



AeroCube-6: Microbursts and the Fine Structure of Electron Precipitation

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AC6 Key Features

Two 0.5U Cubesats

LEO Polar orbit 600-700km

Separation controlled by differential drag

Separation GPS measured to 10 meters



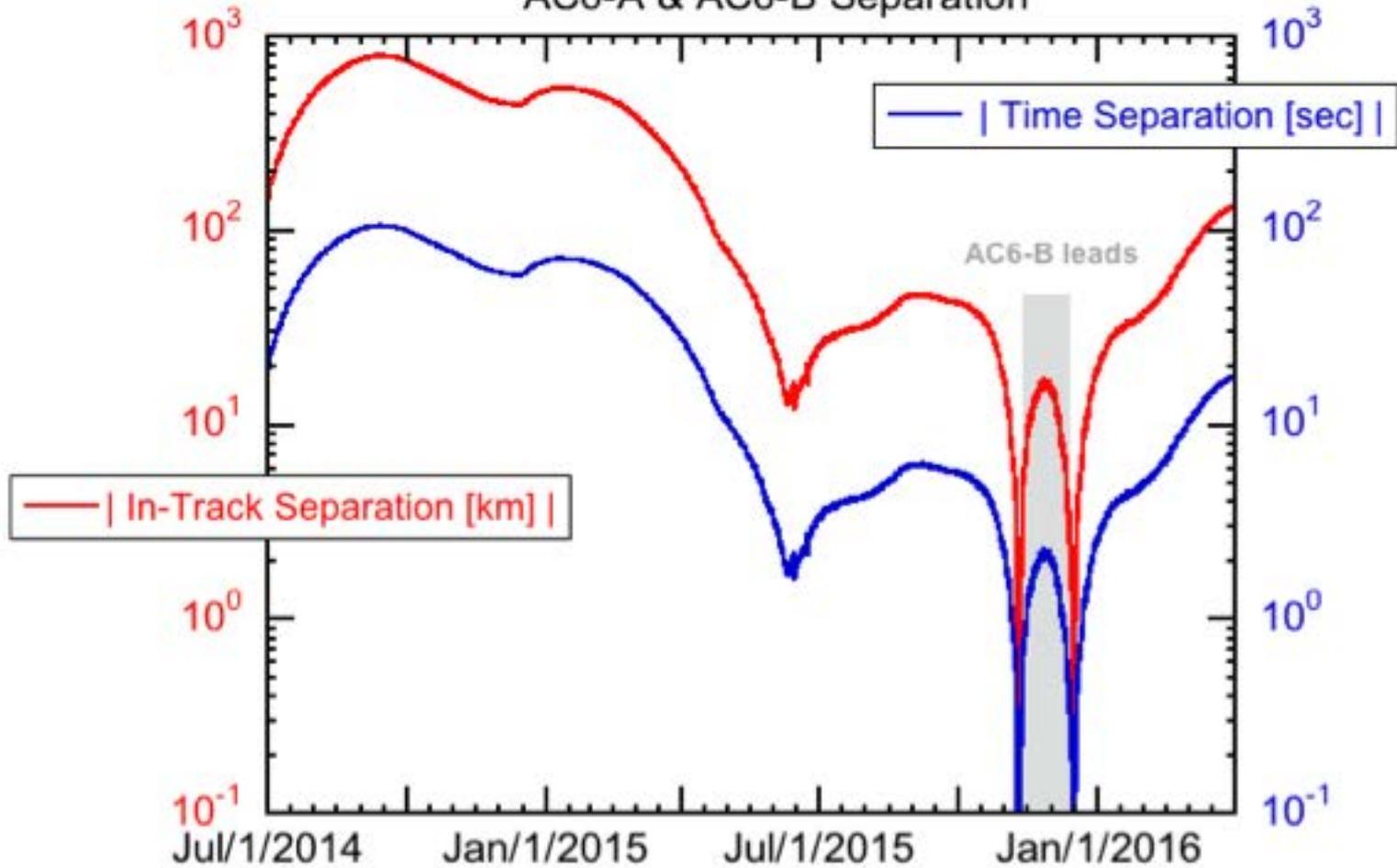


AC6 Dosimeters

- The sensors, being dosimeters, measure the dose deposited in the silicon sensors, and not particle counts/events
- The channel response is determined by detector size, electronic thresholds, and surrounding passive shielding.
 - *Dos1* $e > 35 \text{ keV}$
 - *Dos2* $p > 300 \text{ keV}$
 - *Dos 3 AC6-A*; $e > 1.2 \text{ MeV}$, $p > 18 \text{ MeV}$
 - *AC6-B*; $p \text{ } 18 \text{ MeV} - 30 \text{ MeV}$



