

## Principal Investigator

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## Participating Institutions:

Dartmouth College

U. C. Berkeley

U. C. Santa Cruz

University of Washington

Skobeltsyn Institute of Nuclear Physics,

Moscow State University

Hermanus Magnetic Observatory South Africa

British Antarctic Survey

For a complete list of personal visit:

<http://www.dartmouth.edu/~barrel/team.html>

## Important Websites

### BARREL Data

<http://soc2.ucsc.edu>

### BARREL Home page

<http://www.dartmouth.edu/~barrel/>

### BARREL Blog

<http://relativisticballoons.blogspot.com>

### Van Allen Probes

[http://www.nasa.gov/mission\\_pages/rbsp/main/index.html](http://www.nasa.gov/mission_pages/rbsp/main/index.html)

### Antarctic launch stations

Halley Bay: [http://www.antarctica.ac.uk/living\\_and\\_working/research\\_stations/halley/](http://www.antarctica.ac.uk/living_and_working/research_stations/halley/)

Sanae: <http://www.sanap.org.za/>

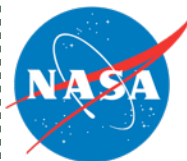
## BARREL

### Launch Dates:

**December 2012 - February 2013**

**December 2013 - February 2014**

BARREL is a balloon-based Mission of Opportunity to augment the measurements of NASA's Van Allen Probes by measuring the precipitation of relativistic electrons from the radiation belts during 2 multi-balloon campaigns. The balloons will be launched from the Antarctic. During each campaign, 5-8 long-duration (5 - 10 day) balloons would be aloft simultaneously over a one-month period to provide measurements of the spatial extent of the relativistic electron precipitation and to allow an estimate of the total electron loss from the radiation belts. Each balloon carries a NaI x-ray spectrometer and a magnetometer. Observations are planned for when the balloon-array will be conjugate with the RBSP spacecraft, such that direct comparison is possible between one another. During the first campaign, conjugations will be in the dawn sector focusing on relativistic electron Microburst precipitation. The second campaign will have conjugations in the dusk sector focusing on duskside precipitation of MeV electrons.



# Instrumentation

Attribute	Value
Payload Mass	24 Kg
Average Payload Power	4.3 W
Payload Telemetry Rate	2.1 kbits/s
Expected Campaign Durations	1/1/13-2/10/13; 1/1/14-2/10/14
Expected Longitude Coverage	0°-150° W
Expected L-value Coverage	3 - 7

Nal Spectrometer attribute	Value	Comments
Energy range	20 keV - 10 MeV	
Electronic resolution	2.4 keV/Channel	due to binning
System resolution	7% at 662 keV	photo peak
Effective Area	16 cm <sup>2</sup> at 1 MeV	

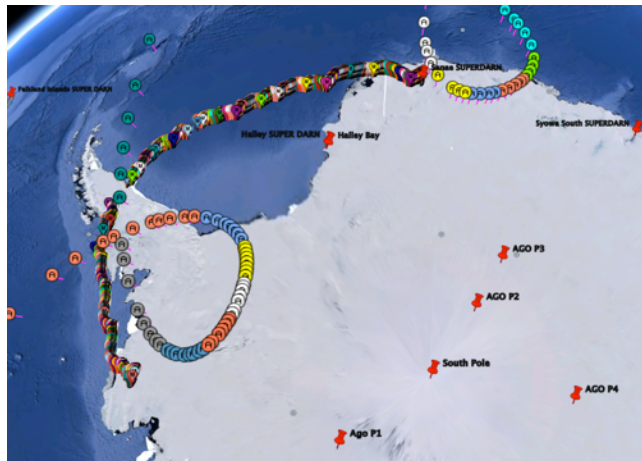


Figure 1: flight path of the 2nd MINIS flight (balloons labeled M) with RBSPa footprint (dots labeled A) and select ground stations. The color of the icons represent one hour in time.



# Data Products

Product	Cadence (s)	Energy Range (keV)	#Energy Channels
Rate Counters	4	-	-
Fast Spectra	0.05	20 - 1500	4
Medium Spectra	4	100 - 4000	48
Slow Spectra	32	20 - 10000	256
magnetometer	0.25	-	-

Level	Description	Format
L0	TM/file (1/payload/day), good frames	binary (BARREL)
L1	Time-tagged, uncalibrated	CDF
L2	Calibrated (physical units)	CDF/IDLSAVE
L3	Higher level products	CDF

# Publications

will be updated and posted on <http://www.dartmouth.edu/~barrel/publications.html>

Millan, R.M., and the BARREL team, "Understanding relativistic electron losses with BARREL", Journal of Atmospheric and Solar-Terrestrial Physics, doi:10.1016/j.jastp.2011.01.006, 2011

Millan, R. M., K. B. Yando, J. C. Green, and A. Y. Ukhorskiy, "Spatial distribution of relativistic electron precipitation during a radiation belt depletion event", Geophys. Res. Lett., 37, L20103, doi:10.1029/2010GL044919, 2010

Millan, R. M., and R. M. Thorne, "Review of Radiation Belt Relativistic Electron Losses", J. Atmos. Solar Terr. Physics, 69, 362-377, 2007

Millan, R. M., R. P. Lin, M. P. McCarthy, "Observation of relativistic electron precipitation during a rapid decrease of trapped relativistic electron flux", Geophys. Res. Lett., 34, L10101, doi:10.1029/2006GL028653, 2007

**R. M. Millan et al, "The Balloon Array for RBSP Relativistic Electron Losses (BARREL)", 2012 Submitted to Space Sciences review as well as a chapter in the Van Allen Probes book.**