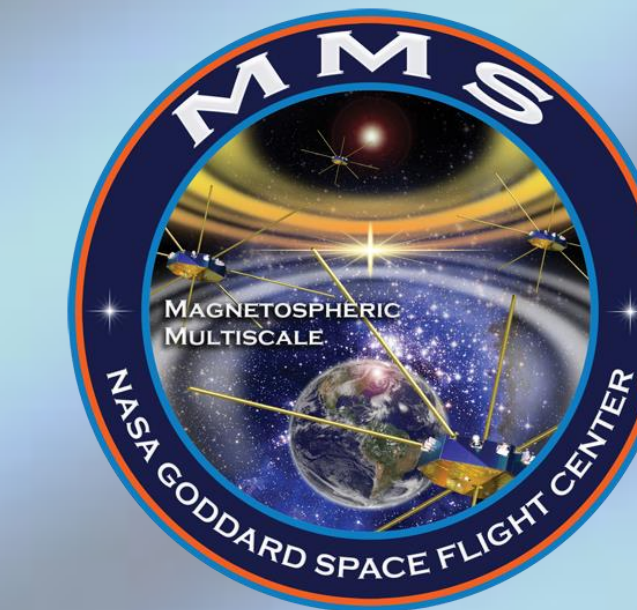




Differential Electron Flux Spectra Measured by the Magnetospheric Multiscale Mission Show Strong Field-aligned Electron Population of Ionospheric Origin



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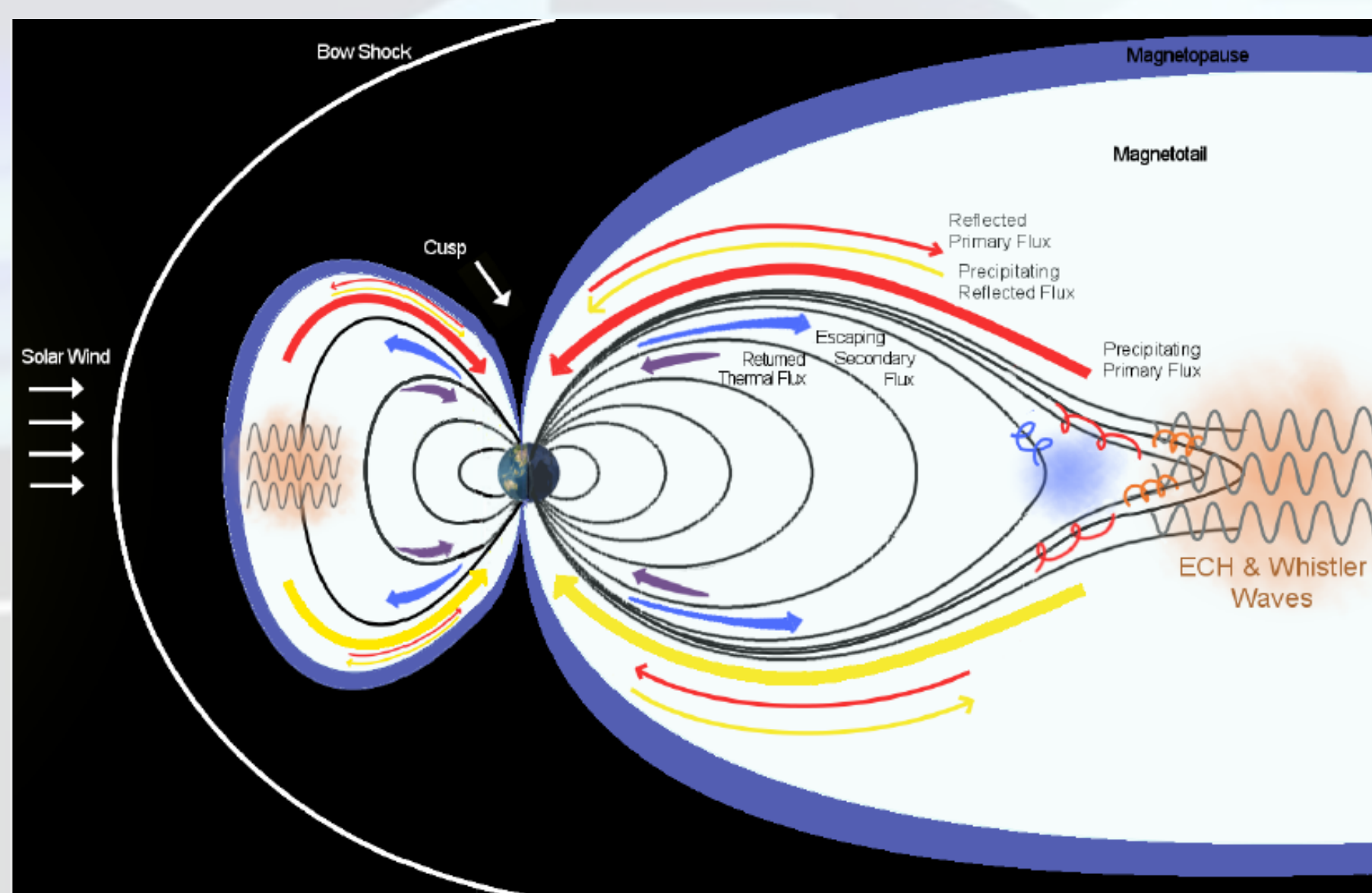
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Background