AC6-A & AC6-B Separation





In This Talk

1. Observations of precipitation curtains
2. Observations made when the two spacecraft were within a few km of each other

Latitude 55.4
Longitude -56.0
MLT 22.7
L 4.71

AC6-A

24

10^3

10Hz

20

Loss_Cone_Type
Lm_IGRF
MLT_IGRF

10^2

12

dos1rate
dos3rate
dos2rate

8

10^1

Bounce Loss Cone

4

0

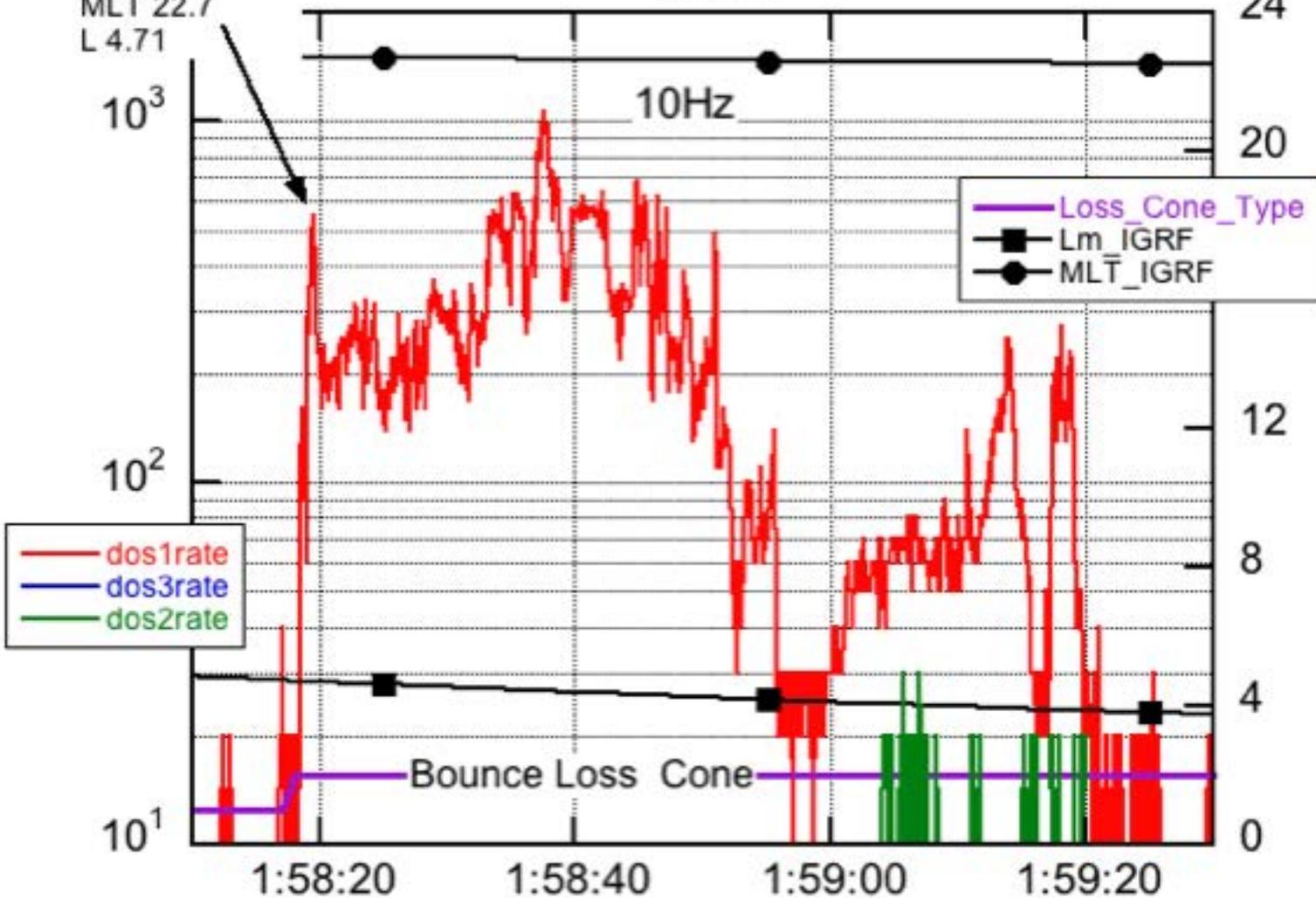
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