NJIT New Jersey's Science & Technology University

Van Allen Probes

Interior Spacecraft Charging of the Van Allen Probes

Lanzerotti and Baker [2017]

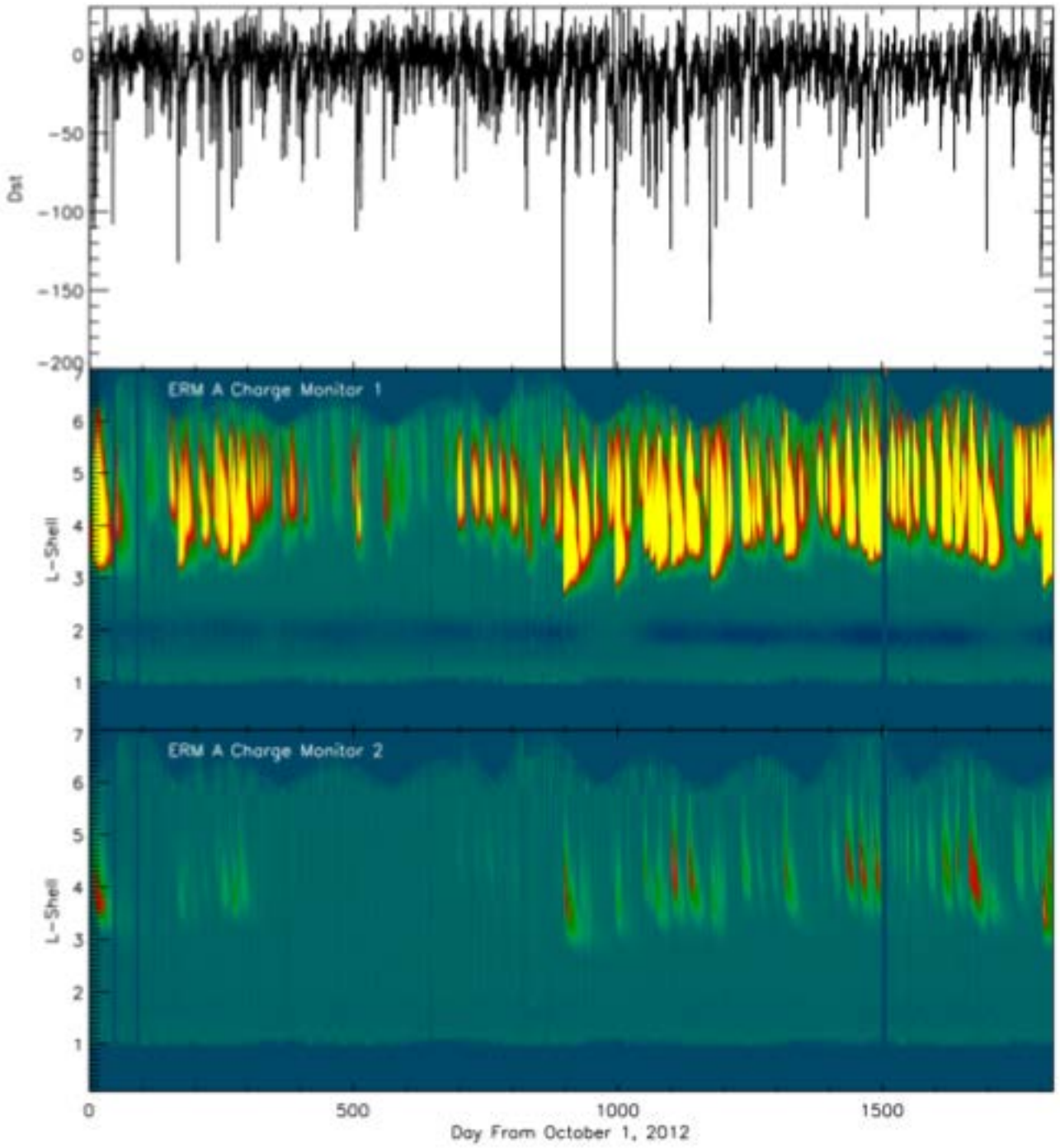
Andrew Gerrard
Louis Lanzerotti
NJIT-CSTR

Thomas Sotirelis, John Goldsten, Barry Mauk
JHU-APL

Joe Mazur
Aerospace Corp.