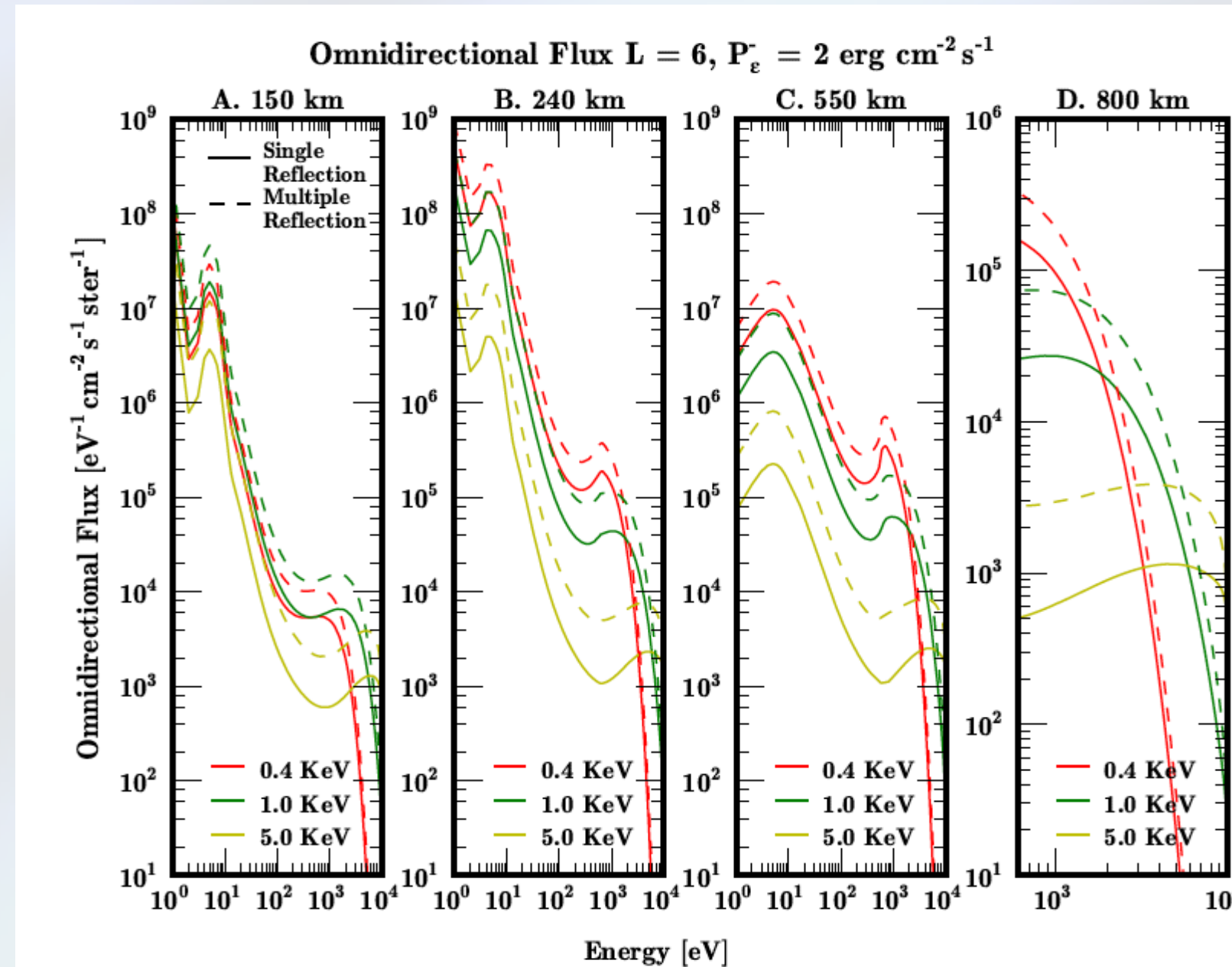
Motivation and Context

The Magnetospheric Multiscale (MMS) fleet, launched by NASA on Mar. 13th 2015, is an elliptical, formation flying mission whose primary purpose is studying magnetic reconnection [1]. Fitted with an array of particle and field instruments, MMS spends between 12-14 hours each orbit in its science region-of-interest (sROI $\sim \geq 9R_E$). When the fleet is in the sROI but away from the magnetopause, there are opportunities to observe/measure secondary electron fluxes of ionospheric origin generated by precipitating magnetospheric superthermal electrons (SE).

Precipitating SEs are one of the main mechanisms contributing to ionospheric mass escape [2]. They form an additional source of ionization via impact and generally lead to heating and subsequent upflowing.

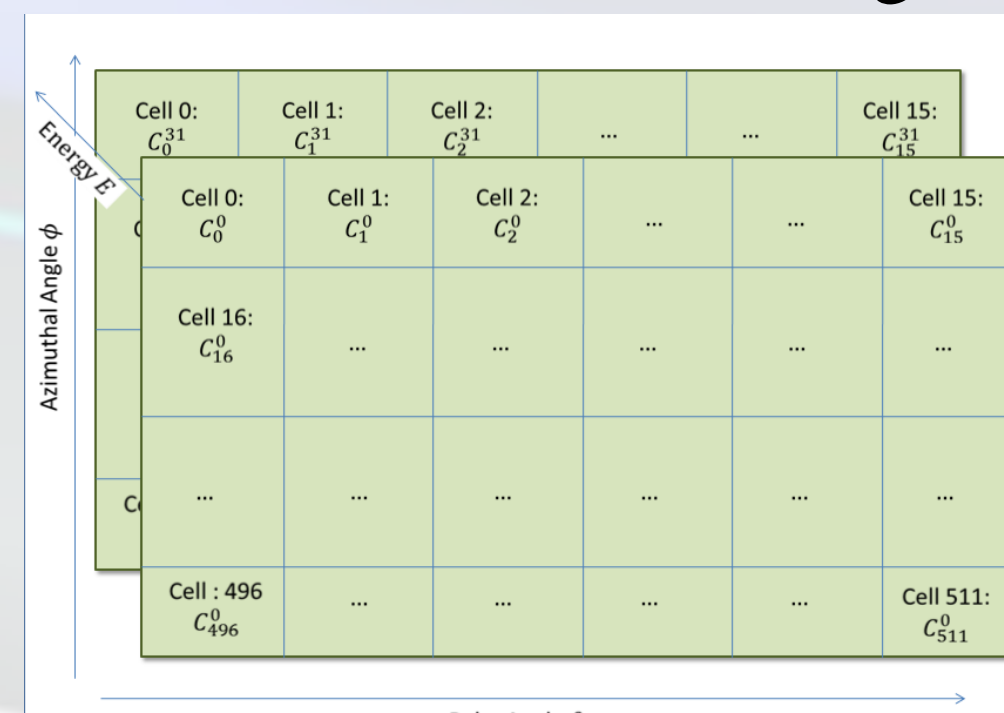


SE physics, as studied extensively in [3-4], identifies the importance of multiple reflections between the conjugate ionospheric footprints of closed field lines. These counterstreaming fluxes interact with the replenished population and secondary fluxes leading to distinct spectra [3]

