Mullard Space Science Laboratory
Department of Space and Climate Physics

A study of photoelectrons on the Cassini spacecraft using the SPINE software

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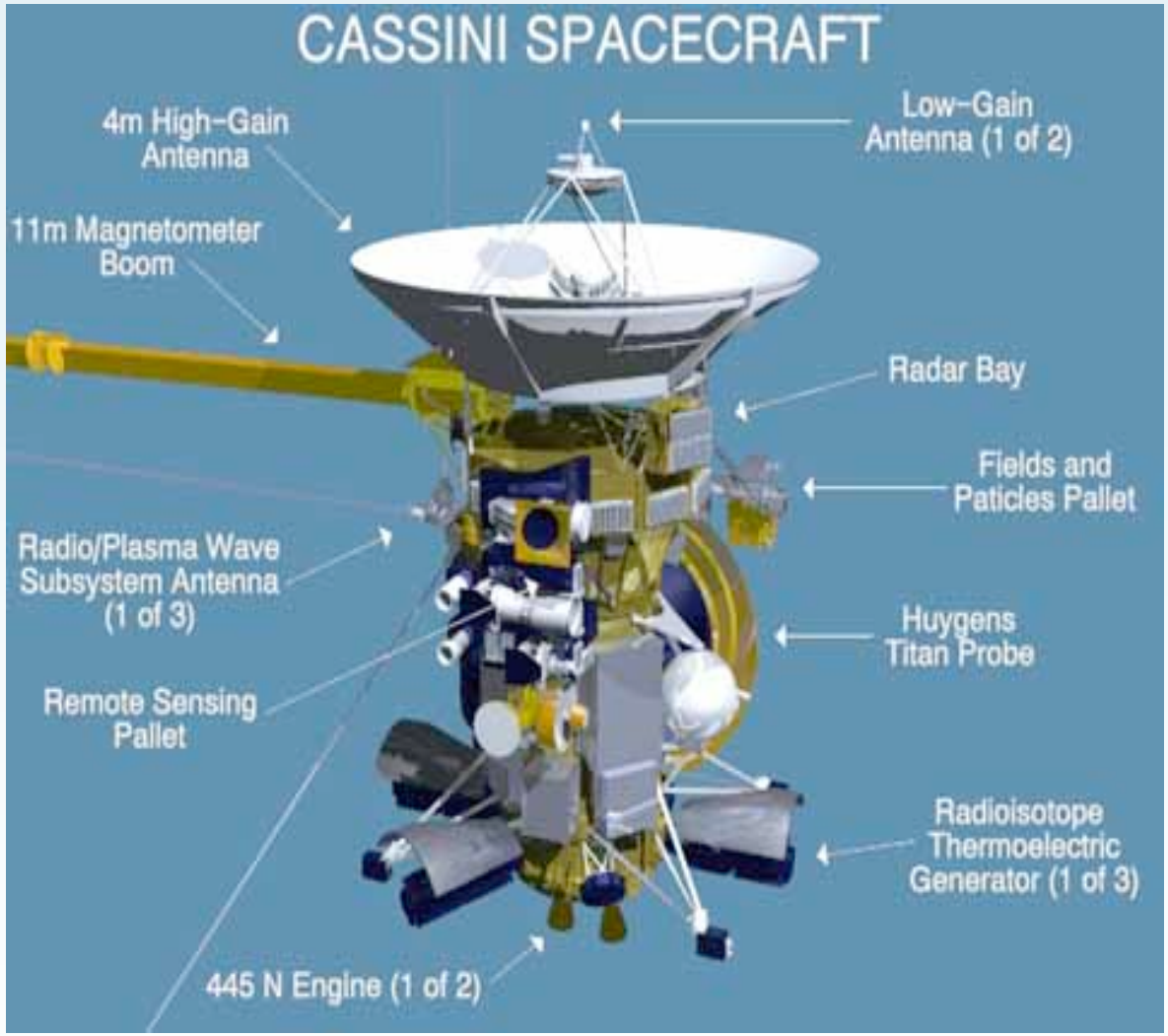
Cassini: an overview

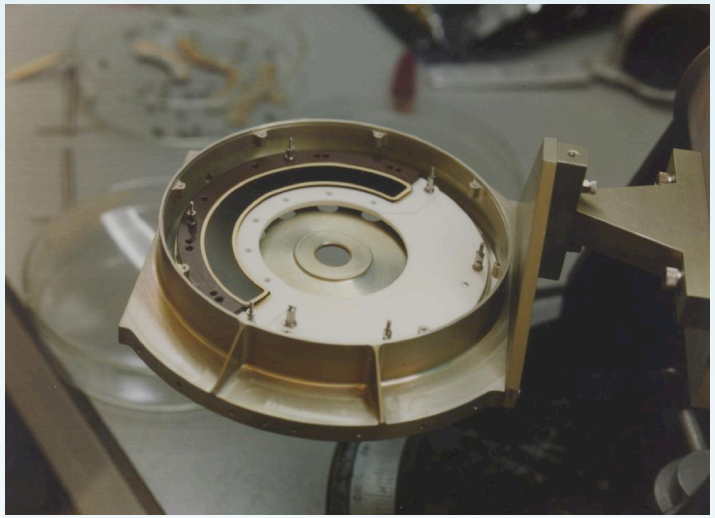


- The most advanced spacecraft to be launched
- 12 instruments on board
- Complex shape. Lots of irregular metallic surfaces
- Tri axis stabilised
- Operates in different plasma regimes

ELS: an overview

- Electron Spectrometer (ELS)
- Ion Mass Spectrometer (IMS)
- Ion Beam Spectrometer (IBS)
- Collectively form the Cassini Plasma Spectrometer (CAPS)

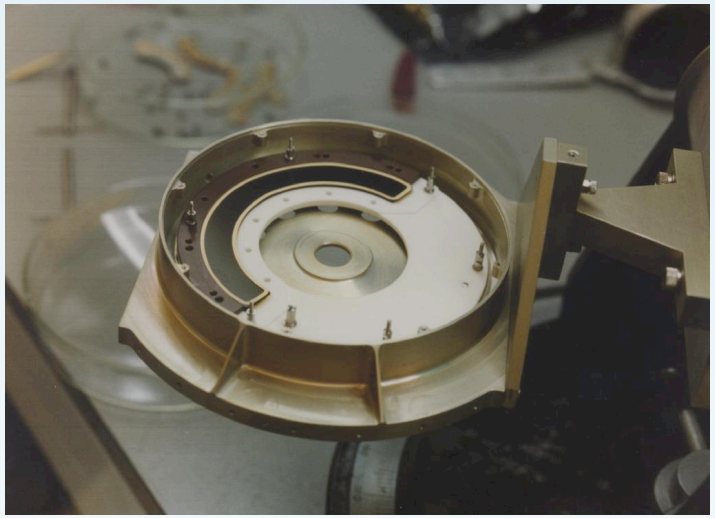
ELS: an overview



- Inside the ELS, electrons are collected over 8 anodes that cover 160^{o}
- The ELS is mounted on an ‘Actuator’ that rotates through ~200^{o}

- Various parts of the spacecraft affect the electron measurements
- The most ‘clear view’ is at Anode 4, Act=0