Full ERM Data

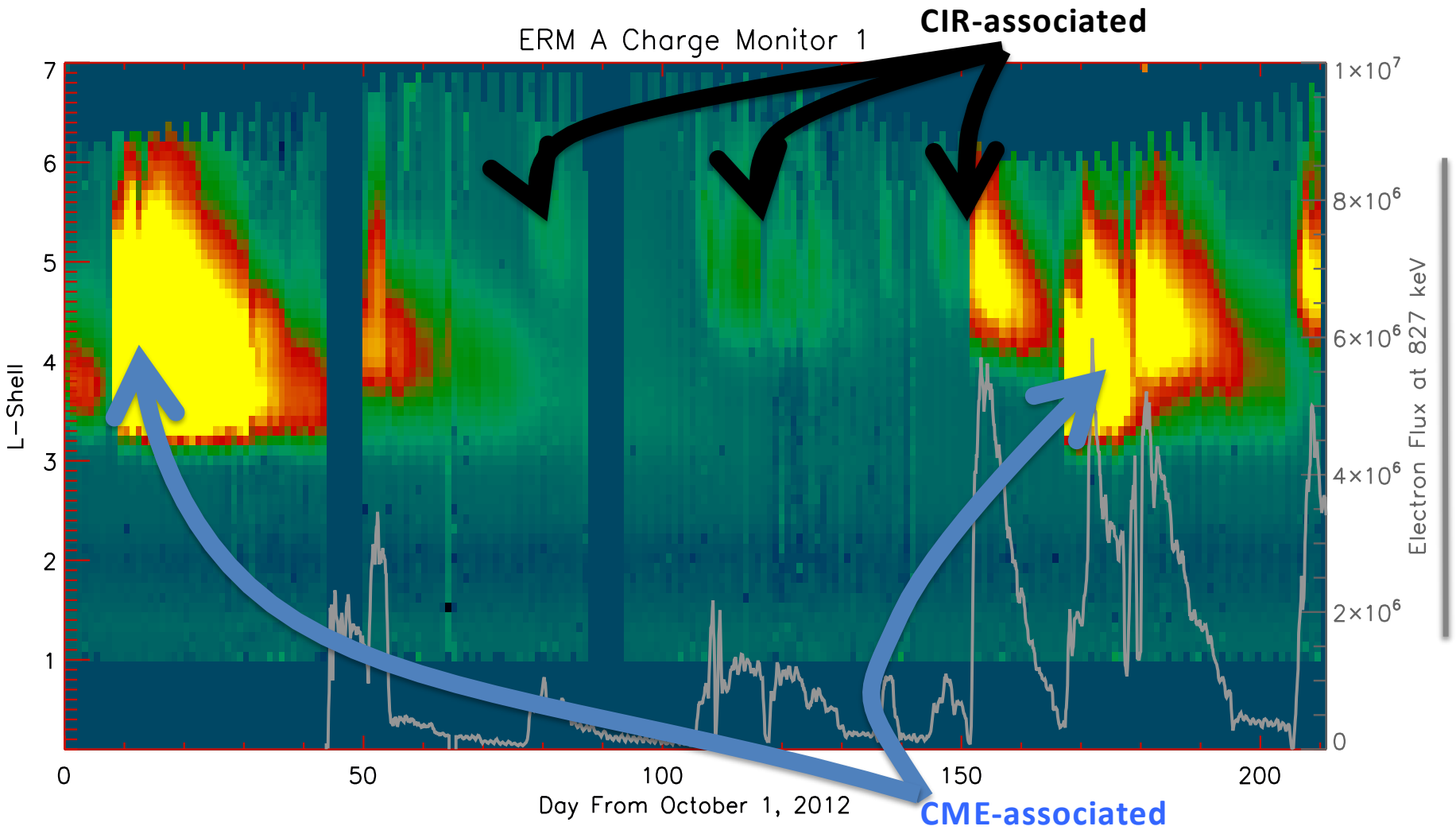
Oct 2012 – Dec 2017

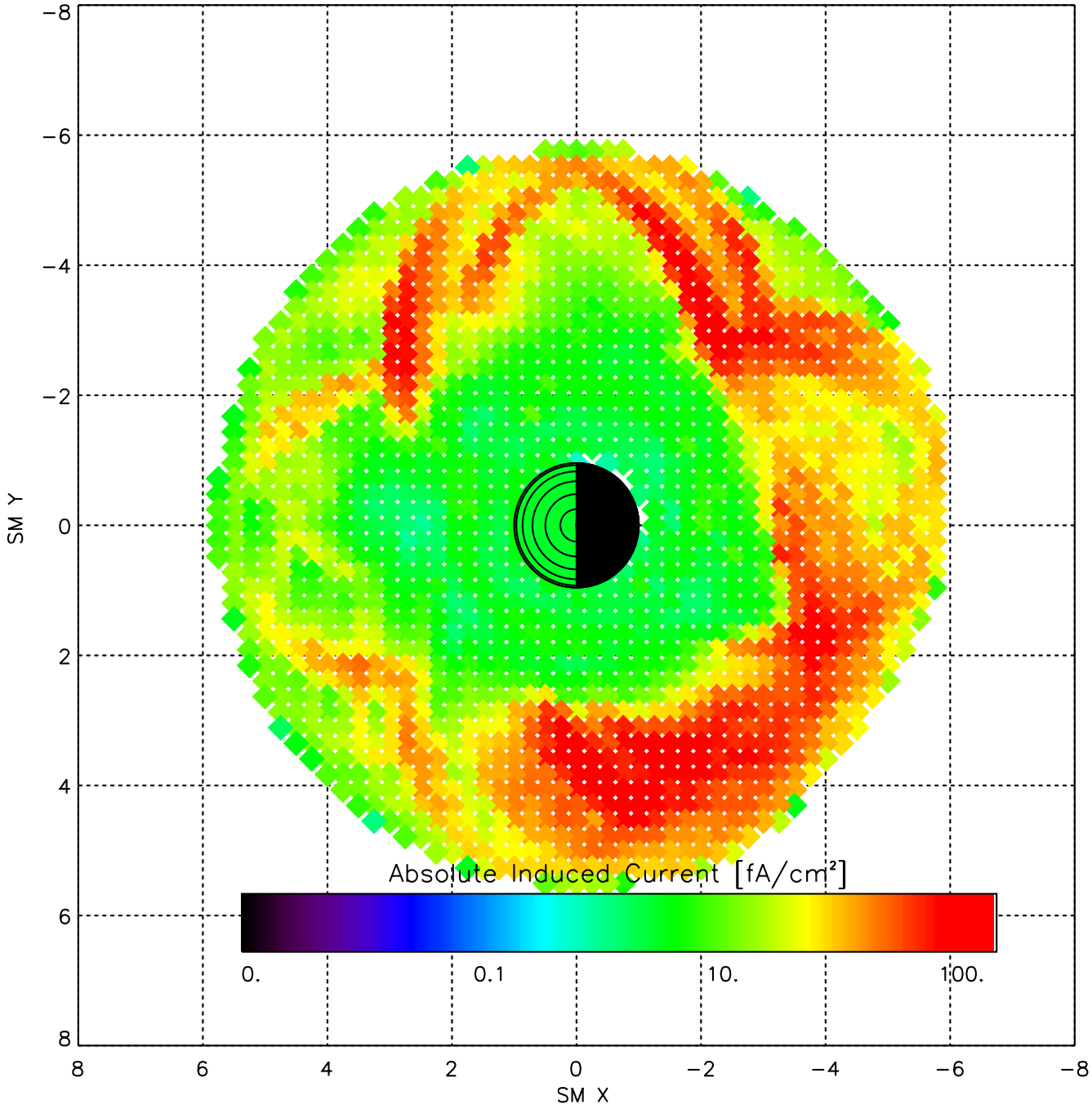


CM1 and CM2, each 38-mm in diameter and under different thicknesses of aluminum (1-mm and 3.8-mm, respectively).

CMs detect penetrating electrons of >0.7-MeV and >2.0-MeV, respectively, and protons of >15-MeV and >30-MeV, respectively.

Zoom of Previous Data: Interior Spacecraft Charging of the Van Allen Probes in Relation to Transient Interplanetary Structures