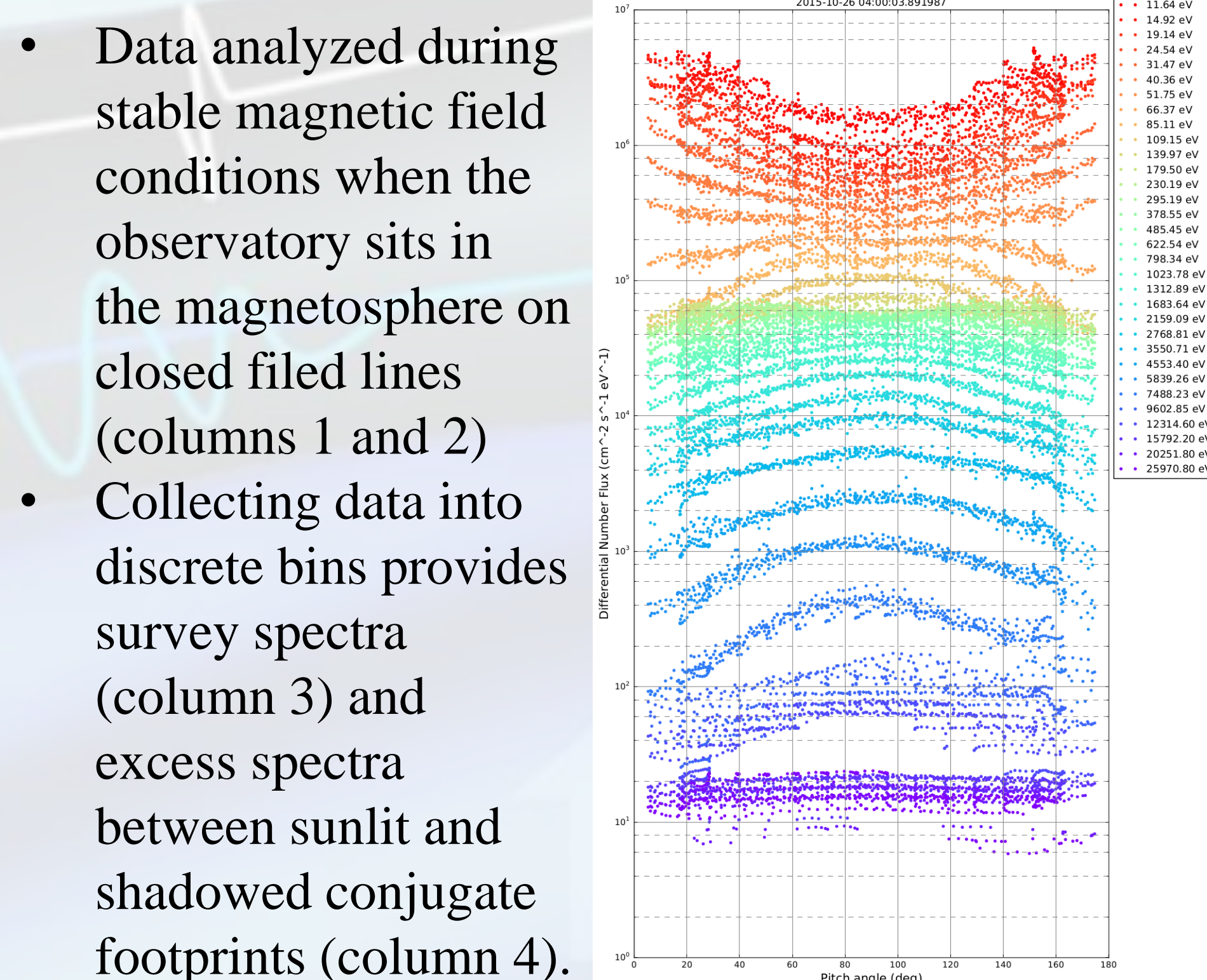


Data Analysis and Methodology

- FPI electron skymaps consist of measured counts distributed over 512 cells ($I = 0 \dots 511$; 32 azimuth (ϕ) \times 16 polar angles (θ)) over 32 energies [5]

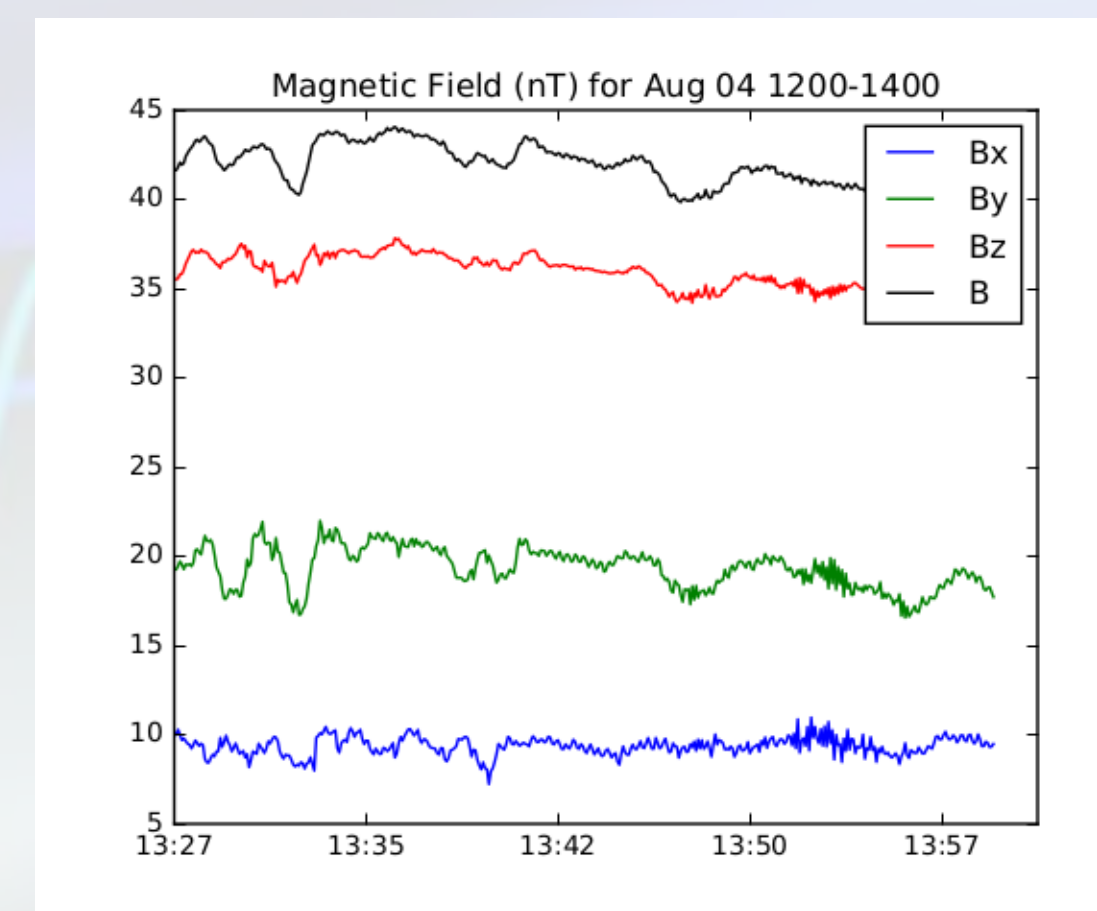


- Each cell has a look direction $\hat{n}_l(\phi, \theta)$ with a corresponding flow direction $\hat{v}_l = -\hat{n}_l$
- Magnetic field in the instrument frame \vec{B}_{DBCS} used to construct pitch angle distribution for each cell, $\alpha_l = \cos^{-1}(\hat{v}_l \cdot \vec{B}_{DBCS})$
- Considered error sources: a) Spacecraft potential, b) Instrument-generated photoelectrons, c) Poisson-noise/counting statistics