ELS: an overview



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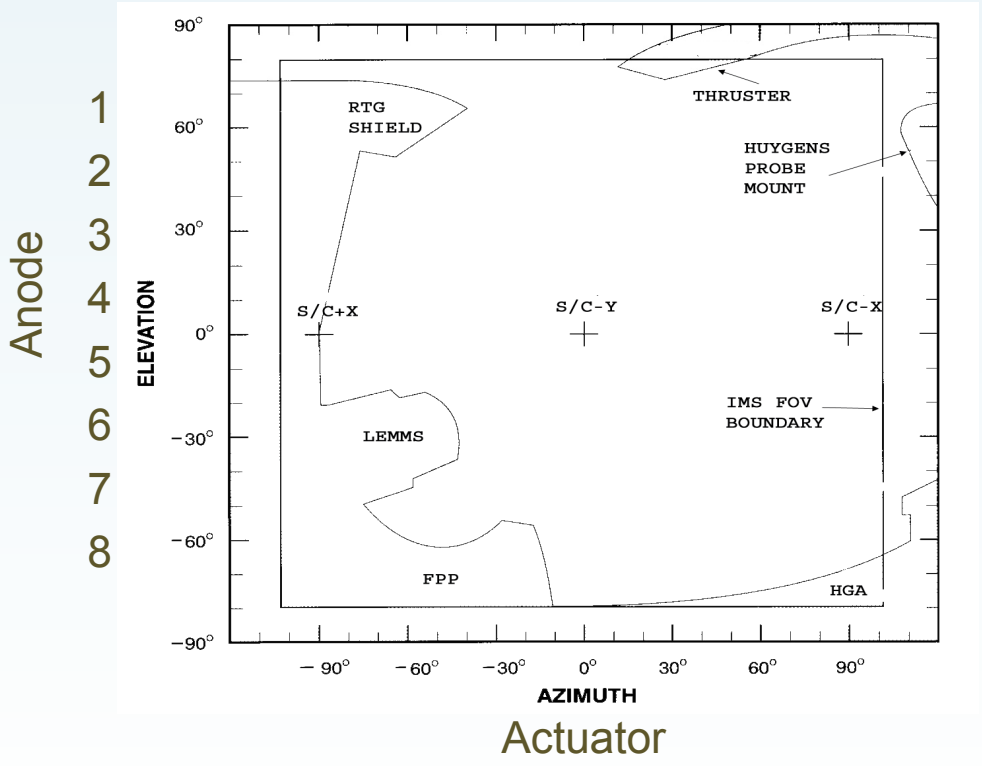
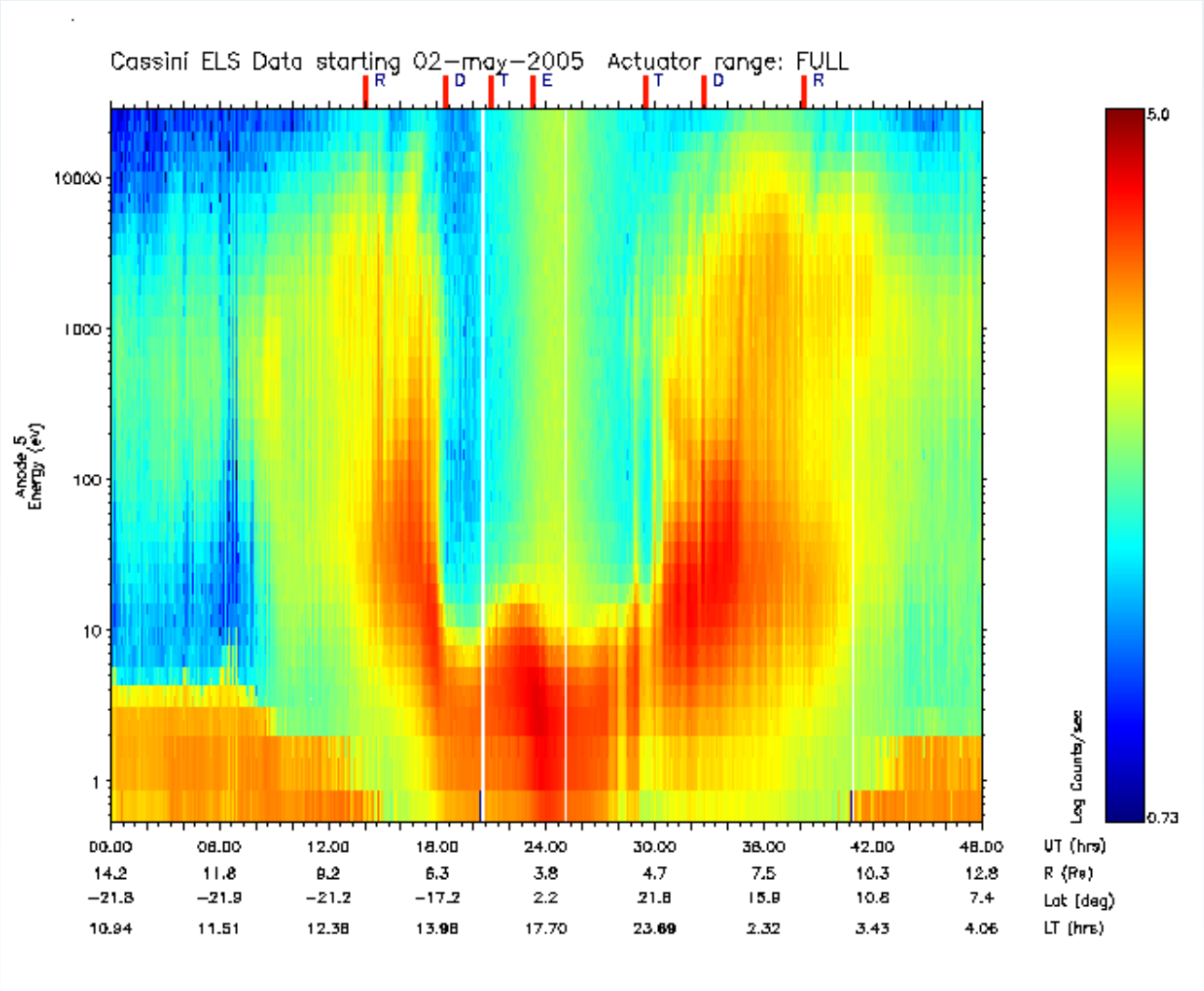


ELS: the data

- An example of the data measured by the ELS
- 63 log spaced energy sweep from 0.5eV - 26KeV
- This data spans two days that cover a Saturn periapsis



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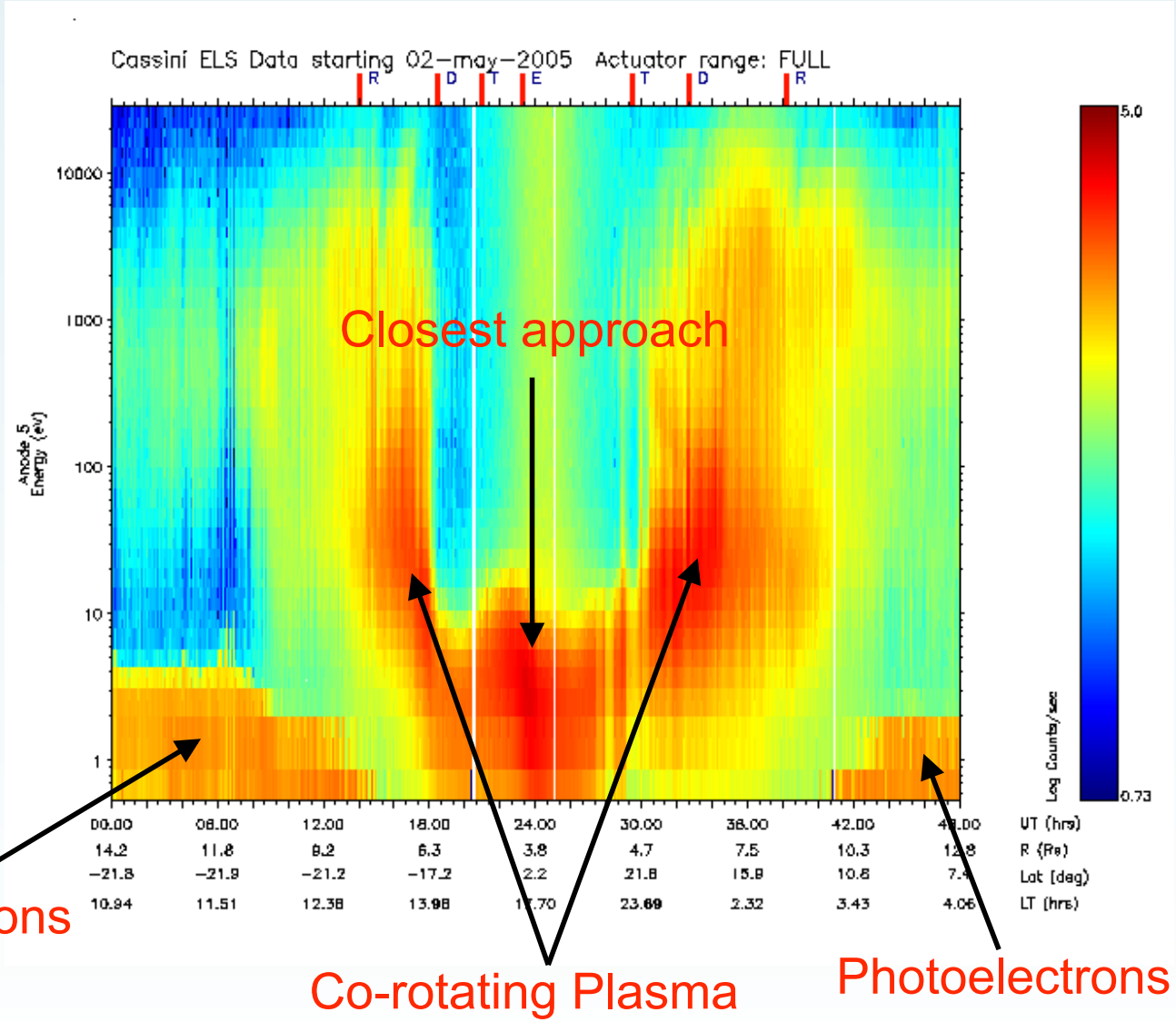
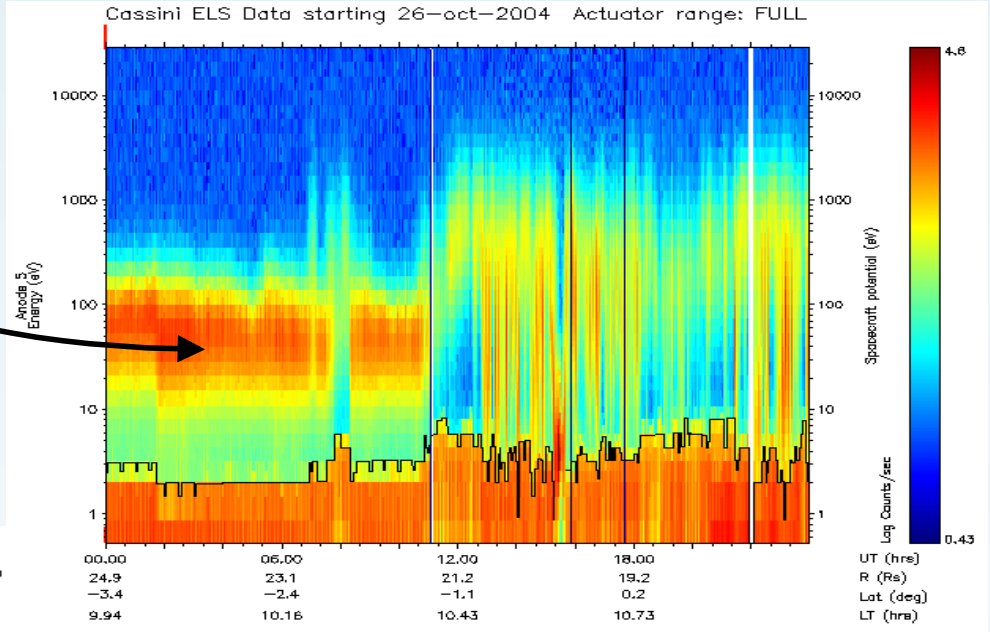
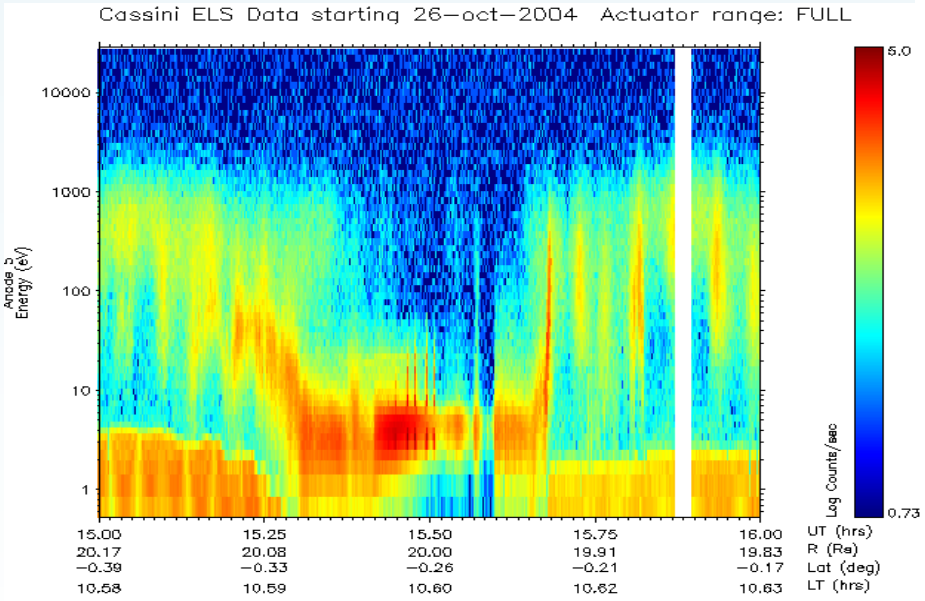


