of, "differentiating among competing processes affecting precipitation and loss of radiation particles" by directly measuring precipitation during the RBSP mission. BARREL (Balloon Array for RBSP Relativistic Electron Losses) will simultaneously measure precipitation over 8-10 hours of magnetic local time, and observe precipitation in conjunction with the RBSP spacecraft. We will combine the measurements of precipitation with the RBSP spacecraft measurements of waves and energetic particles, achieving the following specific science objectives during the RBSP mission:

- Determine the total electron loss rate during RBSP relativistic electron events by simultaneously measuring the precipitating flux of relativistic electrons over a wide range of local times. The loss rate will be compared with changes in the trapped flux for specific relativistic electron events to help quantify relativistic electron acceleration, and determine whether pitch-angle scattering is occurring in the strong-diffusion limit.

- Directly test models of wave-particle interactions in order to differentiate among different loss processes by combining precipitation measurements with simultaneous RBSP in situ wave and energetic particle measurements. We will quantitatively test whether EMIC waves and chorus are responsible for duskside MeV events and microburst precipitation respectively. This will be crucial for validating the models that will be used to calculate losses based only on in-situ RBSP measurements, for example during times when global precipitation measurements are not available.

- Determine the relative importance of duskside MeV events and microburst precipitation and their associated precipitation mechanisms for different magnetic activity levels. This will be achieved by comparing the precipitation loss rates due to both types of precipitation. BARREL will detect 120 duskside MeV events, allowing us to produce the first magnetic local time/L-value distribution of these events, which can then be compared to the distribution for microbursts measured by SAMPEX.

- Characterize the spatial extent and spatial structure of precipitation, which has been addressed previously only in a statistical sense. The region over which waves scatter electrons is a critical parameter for modeling electron loss timescales. This is particularly important when direct precipitation measurements are not available. BARREL will simultaneously measure precipitation at 5-8 different locations in correlation with wave measurements made by RBSP.

To achieve these objectives, we are proposing three balloons campaigns that will directly measure precipitation during the RBSP mission. Specific requirements to achieve these objectives are described in Section D.2 below. Specific science and data products are described in D.3. The instrumentation and proposed balloon campaigns are described in D.4.