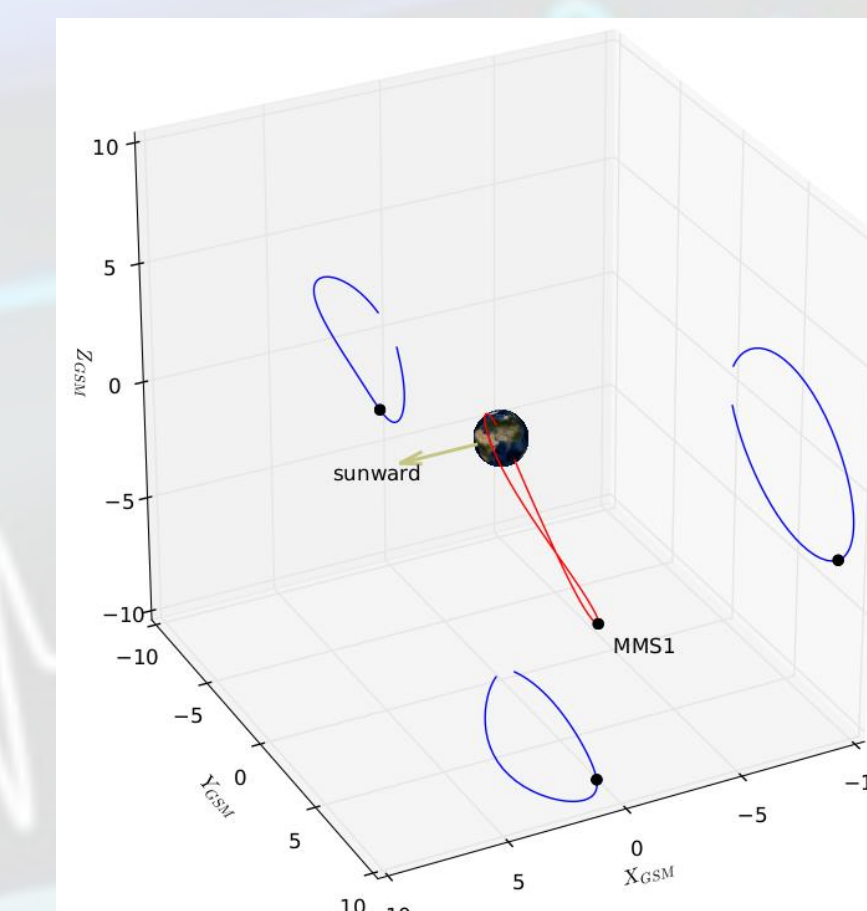


Results

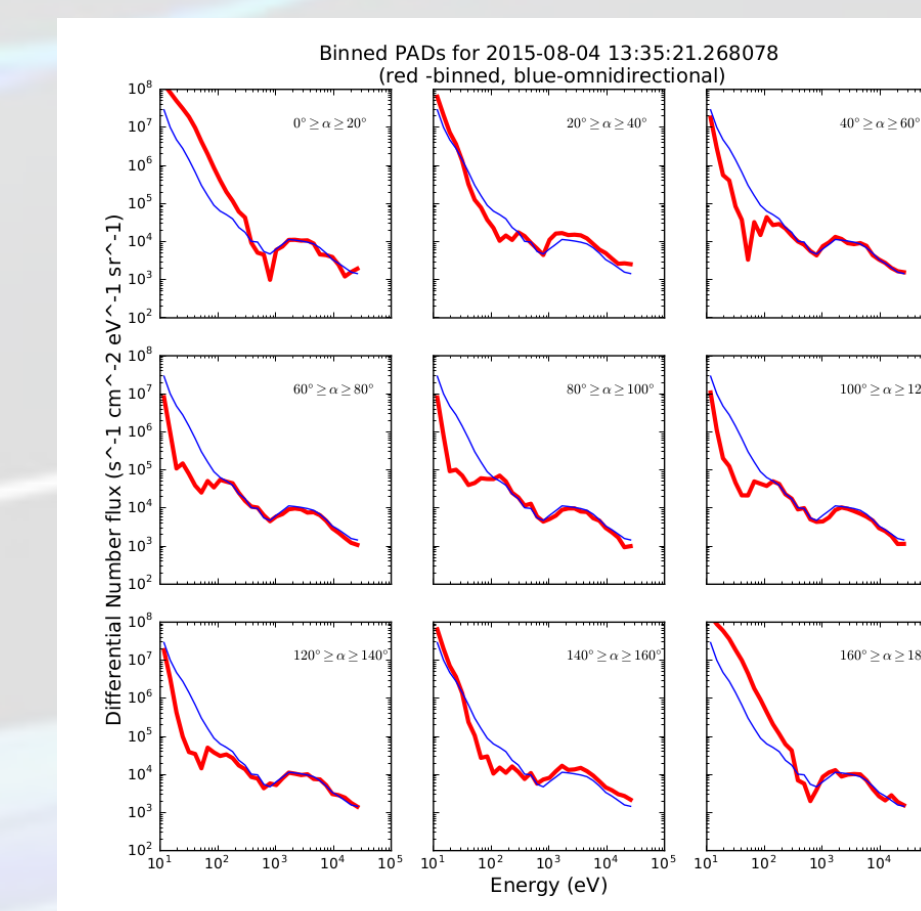
Magnetic Field



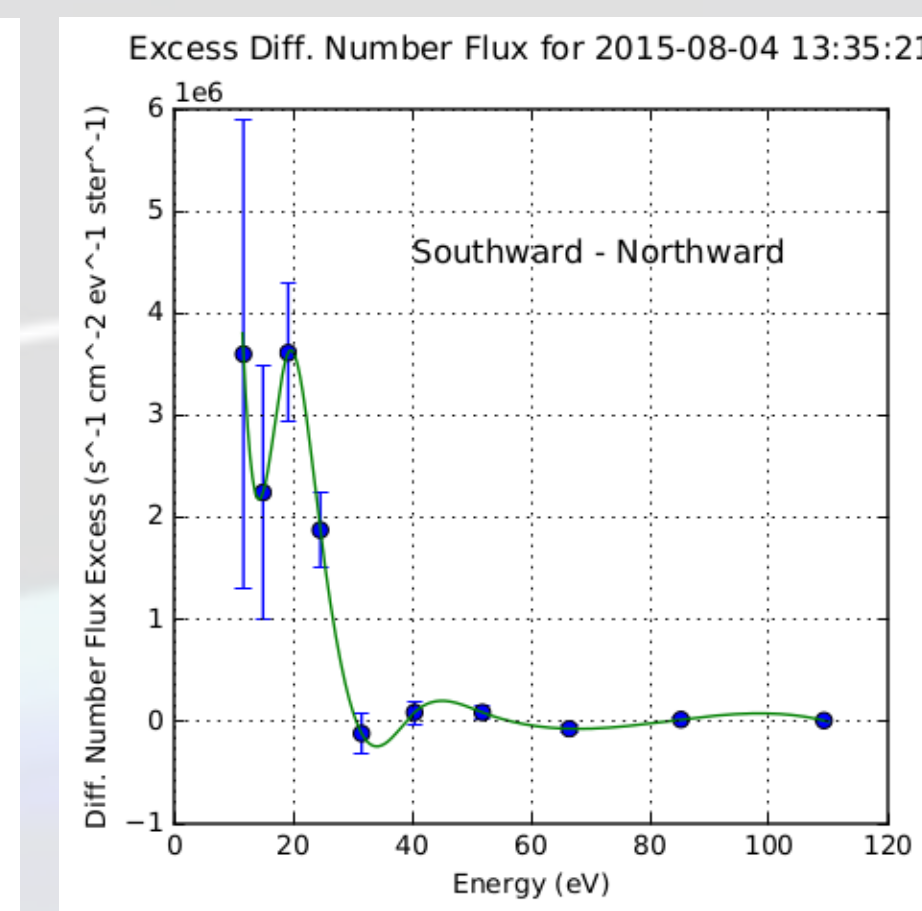
