

LA-UR-16-24515

Approved for public release; distribution is unlimited.

Title: Quick spacecraft charging primer

Author(s): Larsen, Brian Arthur

Intended for: Program training

Issued: 2016-06-28

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the Los Alamos National Security, LLC for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.



Quick spacecraft charging primer

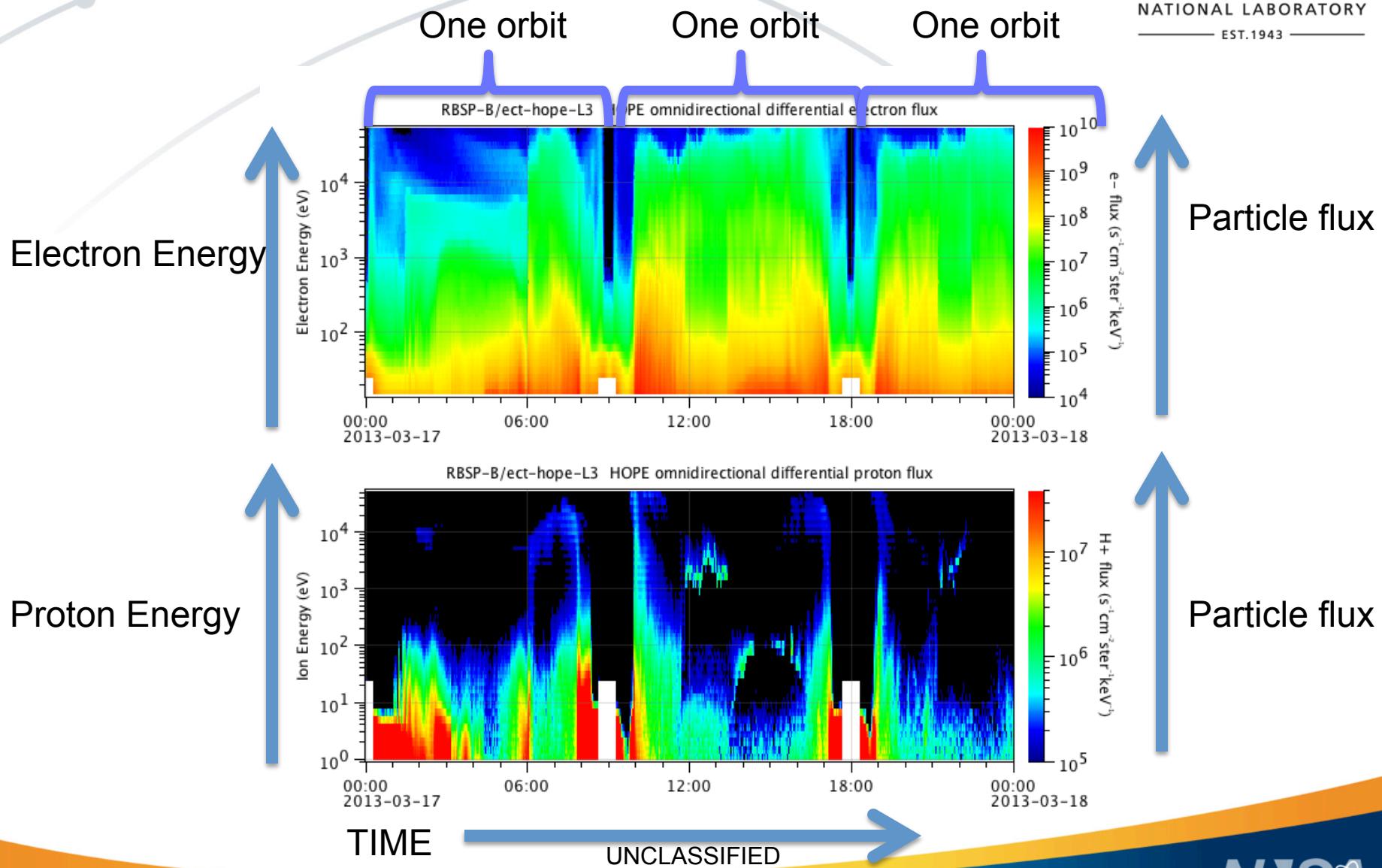
Brian Larsen

balarsen@lanl.gov

ISR-1
March 12 2014

UNCLASSIFIED

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 ($\sim 10\text{keV}$) electrons their collisions with the spacecraft drive it negative relative to the local plasma
- Less frequently spacecraft can change positive, electron/ion mobility differences often quench this
- A negative spacecraft attracts and accelerates (energizes) ions toward it