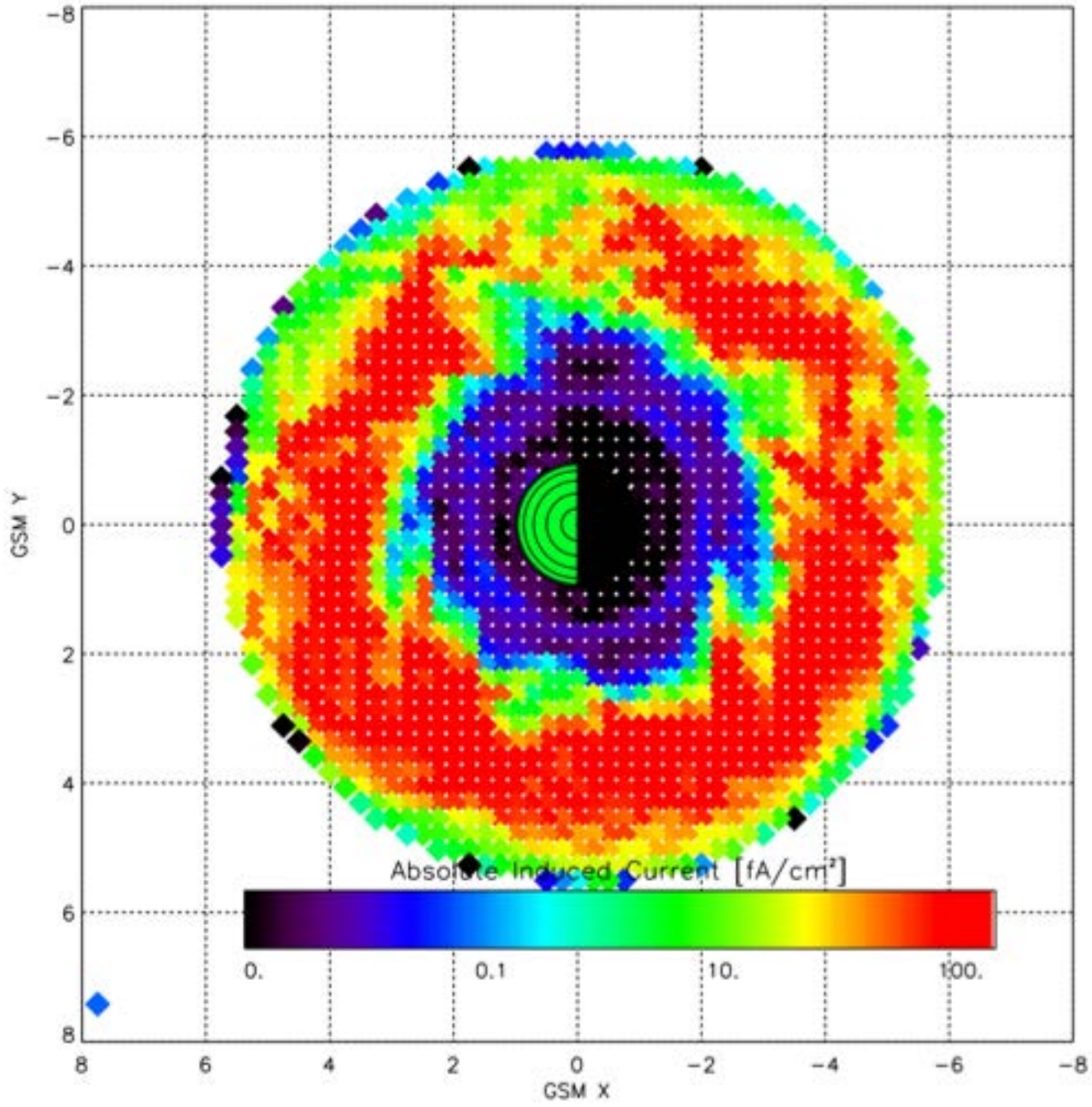




First Full Orbit

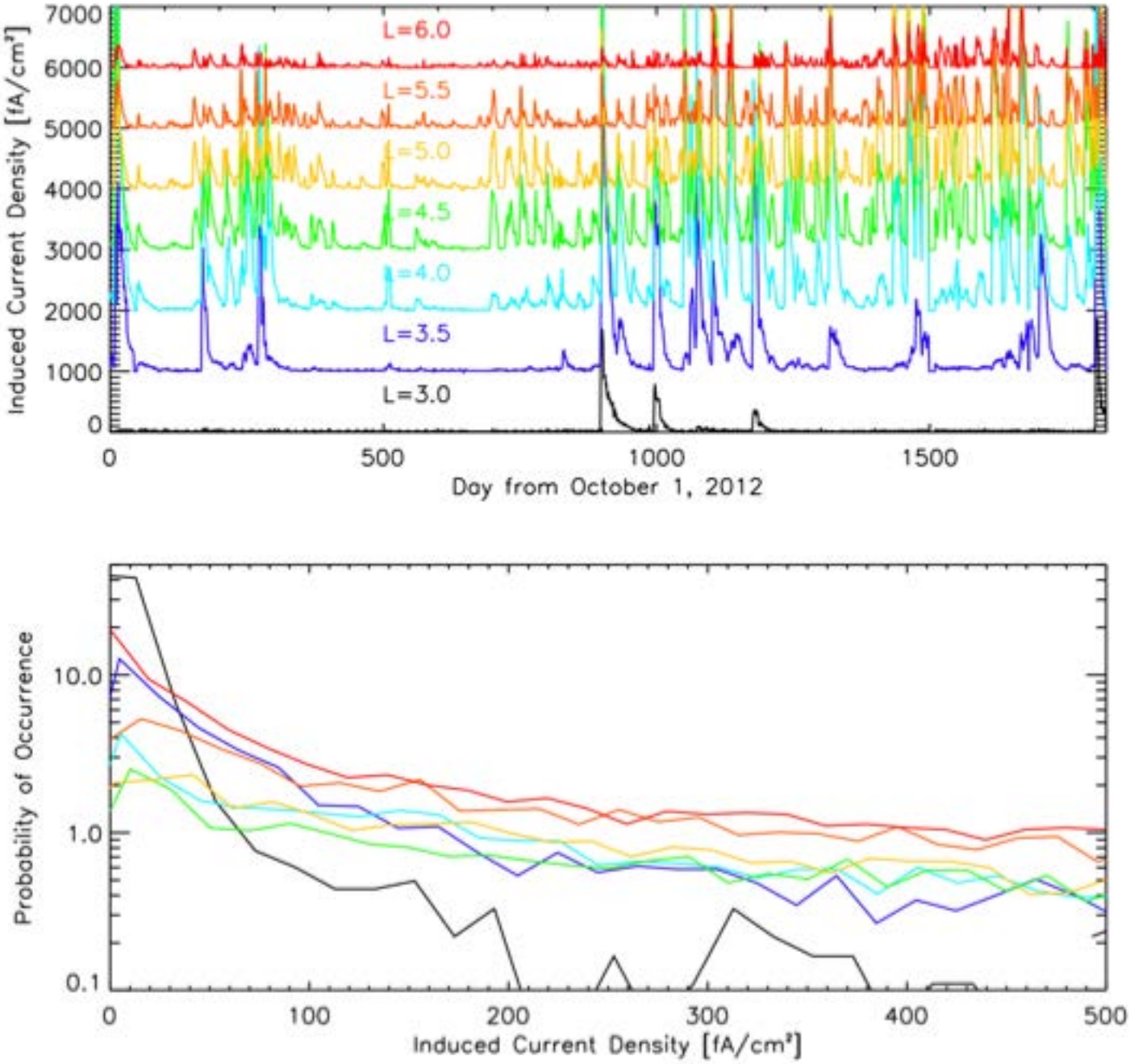
Oct 2012 – Aug 2014

- Persistent "background charging" of ~6-fA/cm^2
- Reduction of charging in the slot region