A wealth of information

Magnetosheath electrons can be seen

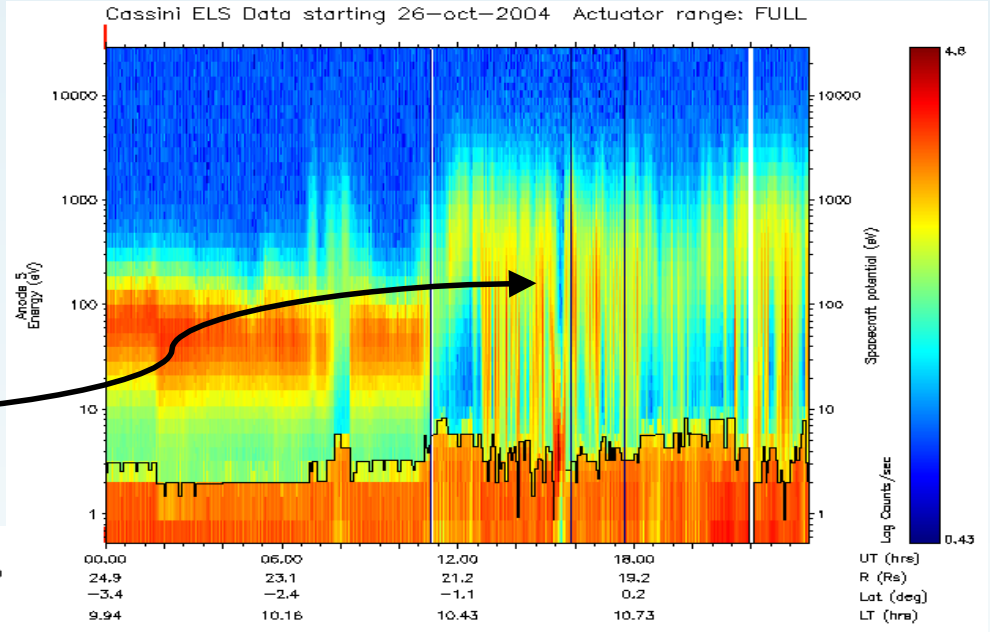


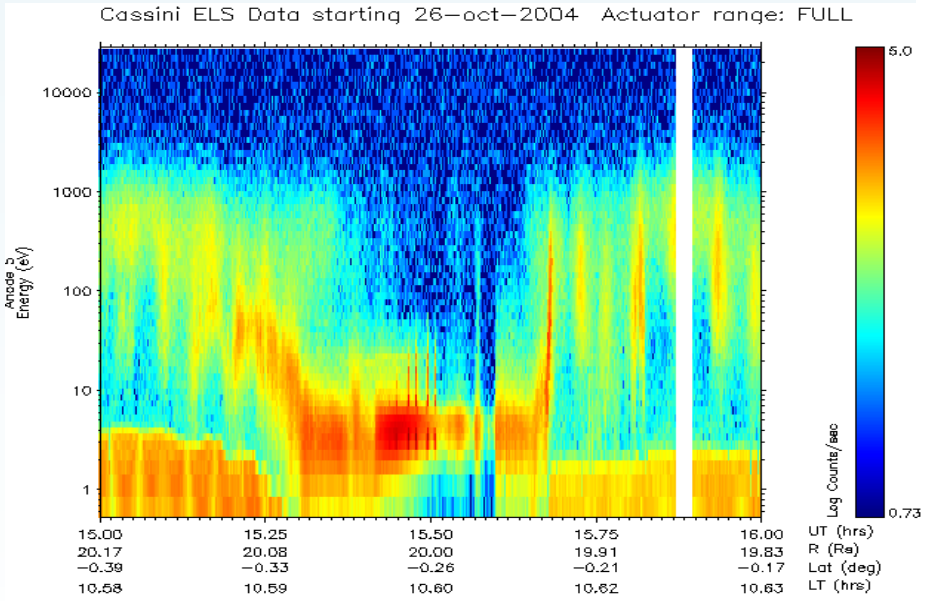


A wealth of information

Magnetosheath electrons can be seen

and outer magnetspheric electrons





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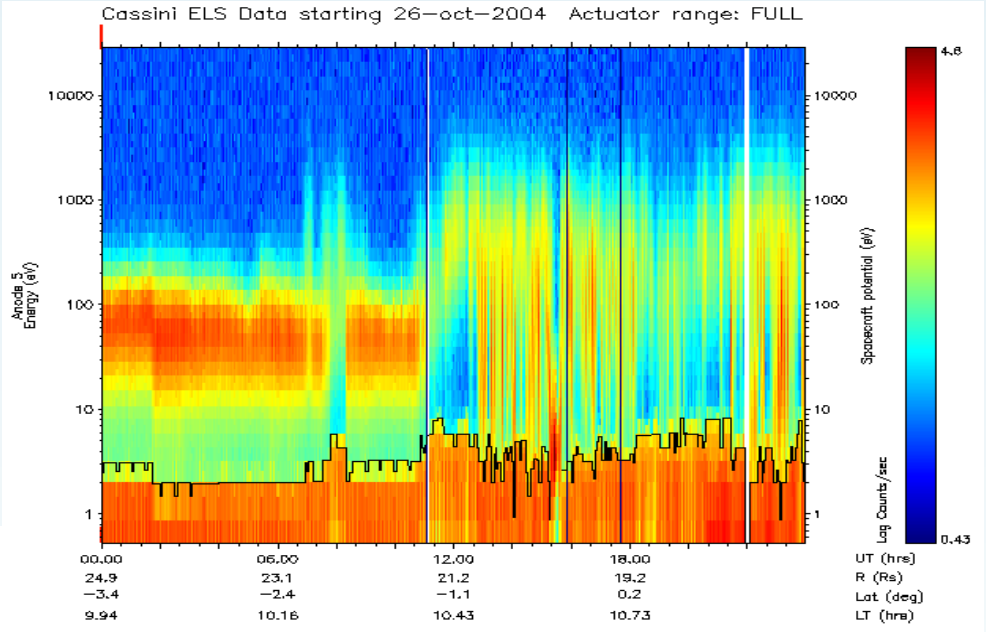
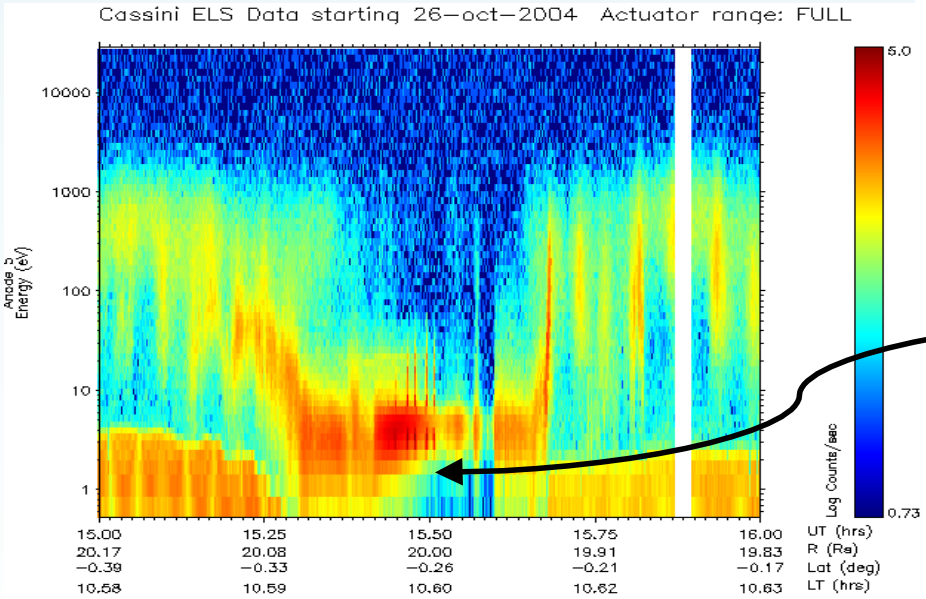
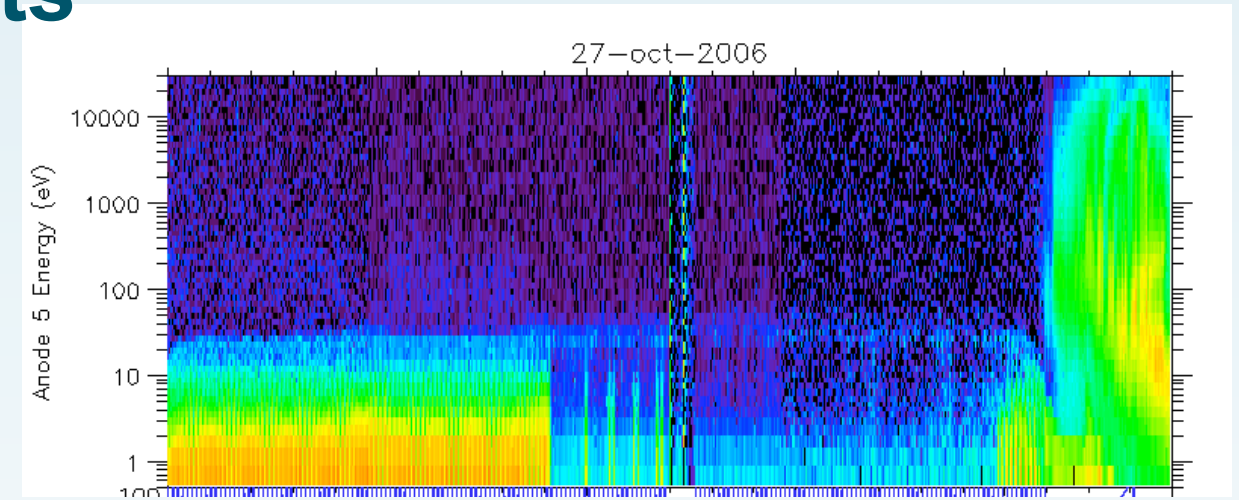




