Energy Dependent Dynamics of keV and MeV Electrons in the Slot and Inner Zone

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MagEIS 1.553 MeV

Uncorrected Flux (cm\(^{-2}\) s\(^{-1}\) sr\(^{-1}\) keV\(^{-1}\))

Corrected Flux (cm\(^{-2}\) s\(^{-1}\) sr\(^{-1}\) keV\(^{-1}\))
Different Energies Compared
a ‘multi-energy' view
From mono-energetic, i.e. > 2 MeV to multi-energy, i.e. 5 to 10 energies to broad-spectrum, ~100 energy channels below: 10 keV to 4 MeV
Radiation Belt Enhancements and Transport Through the Slot Region

March 1 Event
Quiescent State

Energy

- 4 MeV
- 1 MeV
- 100 keV
- 50 keV

L-Shell

Inner Zone
- No MeV electrons
- Fennell et al, 2015

flux (cm$^{-2}$ s$^{-1}$ sr$^{-1}$ keV$^{-1}$)
Inner Zone

- Energy-dependent outer boundary
- Lower energies extend to higher L
Quiescent State

Outer Zone
- Energy-dependent inner boundary
- S-shape

Energy
- 4 MeV
- 1 MeV
- 100 keV
- 50 keV

L-Shell
- 2.0
- 2.5
- 3.0
- 3.5
- 4.0
- 4.5
- 5.0
- 5.5
- 6.0

Flux (cm$^{-2}$ s$^{-1}$ sr$^{-1}$ keV$^{-1}$)
Quiescent State

Slot Zone

- Energy and L-dependent
- “Bite-out” at intermediate energies
Active - Enhanced State

All of these are newly ‘injected’ electrons
Flux Enhancement (transport?) through the slot into the inner zone

5 orbits
45 hours
≈2-days
Feb 28 - Mar 2
- This boundary is not the same for all events
- It can be shifted in slope and in location
Does hiss control the outer boundary of the inner zone?

Irrelevant
No Electrons to Lose

1-10s days

>1,000 days
Conclusions

• Essentially all aspects of radiation belt structure and dynamics are energy dependent - outer zone, inner zone & slot
• At lower energies there are more events and they penetrate deeper in L-shell
• Enhancements fill in the slot up to some threshold energy and move the outer zone boundary inward forming a boundary roughly linear in L vs log(E)
• The quiet time decay of the Enhanced state seems to be consistent with energy and L-dependent losses due to hiss forming a ‘linear’ inner zone boundary and “S-shaped” outer zone boundary
• A broad-spectrum view shows characteristics that are quite common across events even though the details vary a lot