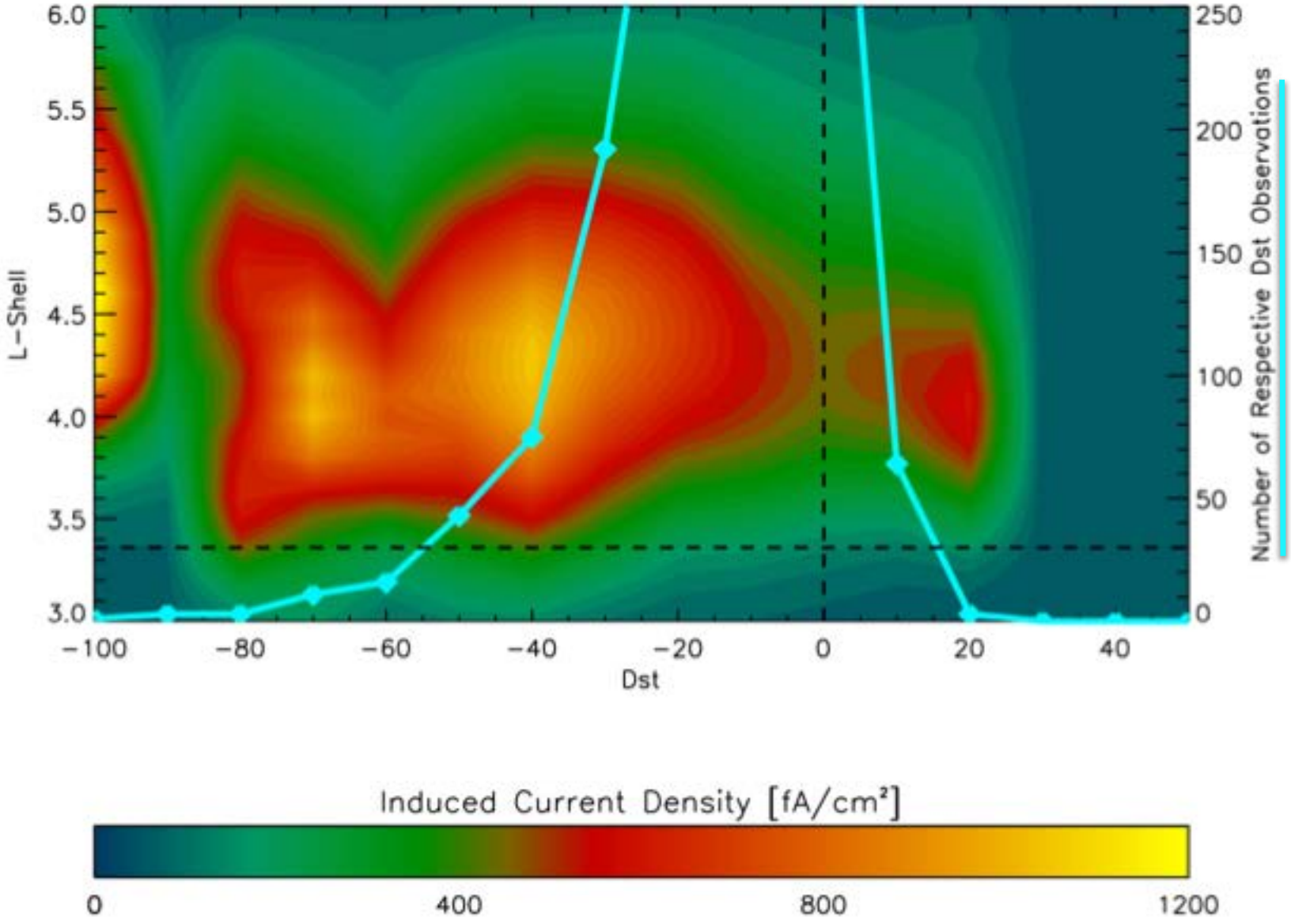


Full ERM Data

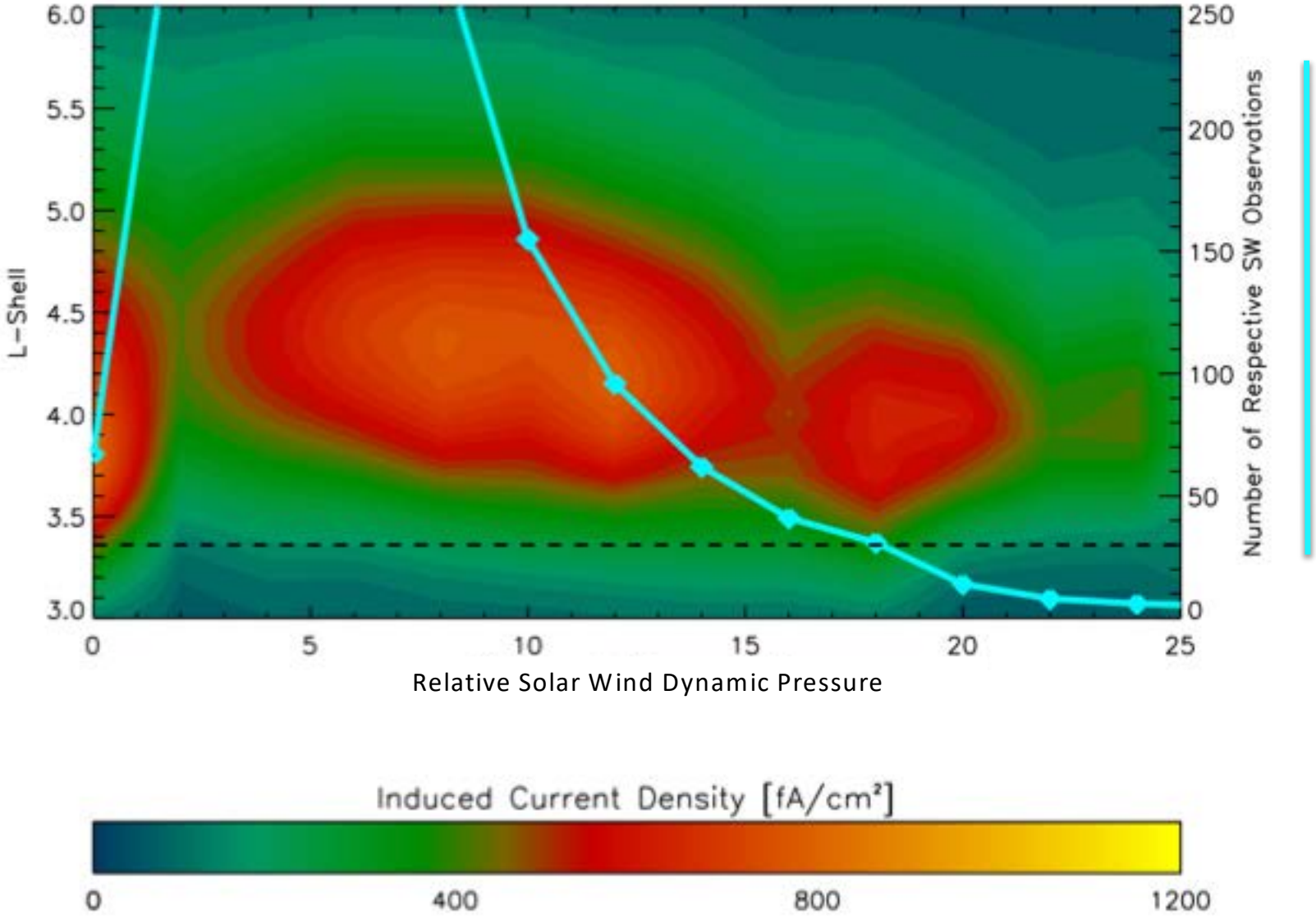
Oct 2012 – Dec 2017


Induced Current Density [fA/cm³]
7000
6000
5000
4000
3000
2000
1000
0
L=6.0
L=5.5
L=5.0
L=4.5
L=4.0
L=3.5
L=3.0
0
500
1000
1500
Day from October 1, 2012
Probability of Occurrence
10.0
1.0
0.1
0
100
200
300
400
500
Induced Current Density [fA/cm²]