Here photoelectrons disappear during the Titan encounters due to high density

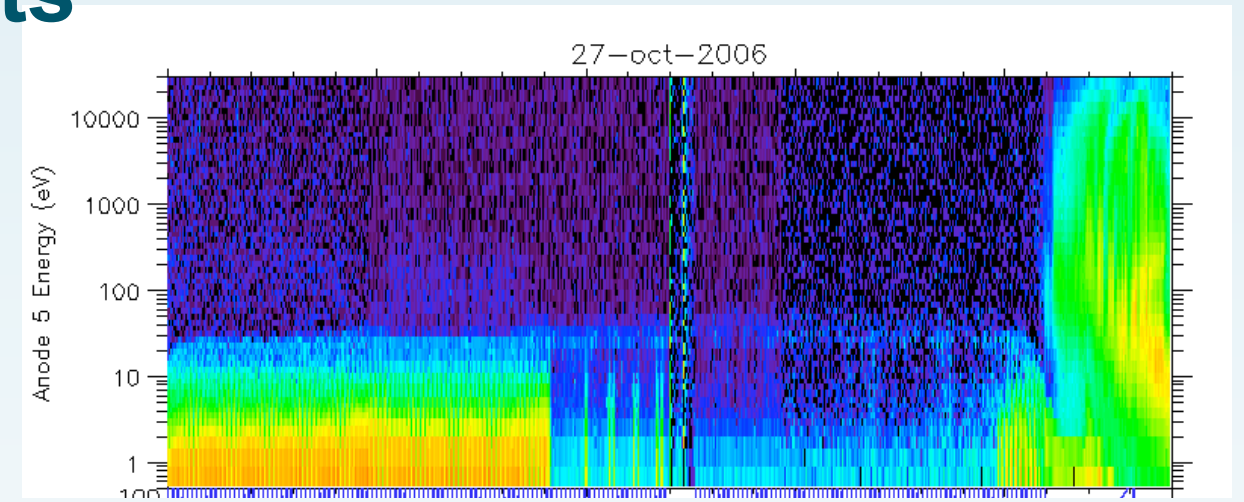
Charging effects

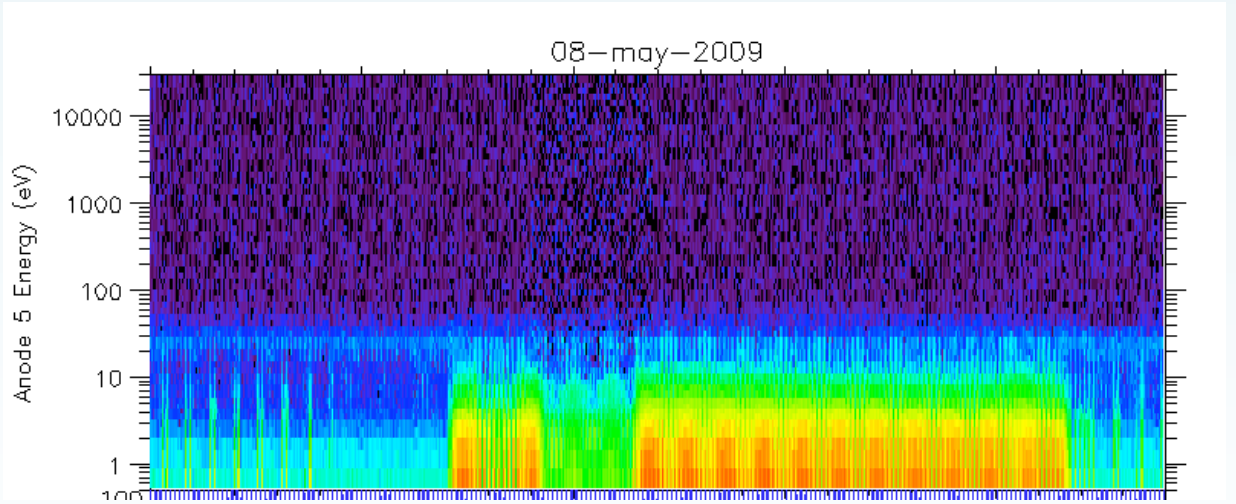
- An example of the variation in photoelectron distribution
- SC close to periapsis
- Are these ionospheric photoelectrons?



Charging effects

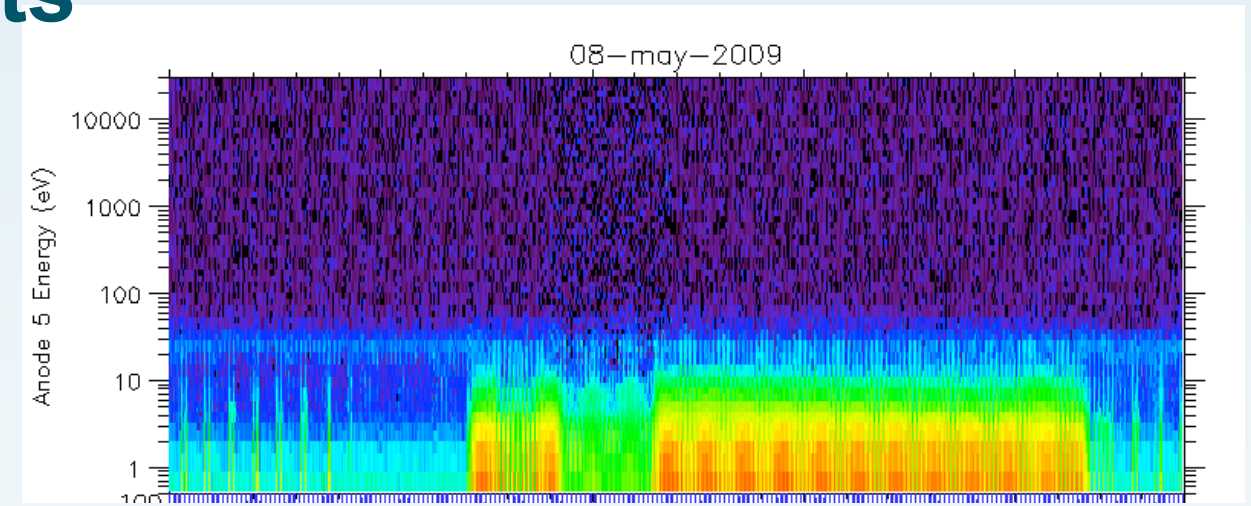
- An example of the variation in photoelectron distribution
- SC close to periapsis
- Are these ionospheric photoelectrons?
- No.