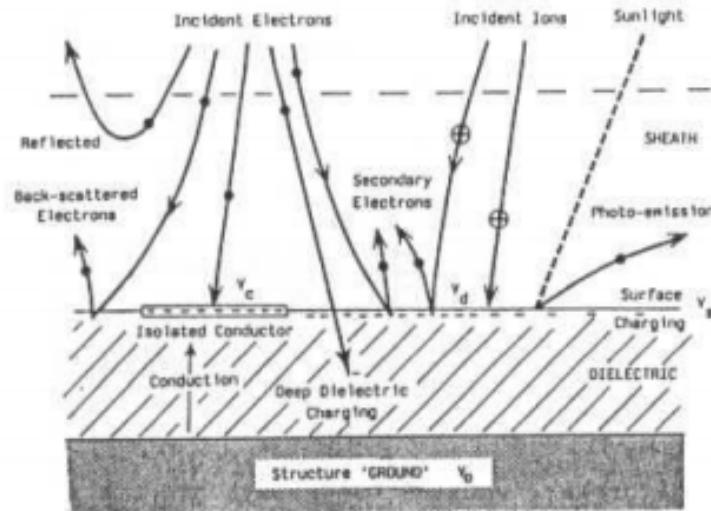


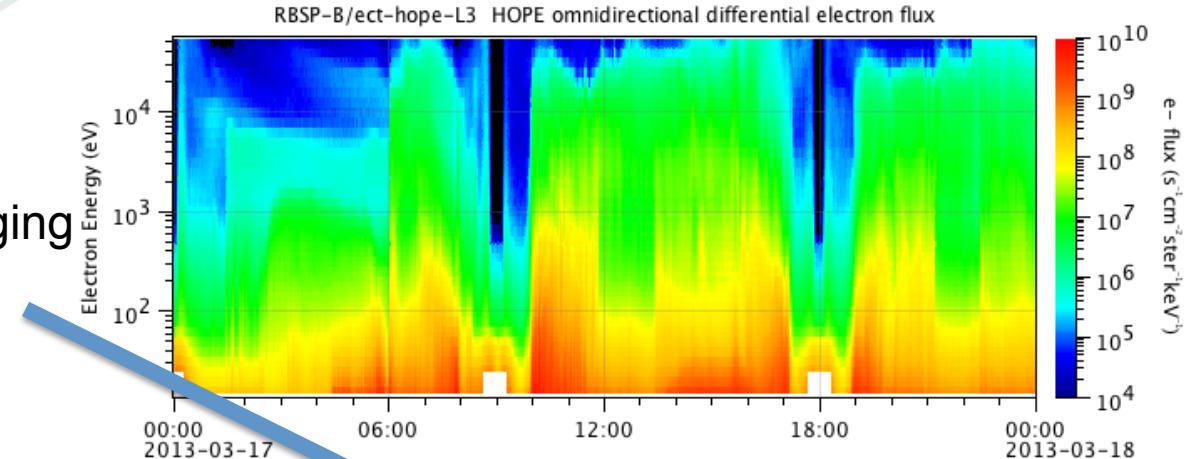
Figure 4. Currents which control surface charging (after Wrenn and Sims, 1993).