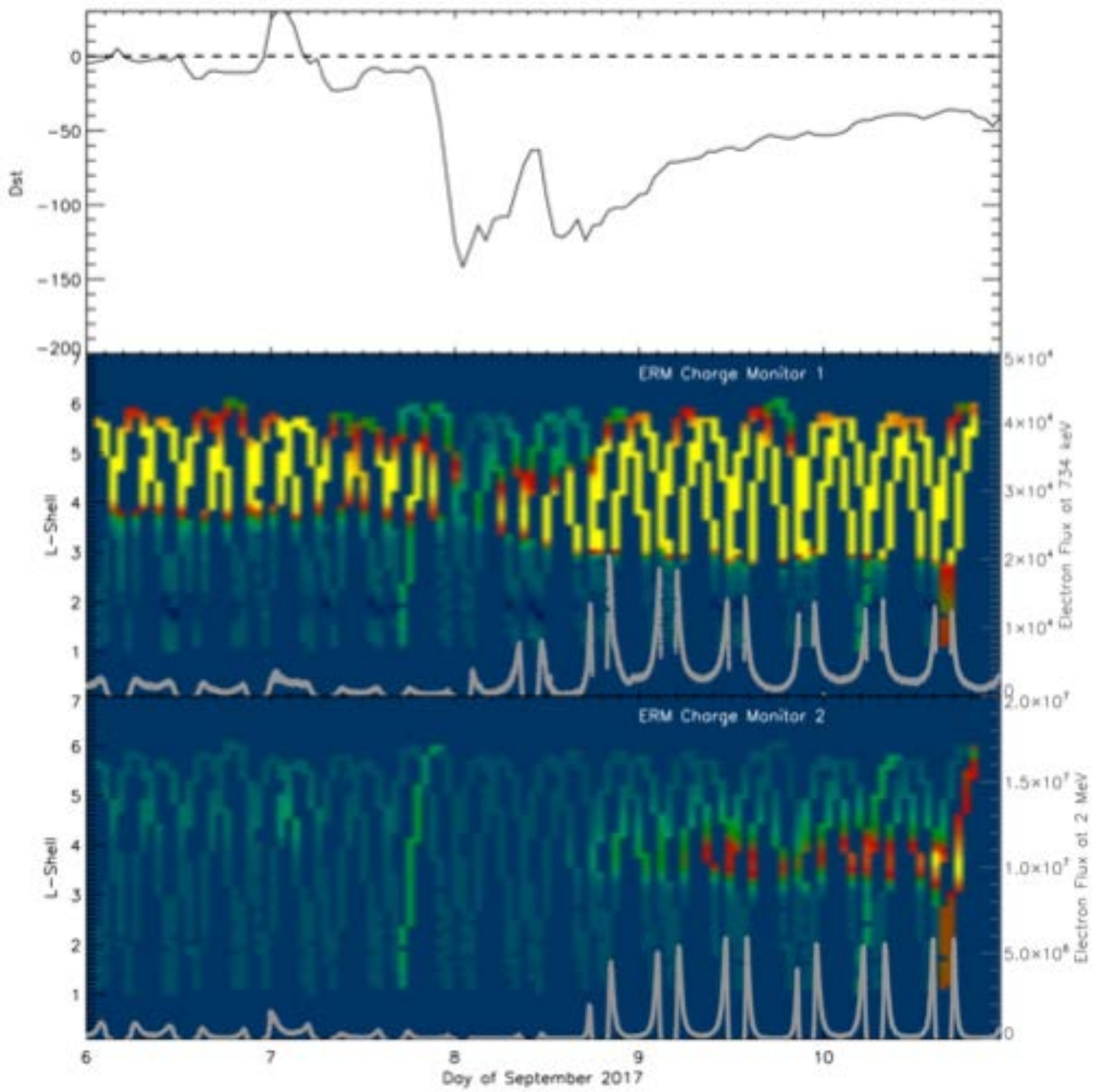
Dst as a Nowcast of Charging



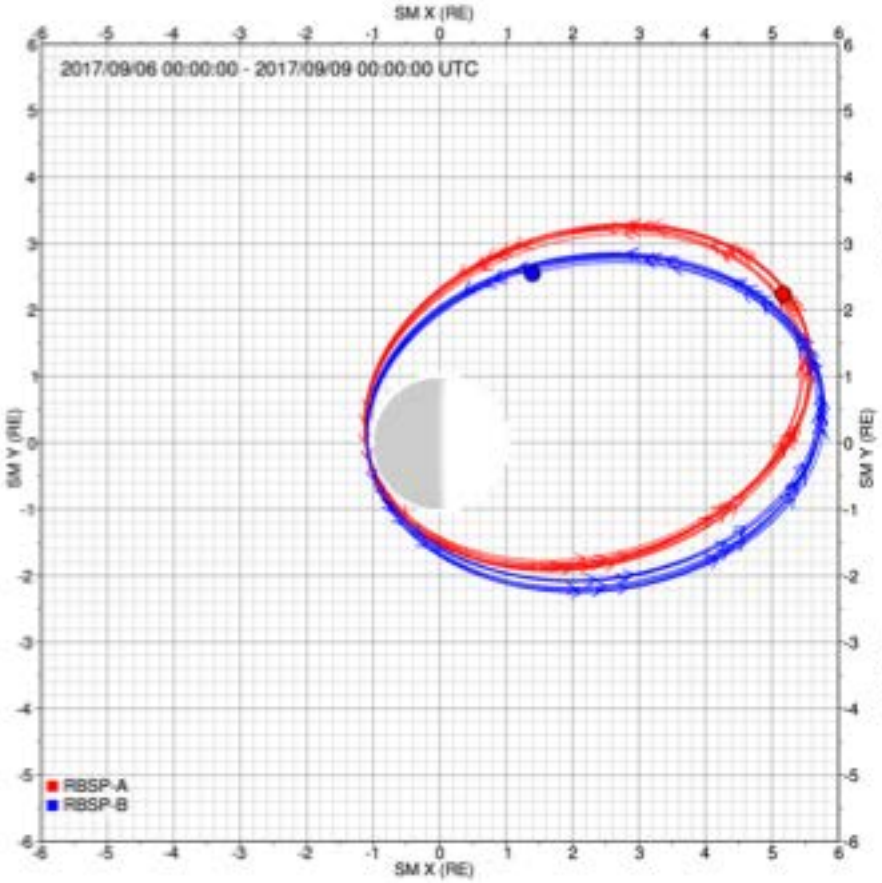
Solar Wind Dynamic Pressure as a Predictor of Charging

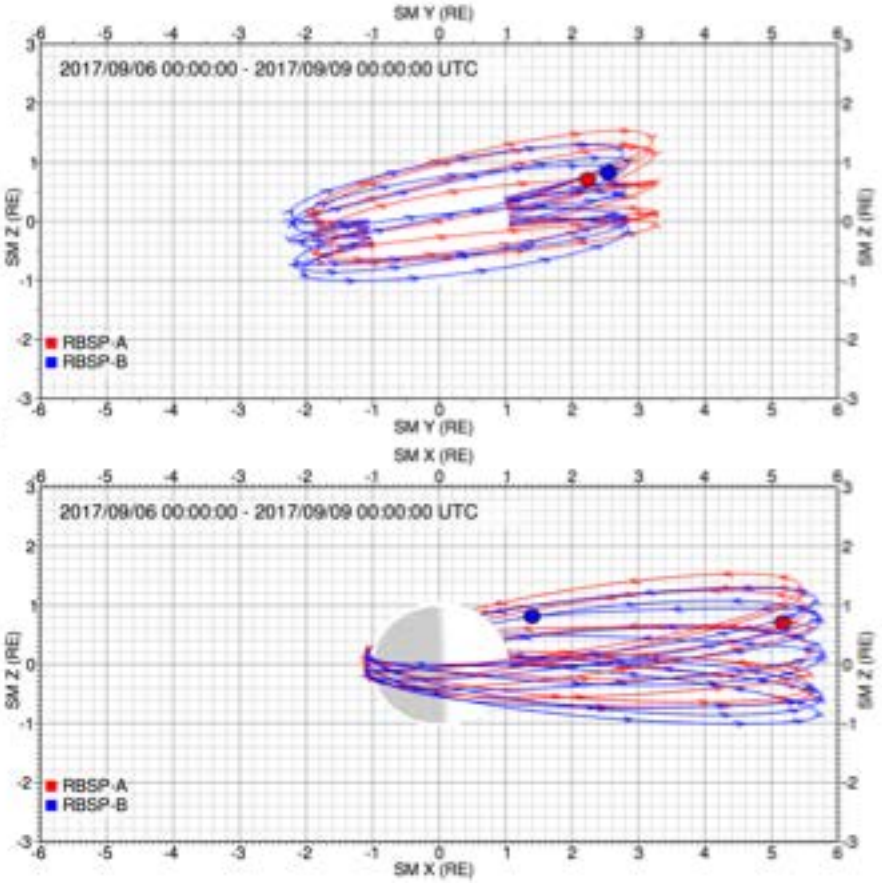


Synoptics (September 2017 Storm)



Synoptics (September 2017 Storm)





Conclusions

- Non-scientific satellites, such as commercial or national defense, normally do not carry instrumentation that provide data on the radiation environmental conditions in which the
- spacecraft are flying.

- The flight of scientific instrumentation, such as the RBSPICE and REPT instrumentation, can be costly.

- This work demonstrates that simple, low cost and low impact charge monitors can provide synoptic space weather measurements and some science results.

- Such information can give 1) real time monitoring of the radiation environment around a satellite, and 2) be used for real-time or post facto anomaly analyses.

- Considerable consideration should be made to incorporate such monitoring packages on future spacecraft.