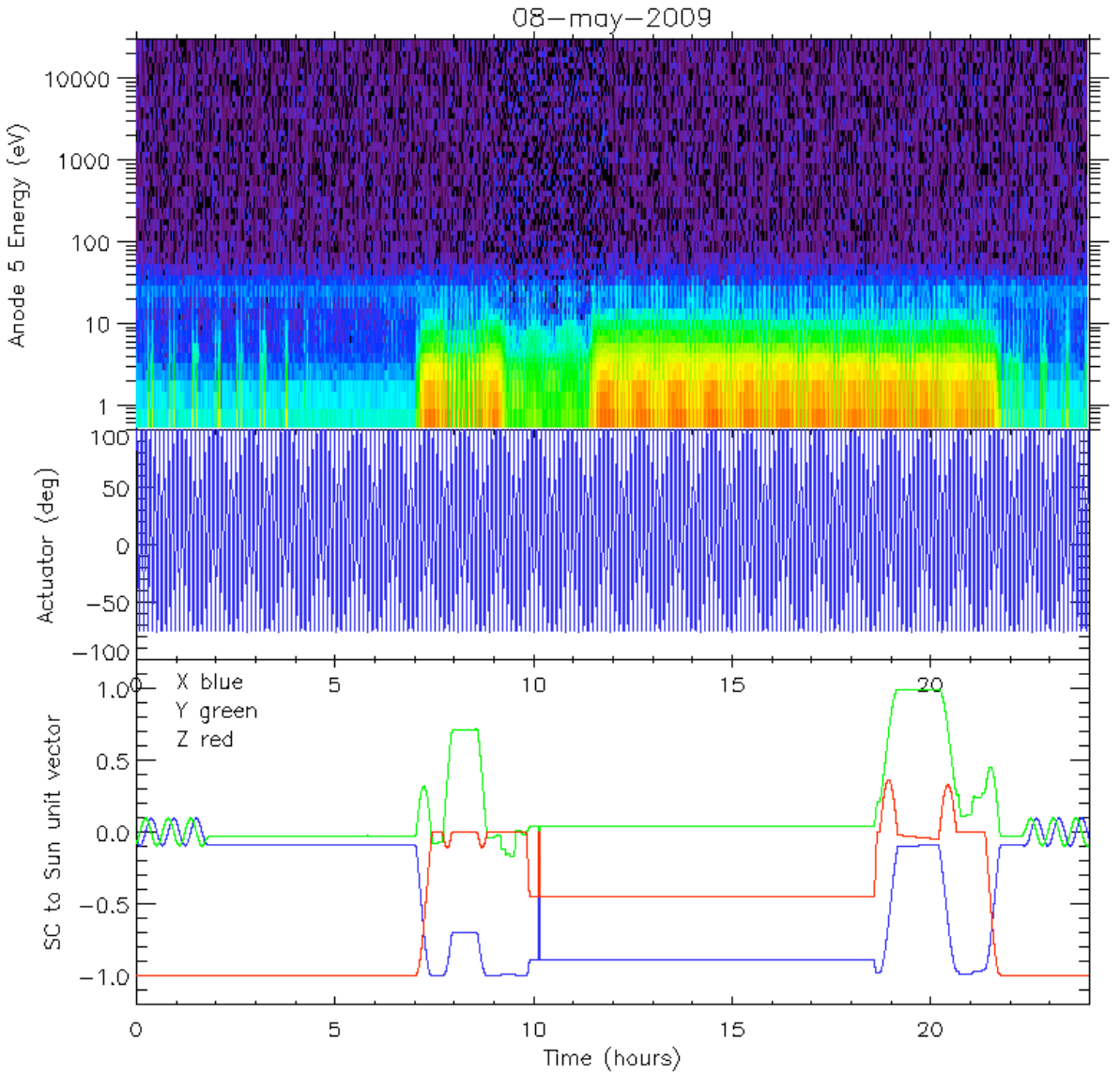
Charging effects

- So what's causing these effect?



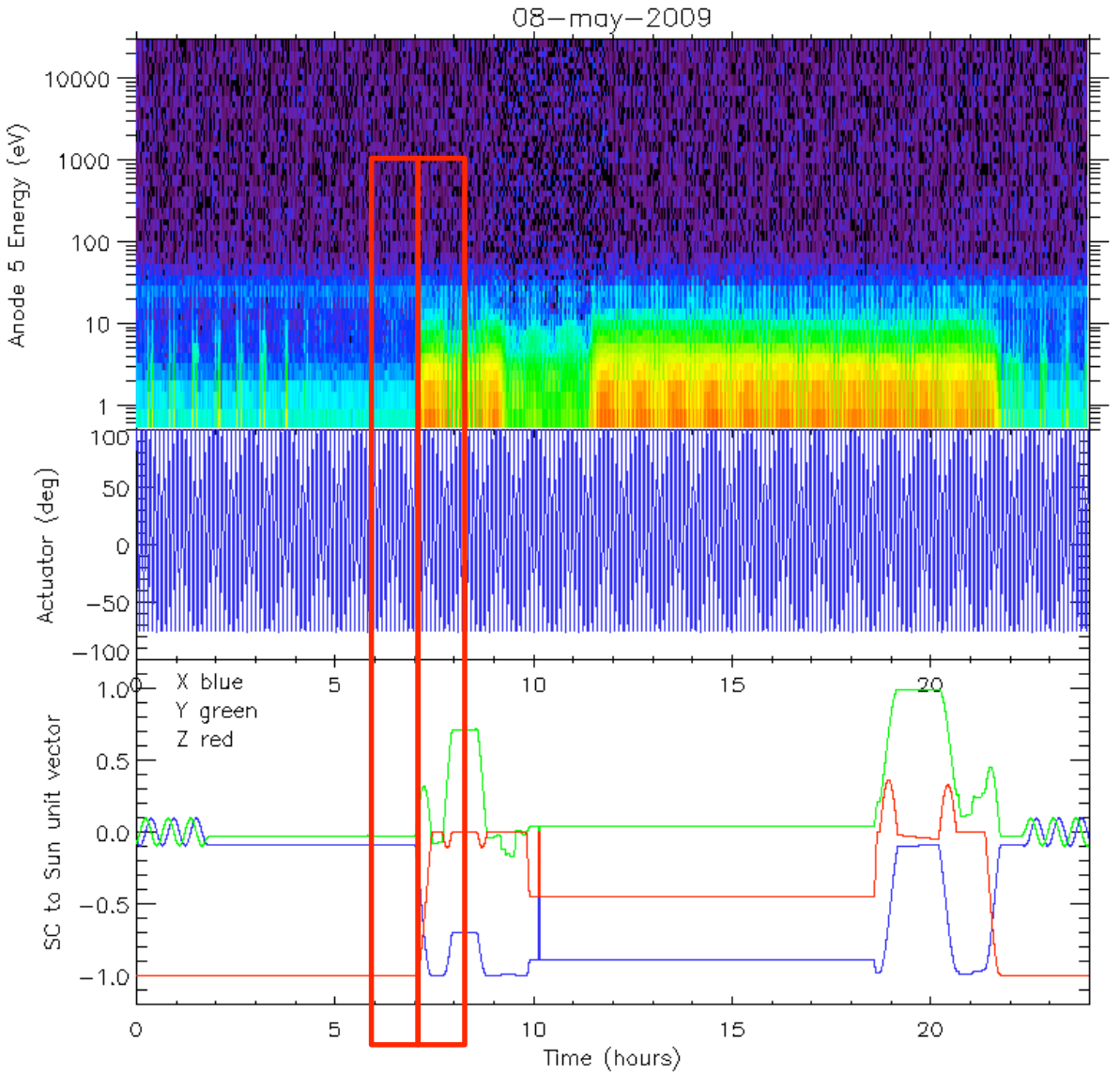
Charging effects

- So what's causing these effect?
- Unit vector of SC to Sun
- HGA points to Sun



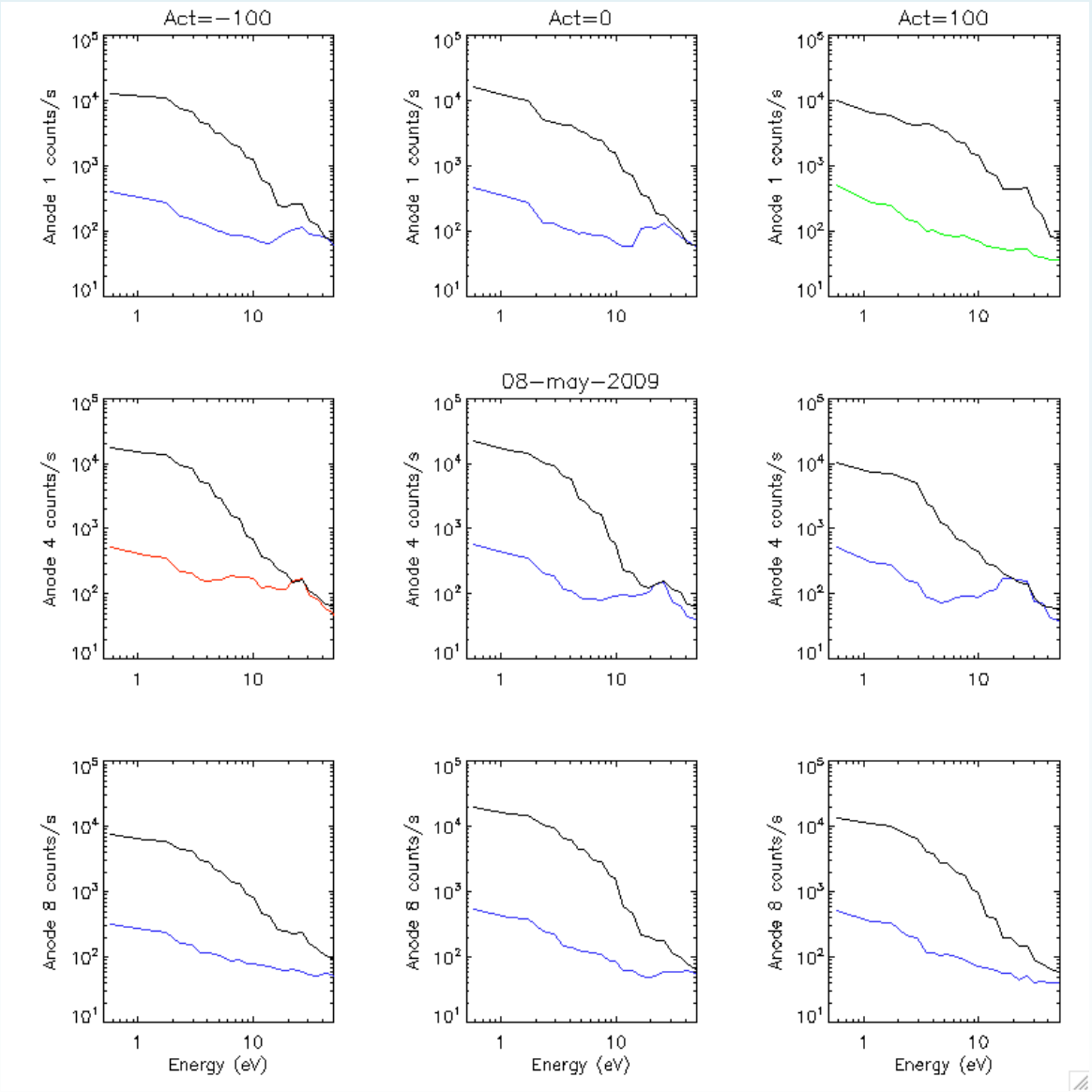
Charging effects

- So what's causing these effect?
- Unit vector of SC to Sun
- HGA points to Sun
- Average data from
  - A: 06:00-07:00
  - B: 07:00-08:00