GSM Fieldline Trace



Flux Spectrum by Pitch Angle

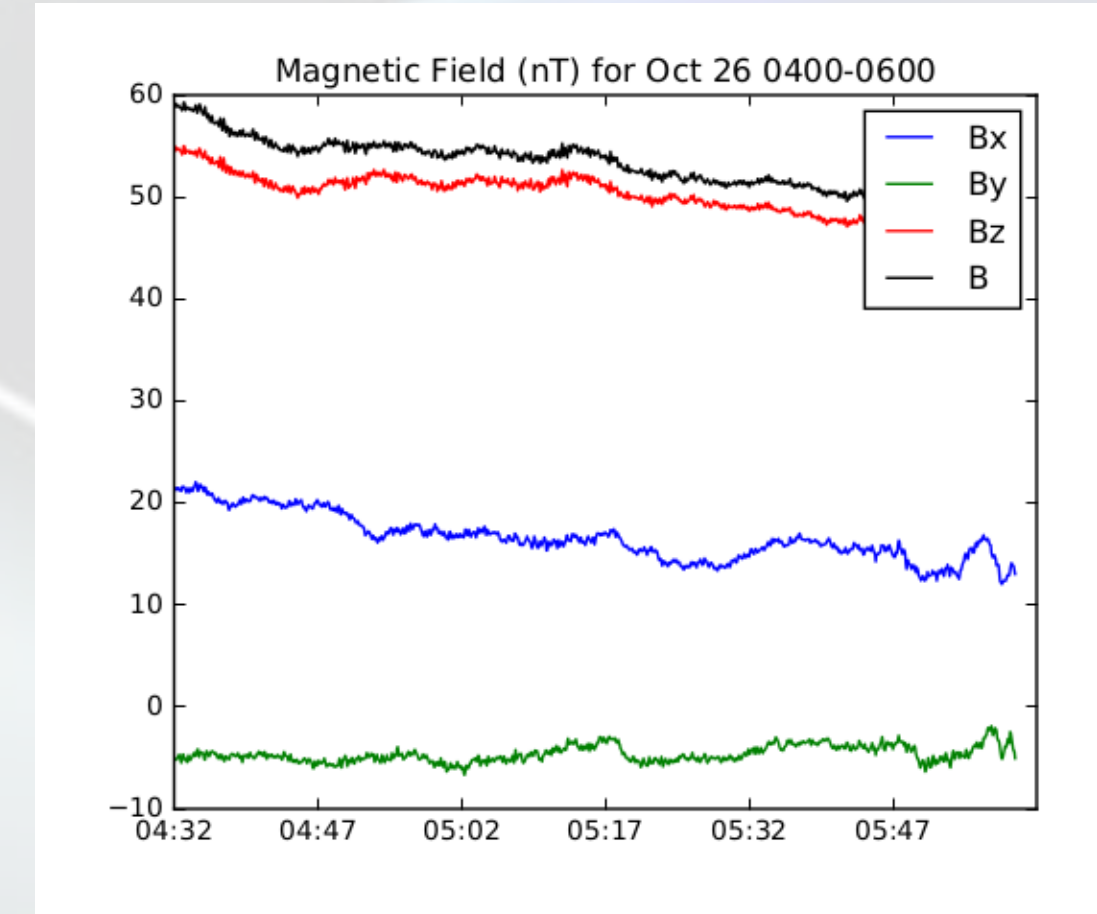


Excess Flux: Sunlit - Shadowed

