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Title: Quick spacecraft charging primer

Author(s): Larsen, Brian Arthur

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# Quick spacecraft charging primer

Brian Larsen

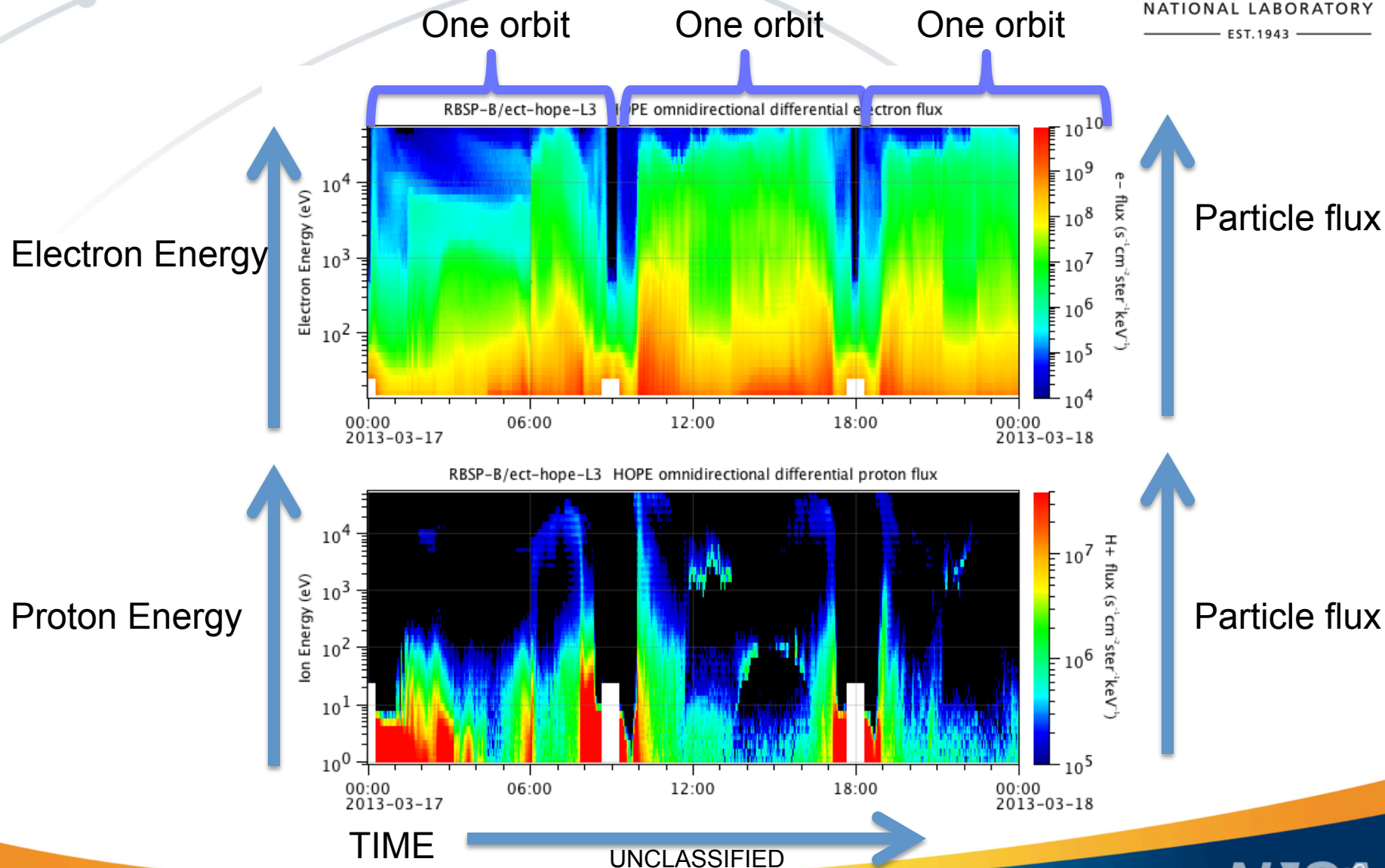
[balarsen@lanl.gov](mailto:balarsen@lanl.gov)