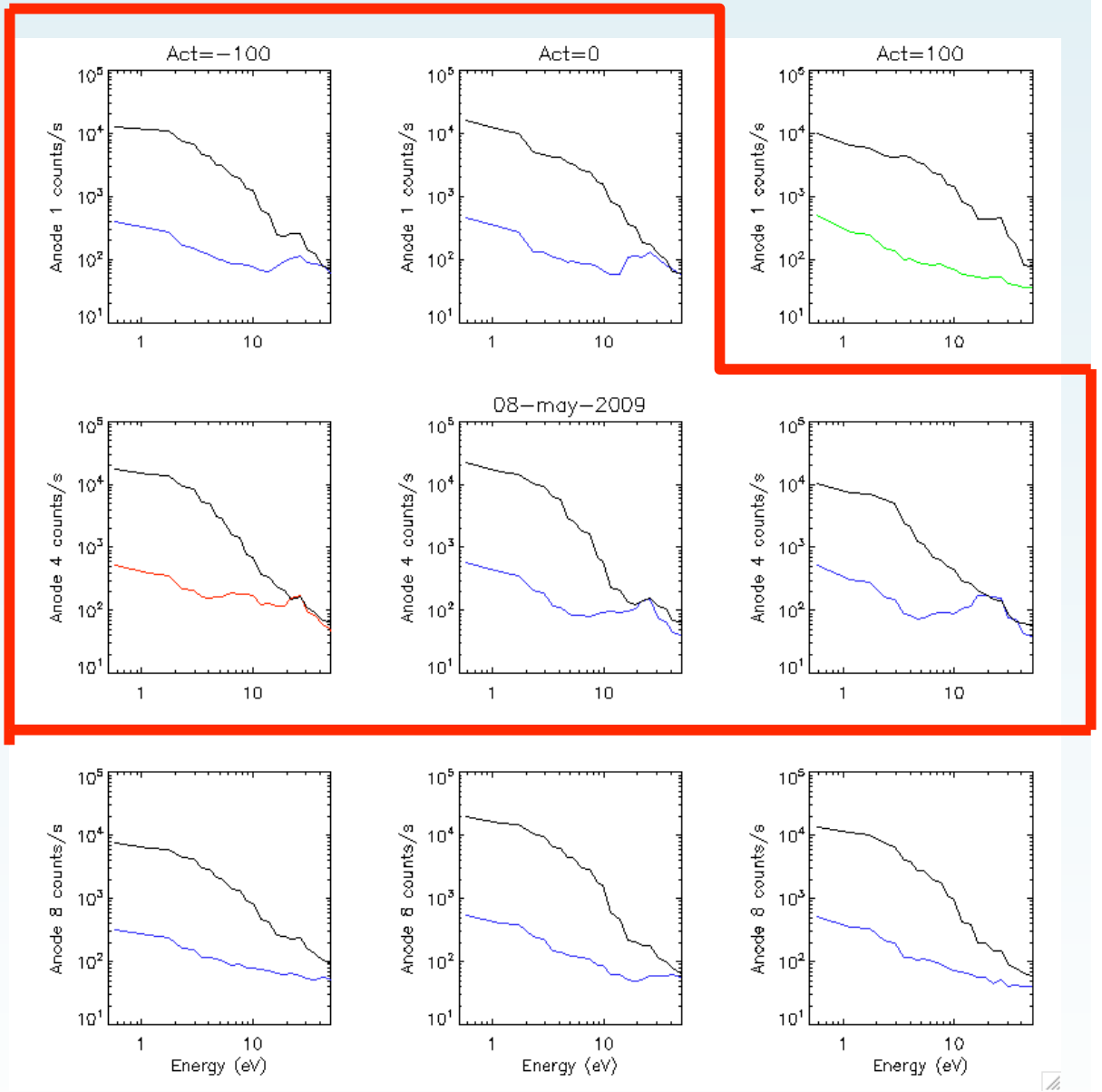
Charging effects

- Black lines from Data B
- Coloured lines from Data A



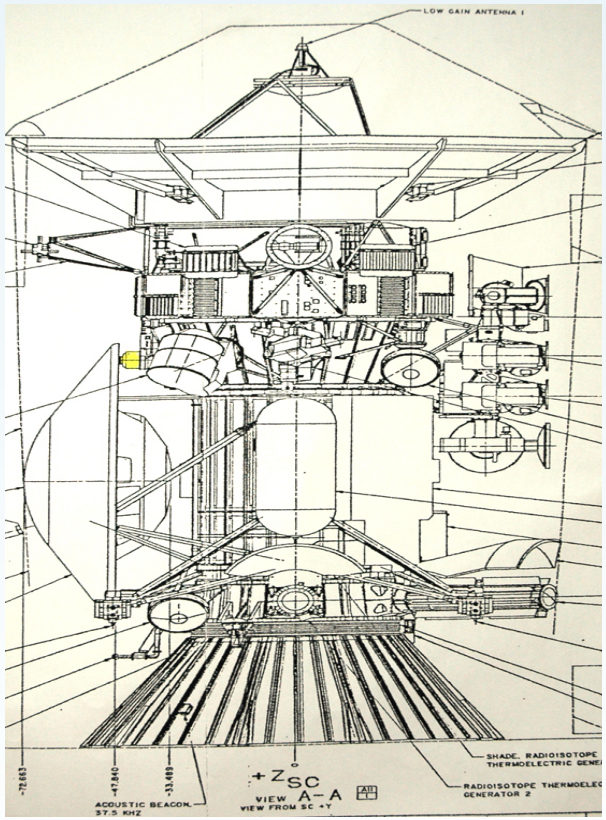
Charging effects

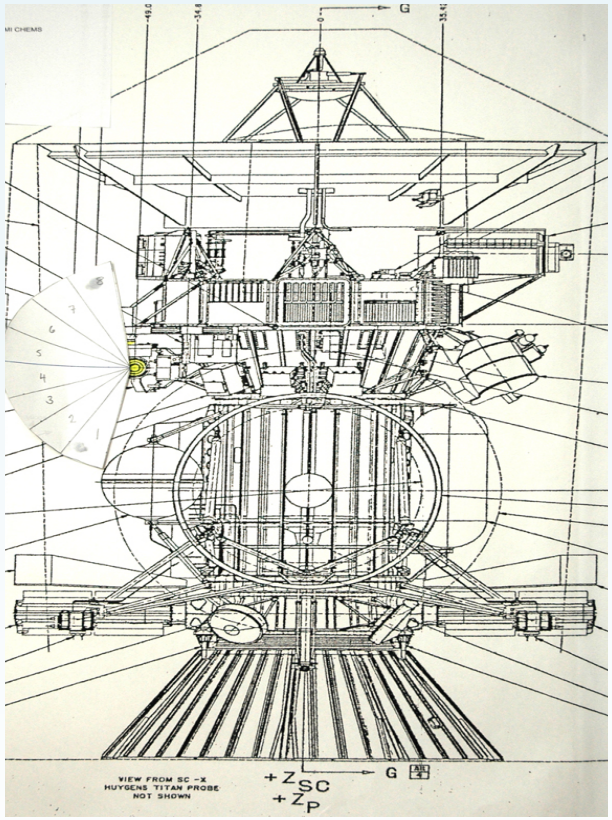
- Black lines from Data B
- Coloured lines from Data A
- 25 eV peak is dependent on direction

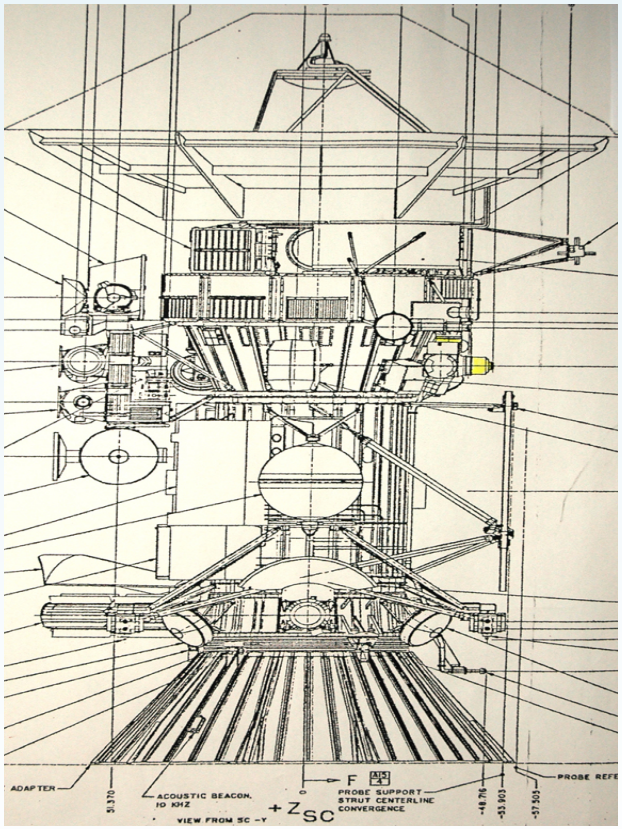


SC Layout

- The space craft diagrams show a possible origin of the photoelectrons based on anode……..