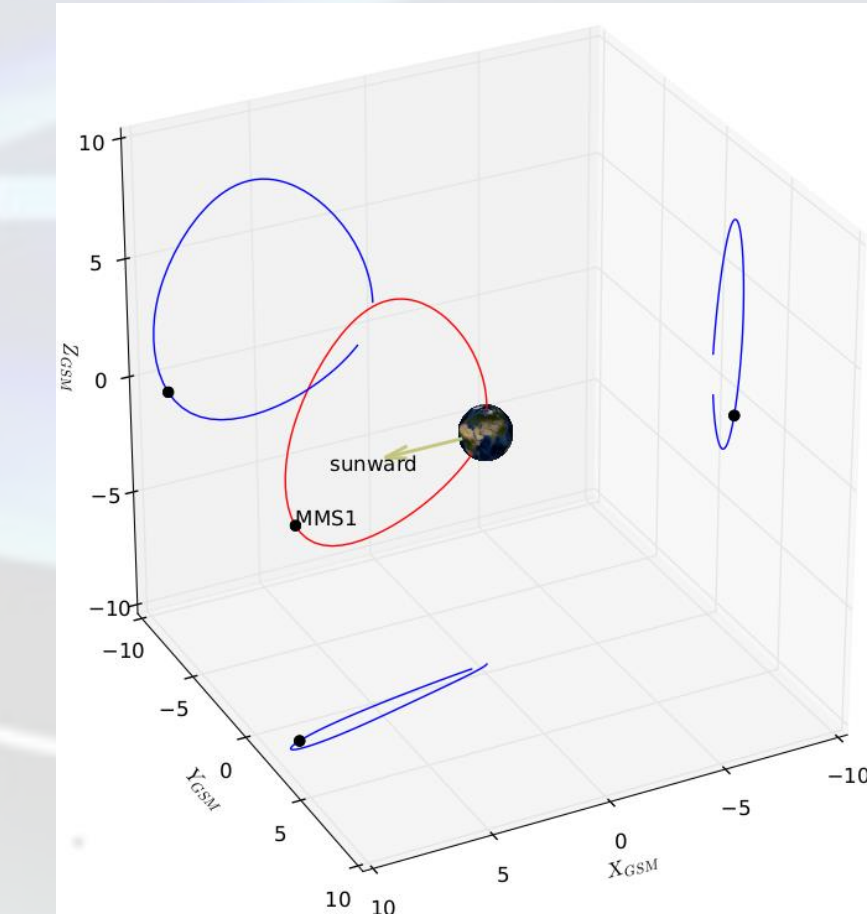


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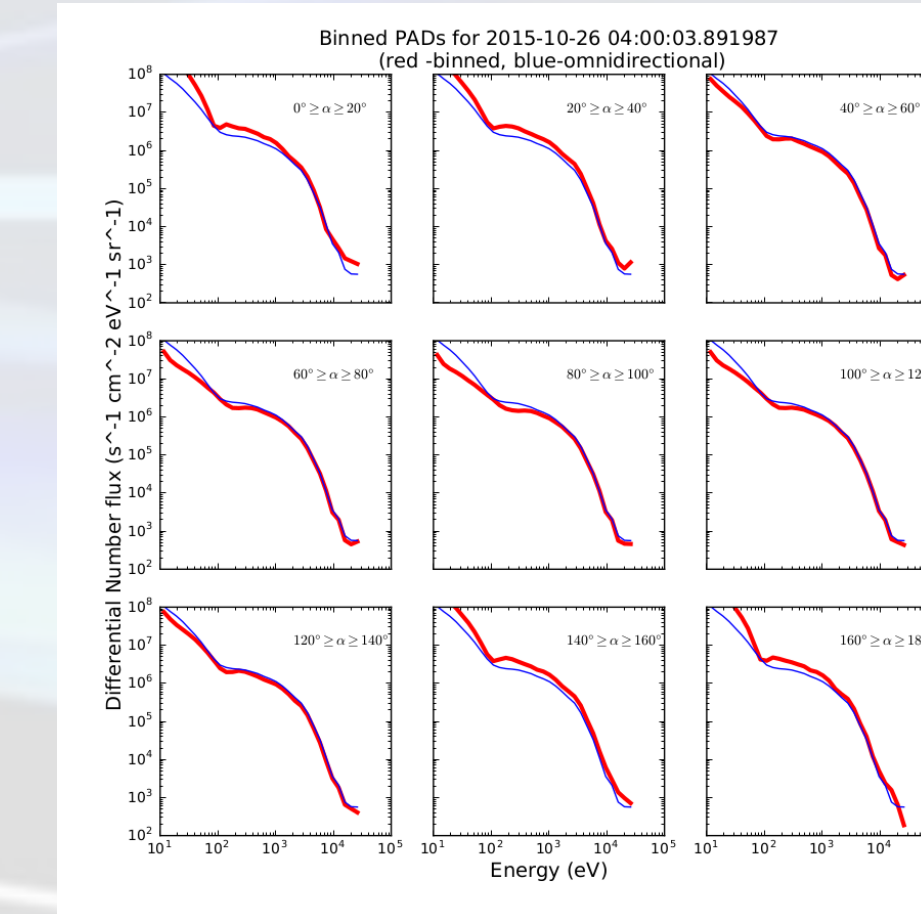
Magnetic Field