ISR-1

March 12 2014

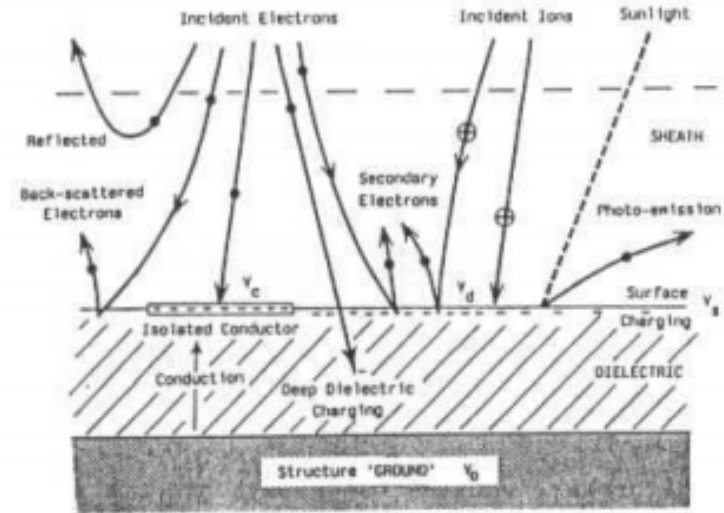
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# RBSP example



# Charging physics

- Spacecraft and local plasma form a balance
- Often in eclipse the loss of photoelectrons drives the S/C negative relative to the plasma (not necessary or sufficient)
- During times of significant hot (~10keV) electrons their collisions with the spacecraft drive it negative relative to the local plasma
- Less frequently spacecraft can charge positive, electron/ion mobility differences often quench this
- A negative spacecraft attracts and accelerates (energizes) ions toward it



**Figure 4.** Currents which control surface charging  
(after Wrenn and Sims, 1993).

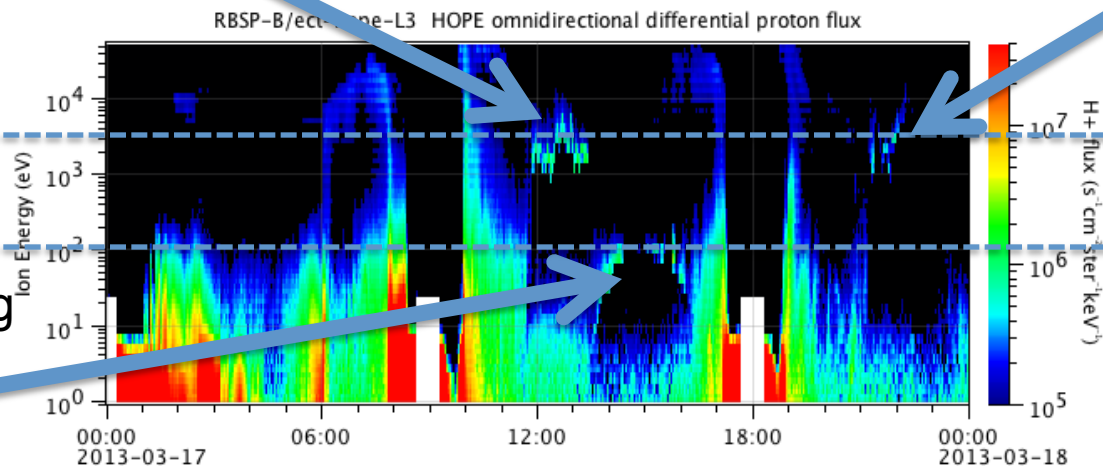
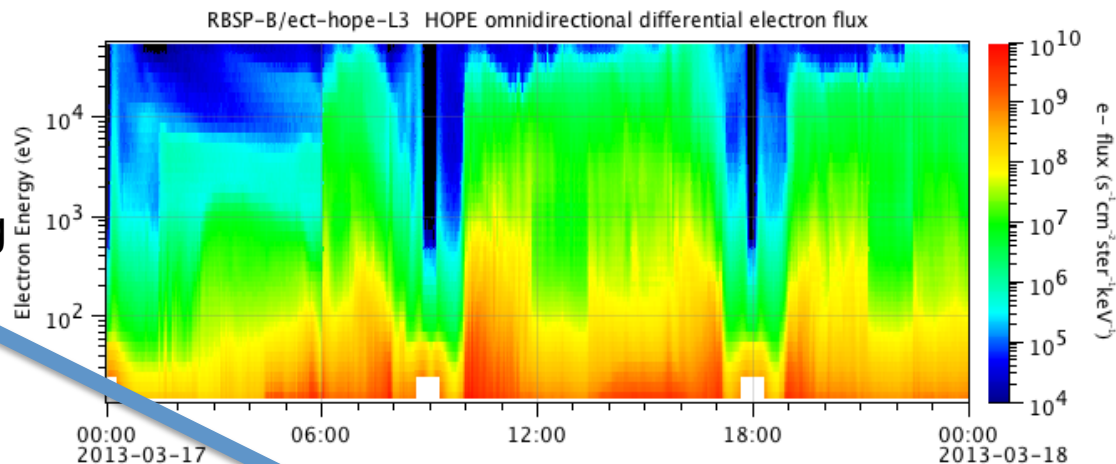
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# RBSP example