SC Layout

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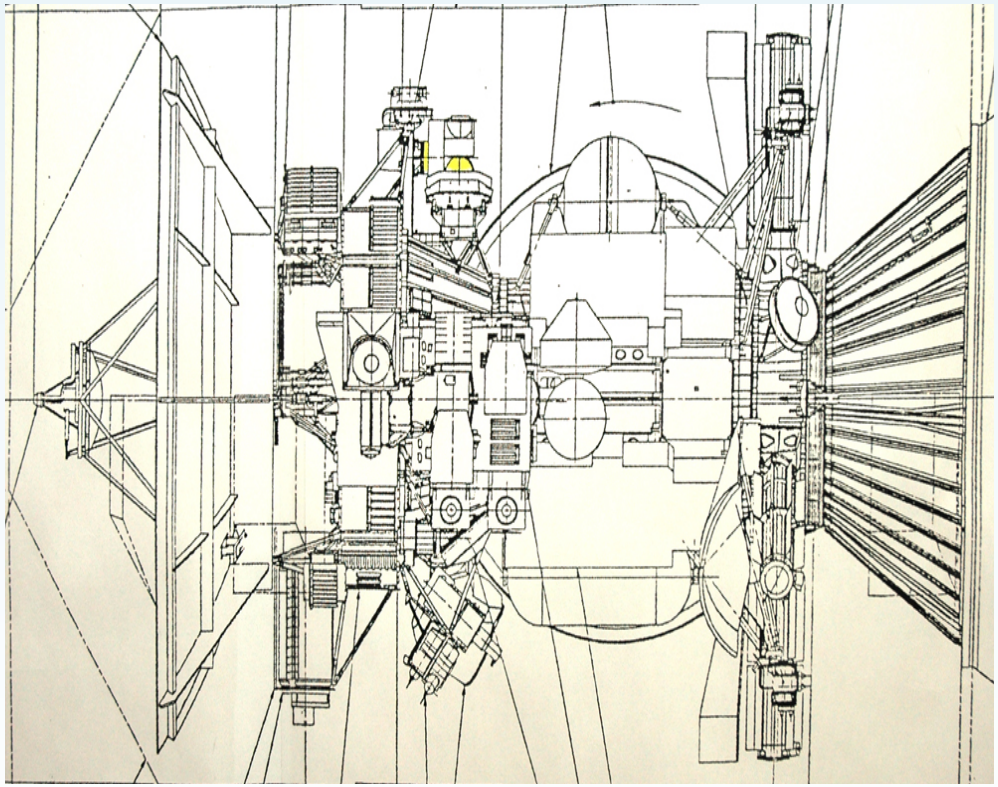
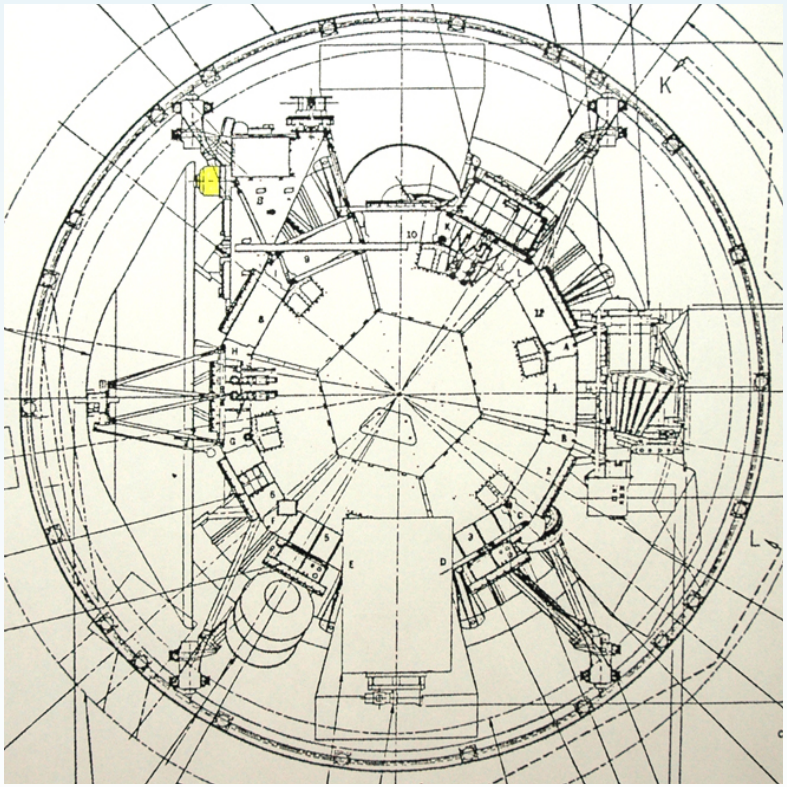
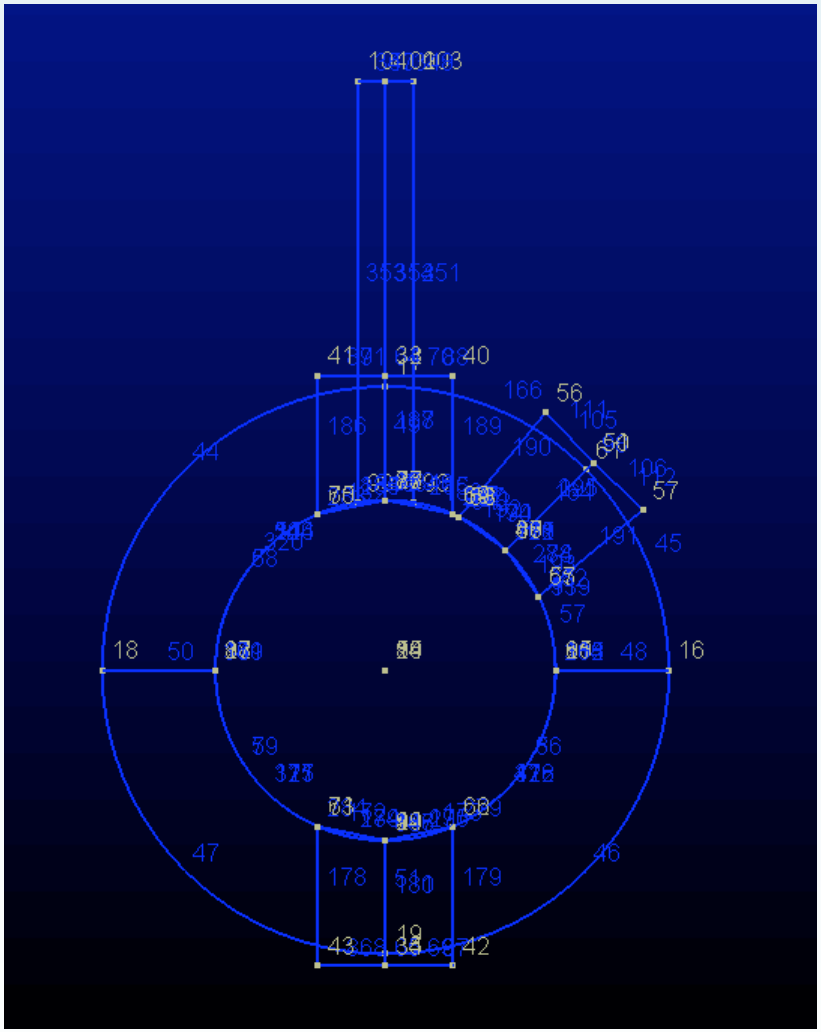
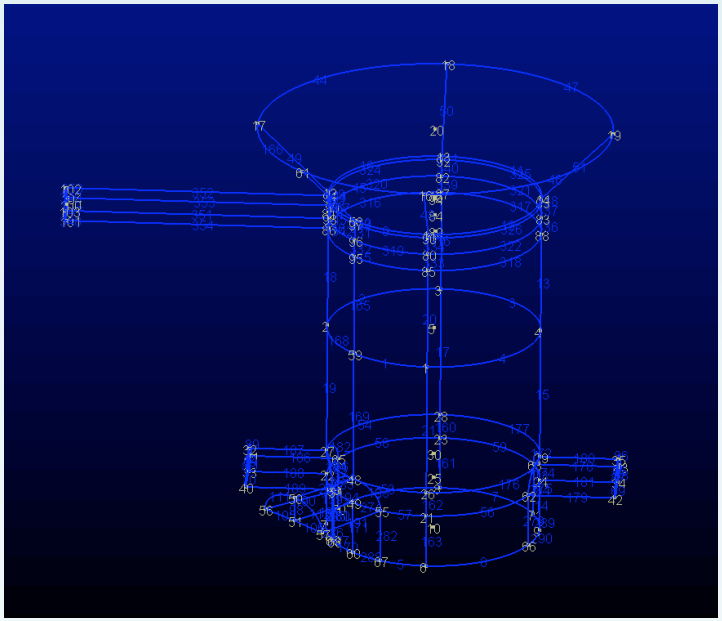
- ……..and actuator