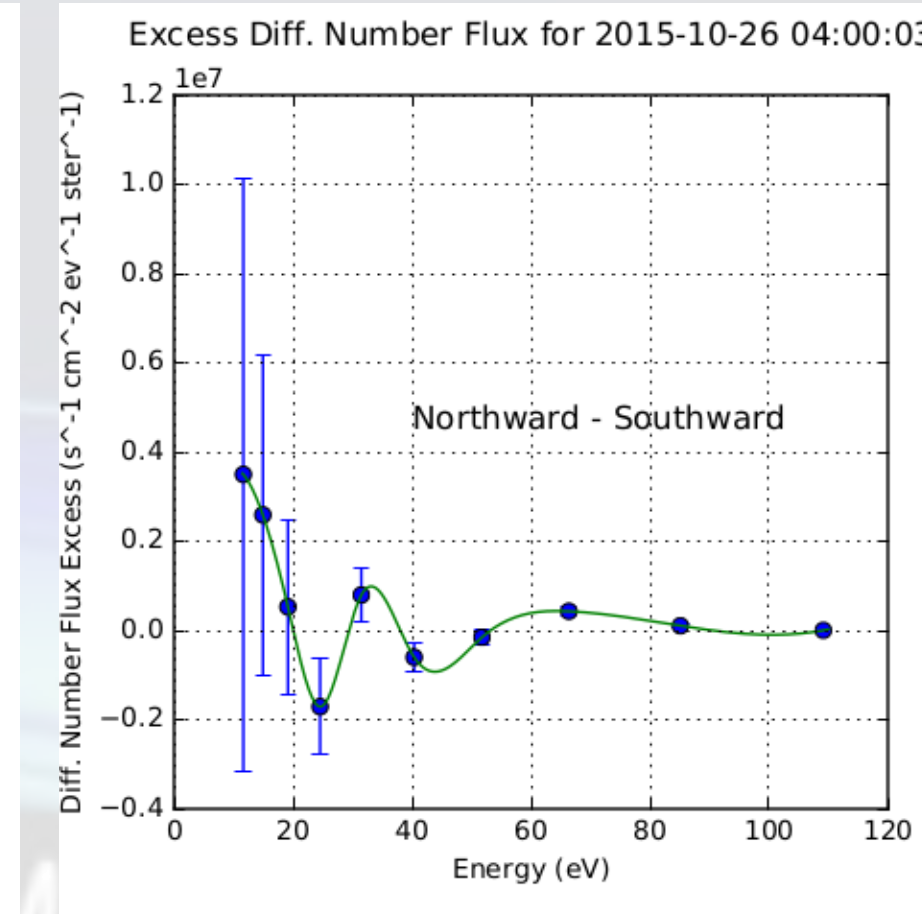
GSM Fieldline Trace



Flux Spectrum by Pitch Angle

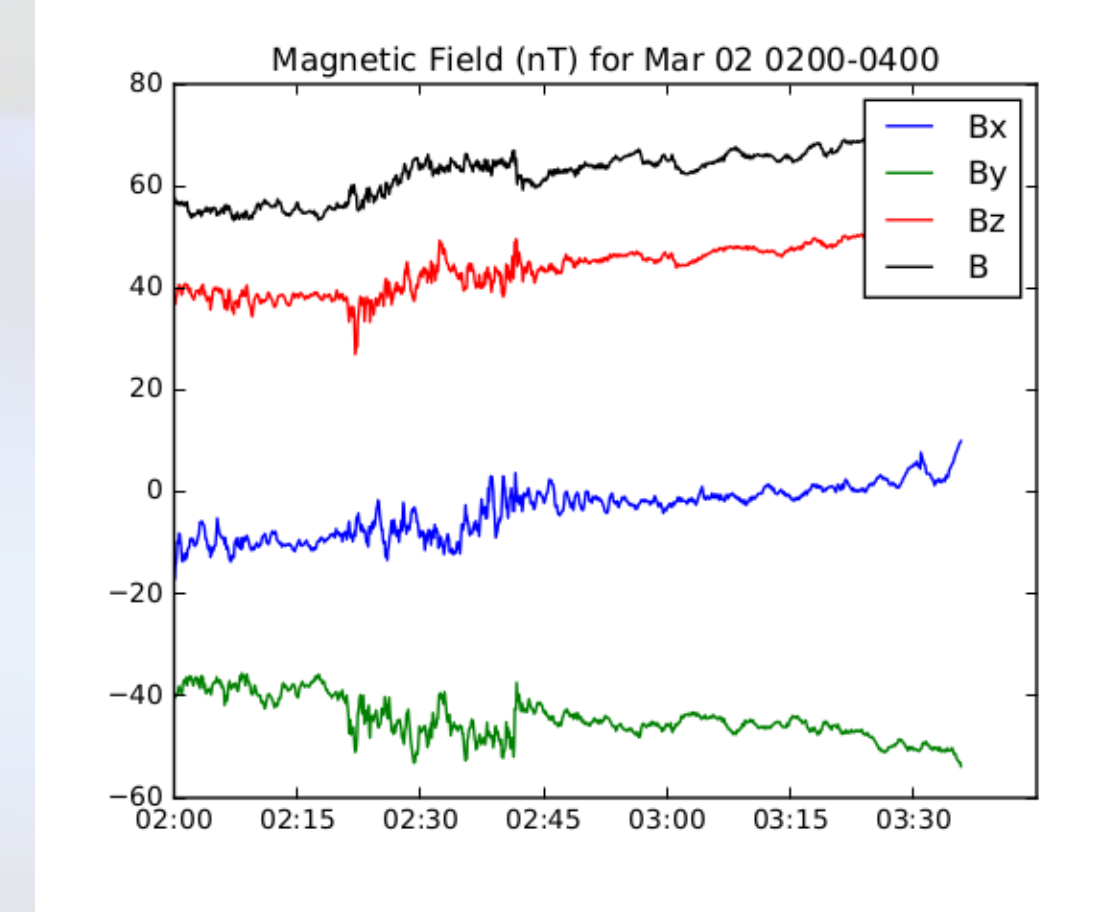


Excess Flux: Sunlit - Shadowed

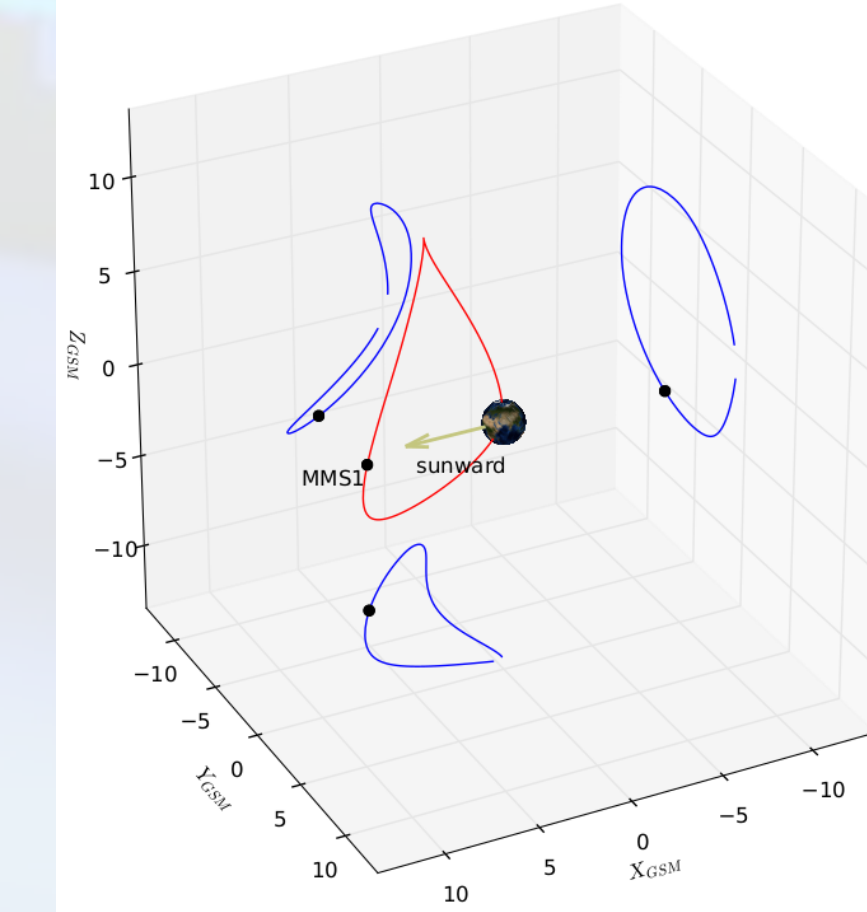


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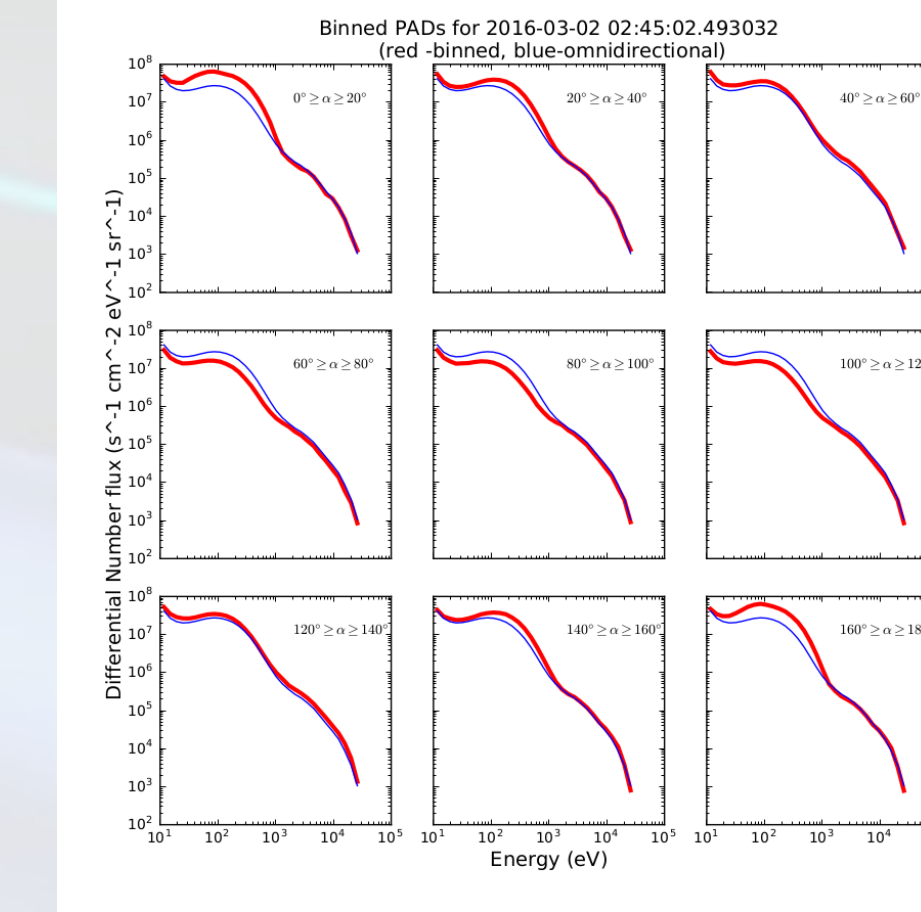
Magnetic Field



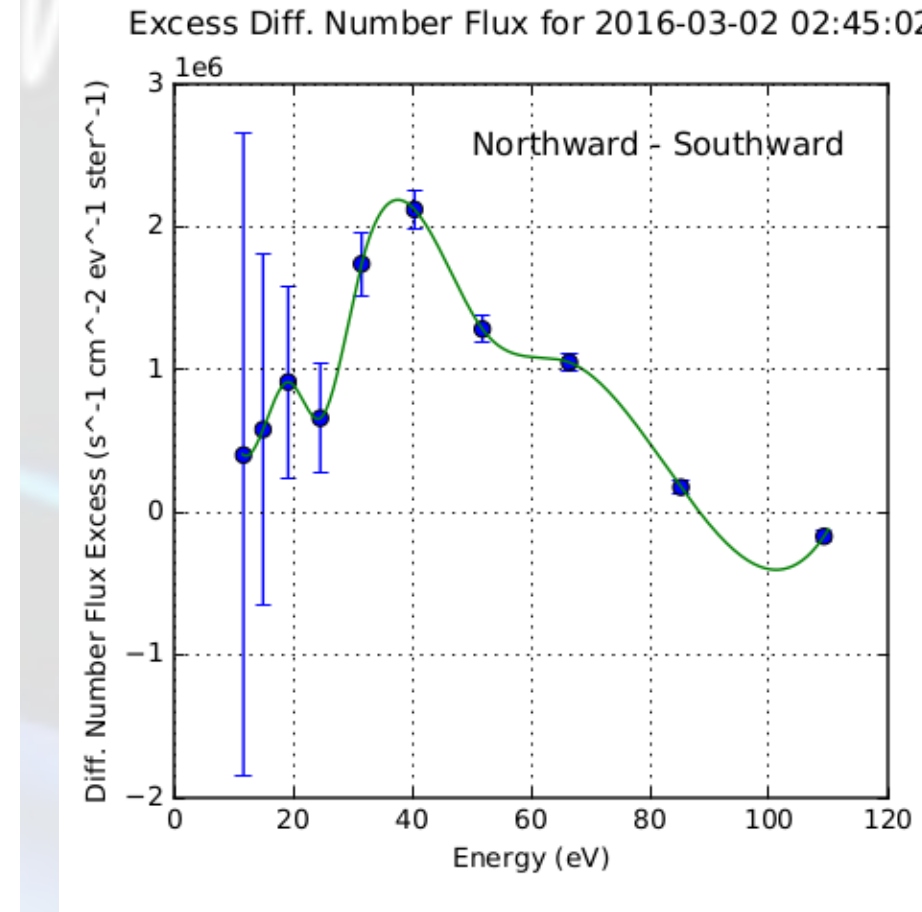
GSM Fieldline Trace



Flux Spectrum by Pitch Angle



Excess Flux: Sunlit - Shadowed



Mar 02, 2016

Conclusions & Future Work

- We present experimental observations of binned pitch angle distributions and excess secondary flux between sunlit and shadowed conjugate points for 3 survey cases distributed in the magnetosphere**
- Each magnetic field configuration gives a unique signature that will inform the identification of the appropriate wave-particle interaction (e.g. ECH, Whistler Chorus, etc.) that scatters plasma sheet electrons into the precipitating population
- Improvements in correcting for instrument-generated photoelectrons is needed to improve knowledge of low-energy electron distributions in the counter-streaming fluxes

References

- [1] Fuselier et al. (2016), Space Science Reviews 199
- [2] Moore et al. (2010), J. Geophys Research 115.
- [3] Khazanov et al. (2013), J. Geophys Research 119
- [4] Khazanov et al. (2015), J. Geophys Research 120
- [5] Pollock et al., (2016), Space Sci. Rev., 199

Acknowledgements

The lead author would like to gratefully acknowledge the opportunity afforded by and the patience and support of George Khazanov, Barbara Giles, and Levon Avanov and the professionalism and dedication of the MMS Flight Dynamics, FIELDs, and (especially) Fast Plasma Investigation Teams.