Total Radiation Belt Electron Content:
A New Radiation Belt Data Product

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Typical Radiation Belt Data Product

- **Flux data**: energy, pitch angle, location (MLT & L), and time

- **Phase space density data**: three adiabatic invariants ($\mu$, $K$, $L$), and time
New Radiation Belt Data Product

- **Goal:** Instead of 4 dimensional data, we create a simple and global index to represent RB electrons by integrating the phase space density data with flexibility.

- **Improvements** from previous studies by Selesnick (Polar) and Baker (SAMPEX): better orbit, particle measurements, calculation method, and index time resolution (3-hour vs daily index).
Total Radiation Belt Electron Content (TRBEC)

- Integrate number of electrons in an elemental phase space:

\[
dN \approx 8.134 \times 10^{29} \tilde{f}(\mu, K, L^*) \frac{\sqrt{\mu}}{L^*^2} d\mu dK dL^*.
\]

Van Allen Probes ECT-MagEIS TRBEC ($\mu = 500 - 2000$ MeV/G, all $k$, $L^* > 2.5$)
Storm Time
Superposed Epoch Analysis

- **59** storm events with enhanced electron
- **18** storm events with loss electron
TRBEC (μ, L*)

2013 February-March Event

TRBEC at $L^* = 3.5$

TRBEC at $L^* = 4$

TRBEC at $L^* = 4.5$

TRBEC at $L^* = 5$

TRBEC at $L^* = 5.5$
TRBEC ($\mu$, $L^*$) - Enhance and Loss Events

Enhancement Events

Loss Events
Summary

• New TRBEC data available from 2012 to 2017

• TRBEC is useful for both event and statistical studies (except microphysics work)

• Other applications include:
  
  • Substorm study by Colin Forsyth
  
  • Geospace systematic analysis by Joe Borovsky
  
  • RB electron precipitation effect on atmospheric chemistry by FIREBIRD team and Kathy Duderstadt.

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Fun Facts on Radiation Belt Electrons

TRBEC ( $5 \times 10^{28}$ electrons ) x electron mass = RBE mass

46 g ~ 2 donuts

TRBEC ( $5 \times 10^{28}$ electrons ) x 0.5 MeV = RBE energy

$4 \times 10^{15}$ Joules (Petajoule)

Chemical energy of combusting 1 million barrel of crude oil or 60 times of the energy released by the atomic bomb that exploded over Hiroshima