UNCLASSIFIED

RBSP example

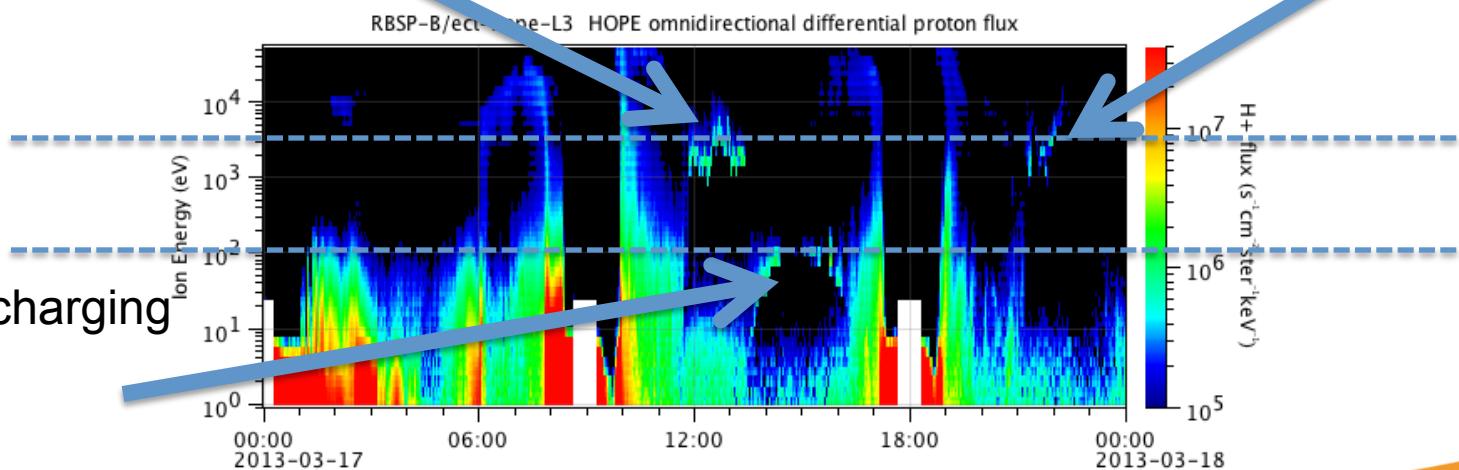


S/C frame charging
to ~2000V



Maybe charging,
not certain

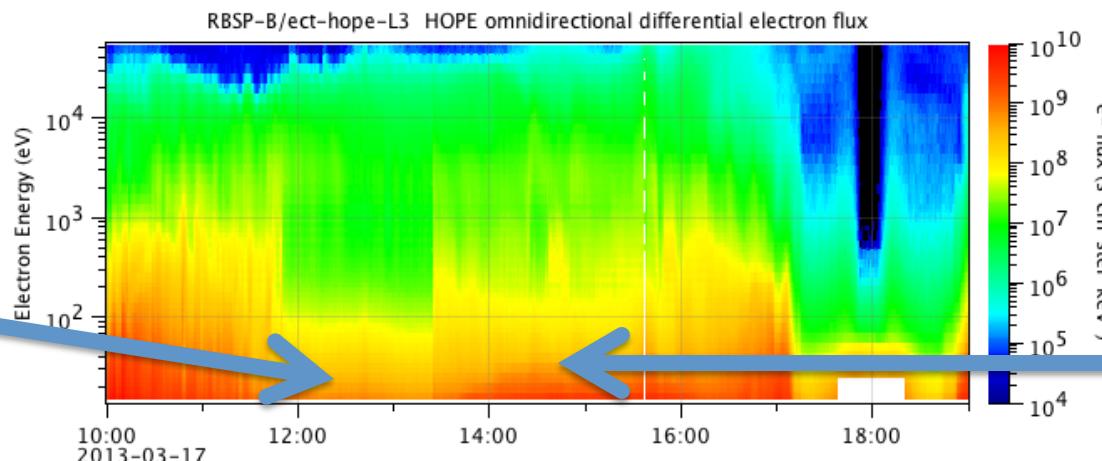
S/C frame charging
to ~100V



UNCLASSIFIED

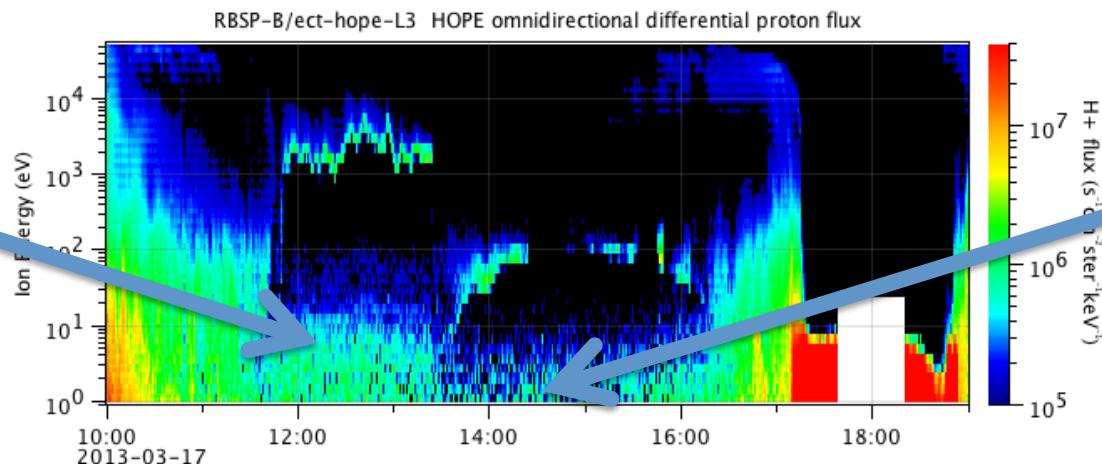
RBSP example

Changed due to charging



Enhanced due to charging

Depleted under charging, but this is intense charging



Depleted under charging

UNCLASSIFIED

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

UNCLASSIFIED