S/C frame charging  
to ~2000V

Maybe charging,  
not certain

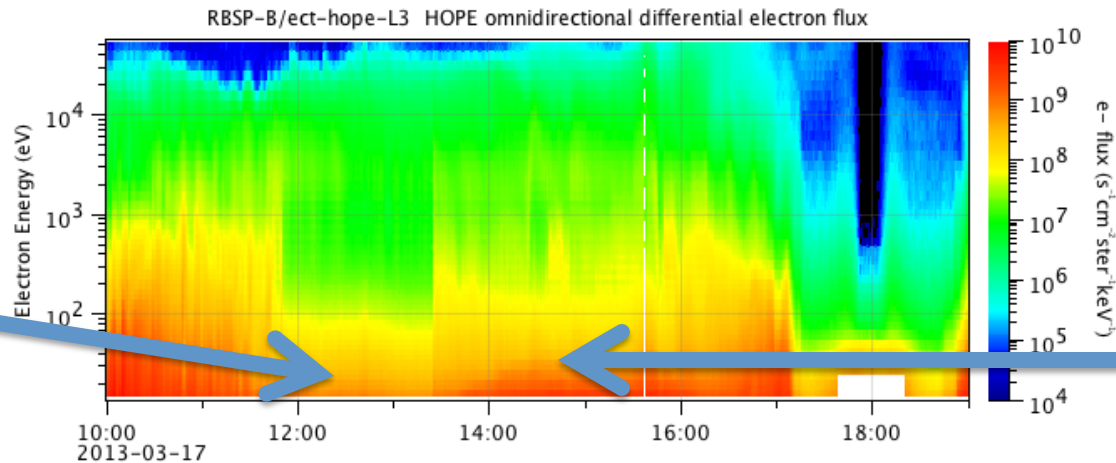
S/C frame charging  
to ~100V



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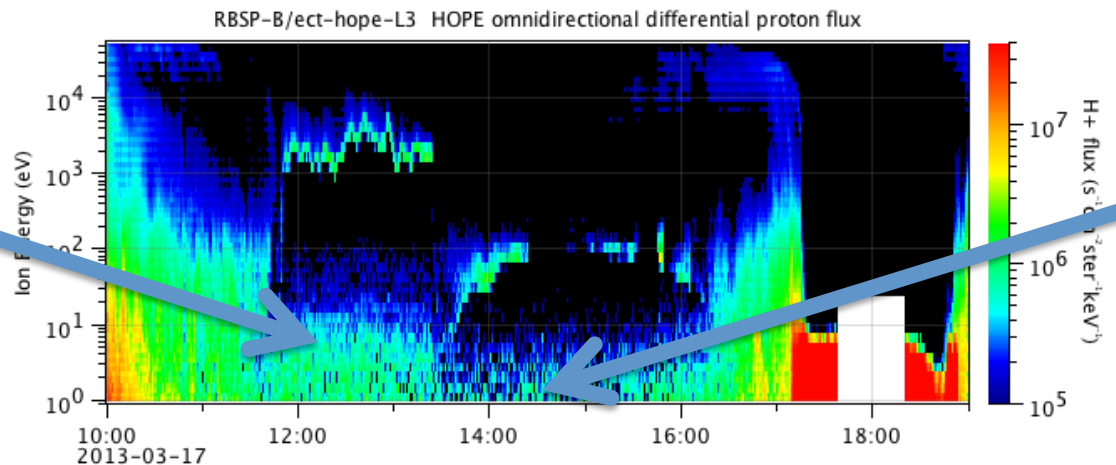
# RBSP example

Changed due to  
charging



Enhanced due  
to charging

Depleted under  
charging, but this  
is intense charging



Depleted under  
charging

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# Identifying charging

- Mostly done in ion spectrograms
  - Look for a very sharp, about 1 channel wide, line of ions and a depletion below relative to times before and after
- Automatic detection has been tried (e.g. M. Thomsen) with moderate success.
  - This was done from a data file standpoint not an imaging processing standpoint
  - New tools and insight may improve either version

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