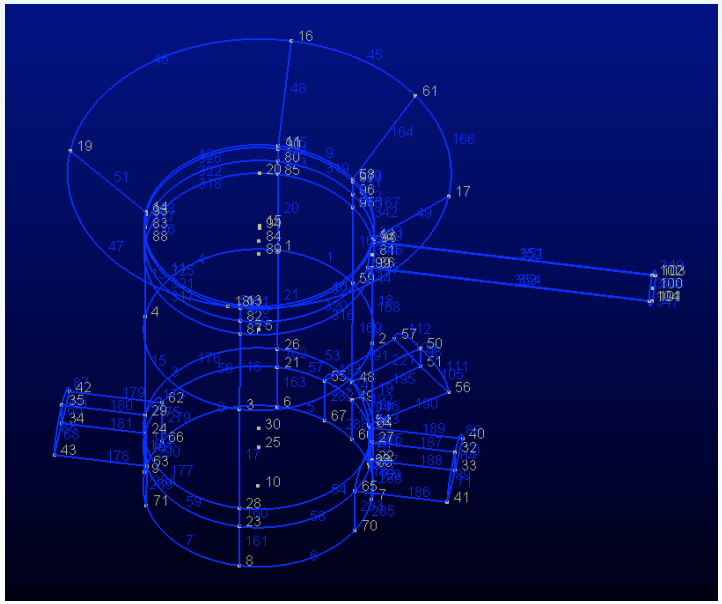




The SPINE model







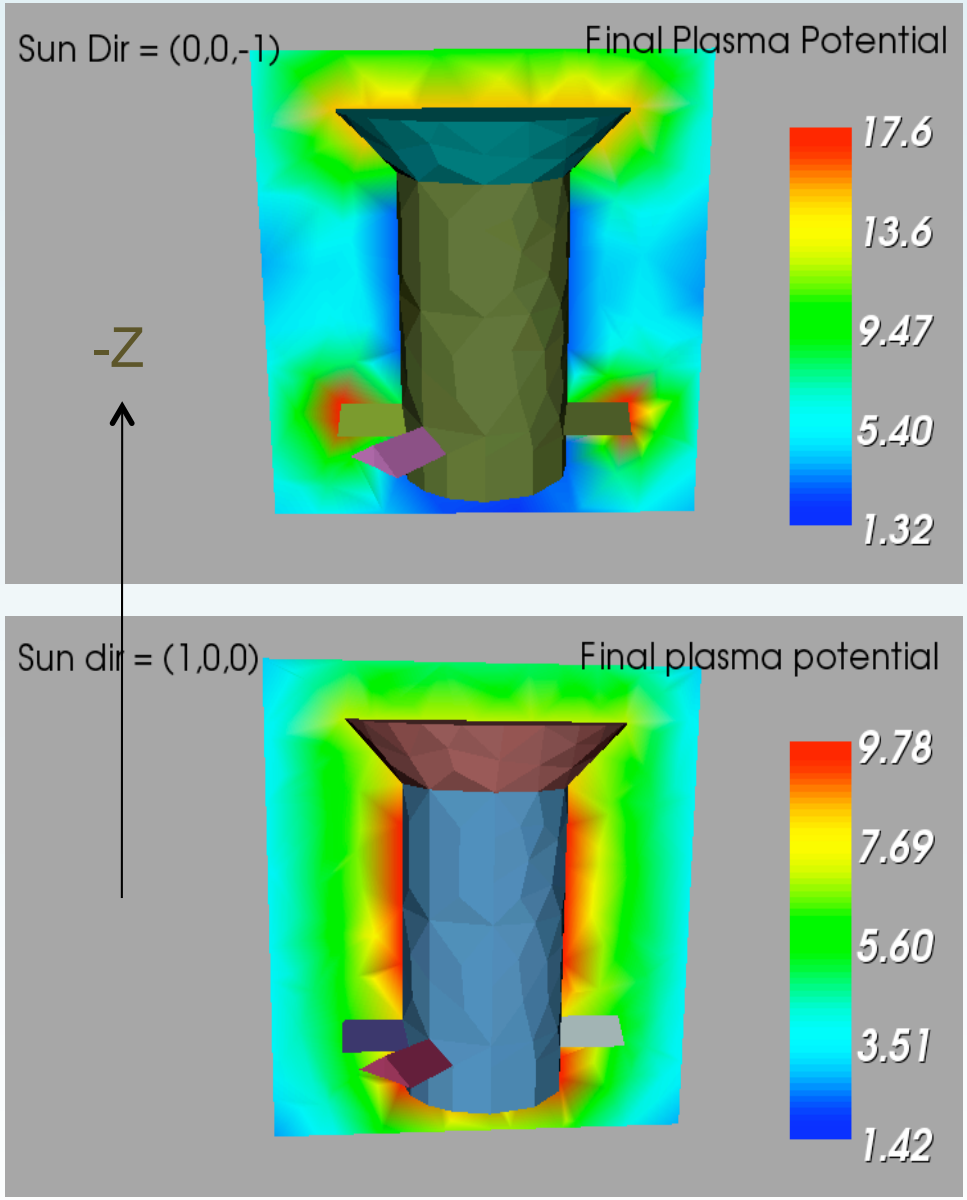
SPINE results

- HGA-steel
- RTG shades-teflon
- SC body-gold
- Initial electron density=800 m^{-3}

➢ Low potential in shadow regions

➢ High potential on tips of RTG shades

➢ High potential on sc body



Summary

- Beam at 25eV may be coming from RTG shades
  - SPINE is very useful in studying the photoelectron distributions
  - Much more work to be done
  - Extend the model
  - Actual materials
  - Much to learn about SPINE
- Future plans
  - More advanced model
  - Different magnetospheric region comparisons
  - Particle trajectories?
- Further uses of SPINE at MSSL
  - Cassini (negative SC charging problem)
  - VEX (Solar Panels)
  - Europa Jupiter System Mission (EJSM)

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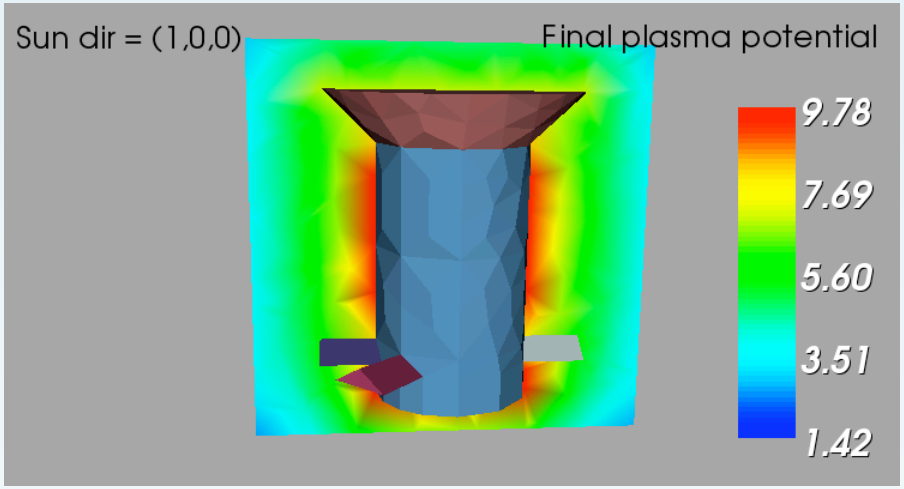
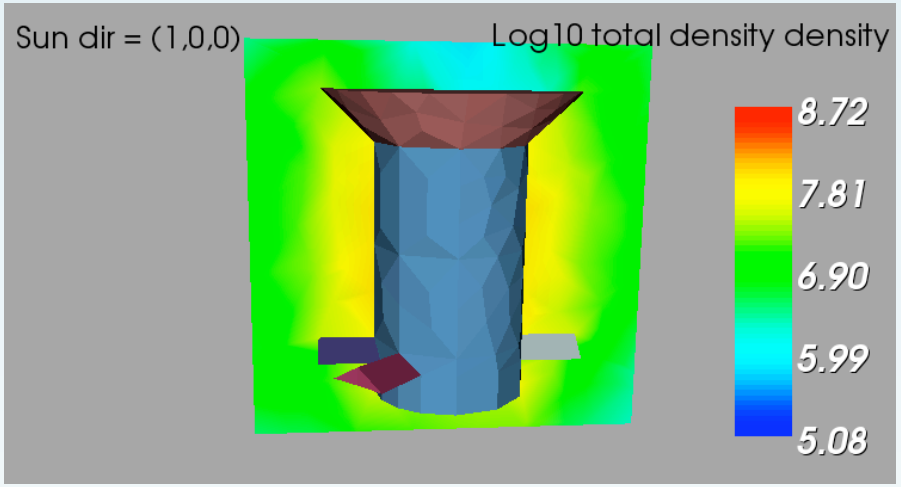
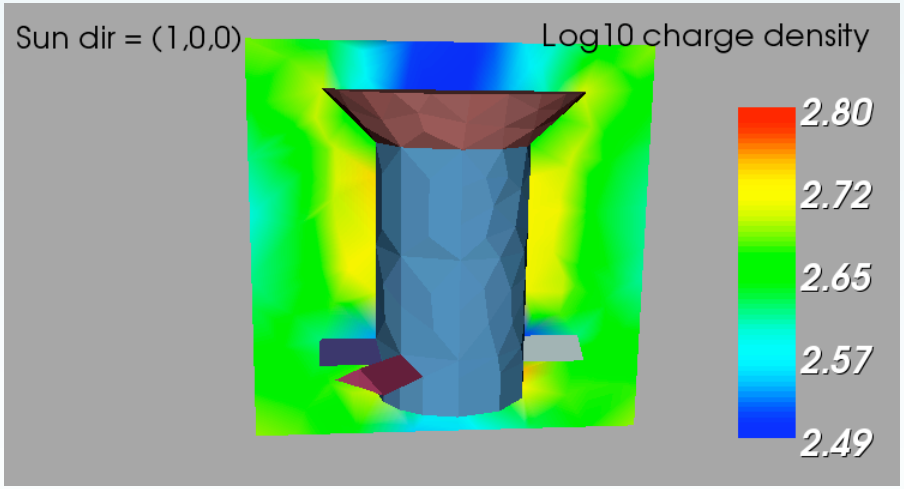
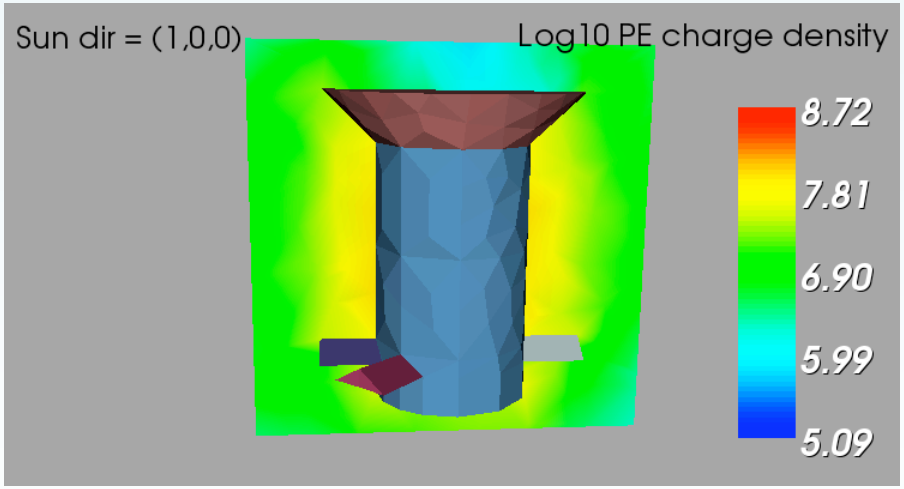
Extras

SPINE results









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