The Relativistic Proton Spectrometer (RPS) On-Line Data Products


What is RPS?
- RPS measures 60 MeV to >1 GeV protons on NASA’s Radiation Belt Storm Probes
- RPS consists of a stack of 12 coaxial silicon solid state detectors (SSDs) followed by a MgF₂, Cherenkov radiator
- Fast coincidence is used to eliminate particles outside the field of view
- Energy deposits in 8 of the SSDs and photons generated in the radiator are pulse-height analyzed to assist in energy/species/direction determination
- The field of view is perpendicular to the spin axis, so RPS obtains angular distributions by analyzing event arrival in the time domain
- The RPS Science Operations Center (SOC) is at The Aerospace Corporation http://rbsp.aerospace.org

Telemetry Description
- Rate and Housekeeping packet
  - Produced every second
  - Contains singles, coincidence rates, dead time
  - PEN rate reflects coincidence in all active SSDs
  - CHE rate reflects coincidence in SSDs and Cherenkov radiator
- Direct Event packet
  - Produced every second or absent
  - Contains fine time (1/64-second) and pulseheights for D1-D9 (10 bits/ea)
  - Number of PEN and CHE events limited by quotas
- Event quotas change with L shell to optimized telemetry usage
  - Very low quotas near apogee – GCR and solar energetic particles
  - Highest quotas in the inner belt – trapped protons

Event Identification
- The “Enigma” algorithm looks up each 9-dimensional direct event against a database of incident particles and their deposits simulated by GEANT4
  - Species identification (H⁺, He⁺⁺, e⁻)
  - Direction (in/out of forward FOV)
  - Incident energy and error estimate

The RPS Science Description System (SDDS) and RBSP Mission Operations Center (MOC)
- Ancillary Data (e.g., L*)

RPS Data Flow
- RBSP Spacecraft
- Science Data Portal, Other SOCs
- Logical SOCs
- Primary SOCs
- Virtual Observatory

RPS Data Products
- Name
- Contents
- Latency
- Reprocessing
- Level 0 Data
  - Raw RPS packets (decoded in CDF, includes space weather data)
  - 1-3 days
  - By MOC

Level 1 Data
- Nearly all L0 data, UTC, energy/photon deposits, singles and coincidence rates, s/c location, RPS boresight vector, magnetic field vector, dead times (including quota effects), minimal OPQ coordinates
  - L0 + 0-1 days
  - Daily up to L0+7 days, and on-demand

Energy Spectra,
- Level 2 Data
  - UTC, flux versus energy spectrum (once per 5 degrees rotation), pitch-angle and full magnetic coordinates (e.g., L, MLT, I, B_eq, B_aur, d) of RPS boresight in OPQ and TS models
  - L1 + 0-2 days
  - Daily up to L0+7 days and on-demand

Energy-Angle Spectra,
- Level 3 Data
  - UTC, energy-pitch angle spectrum (once per spin and once per minute), full magnetic coordinates in OPQ, and TS models
  - L2 + 0-2 days
  - Daily up to L0+7 days and on-demand

Global Maps,
- Level 4 Data
  - UTC, flux vs E/L/R, flux vs E/K/θ, PSD vs M/K/θ maps (once per orbit leg) in multiple field models
  - L3 + 0-2 days
  - Daily up to L0+7 days and on-demand

Acknowledgements: The Aerospace Corporation designed and built the RPS instrument with funding from The National Reconnaissance Office. The RPS Principal Investigator is Joseph Mazur, and the NRO program principal investigator is Dr. David Byers. The authors thank Dr. S. Claudiepierre for assistance with the browse plot mock-ups, VIRBO (http://virbo.org), Autoplot (http://autoplot.org/), and the NASA HPDE program (http://hpde.gsfc.nasa.gov/).