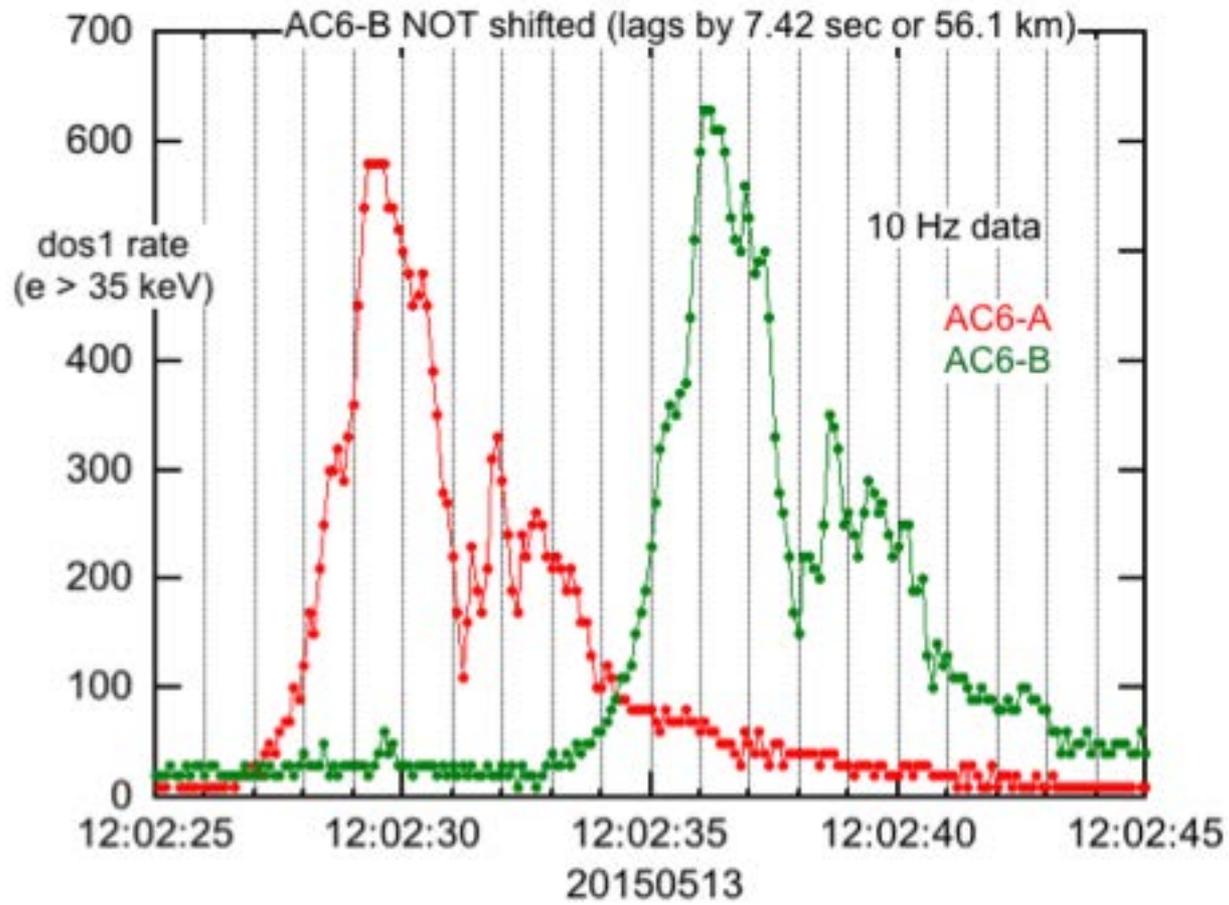
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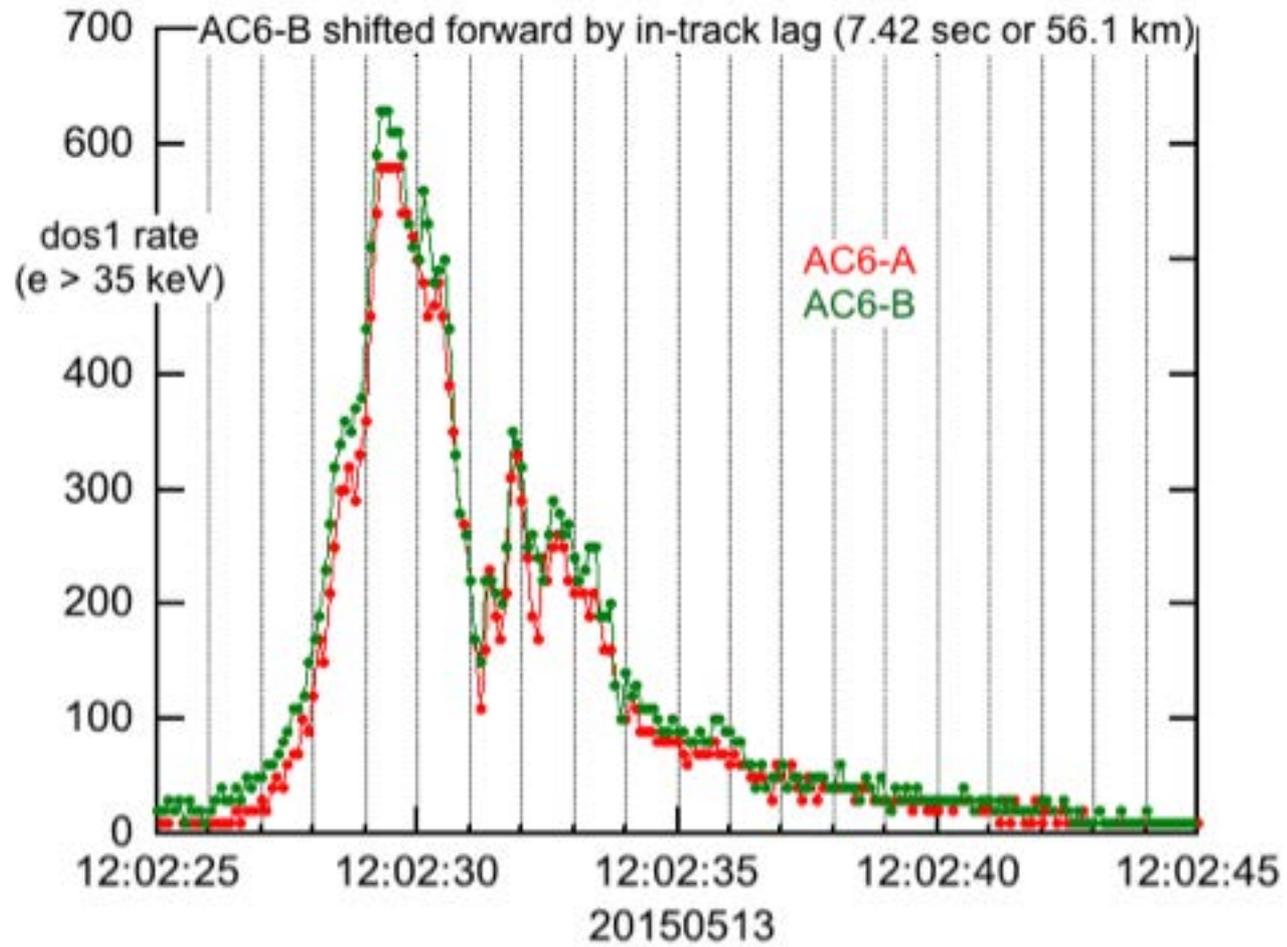
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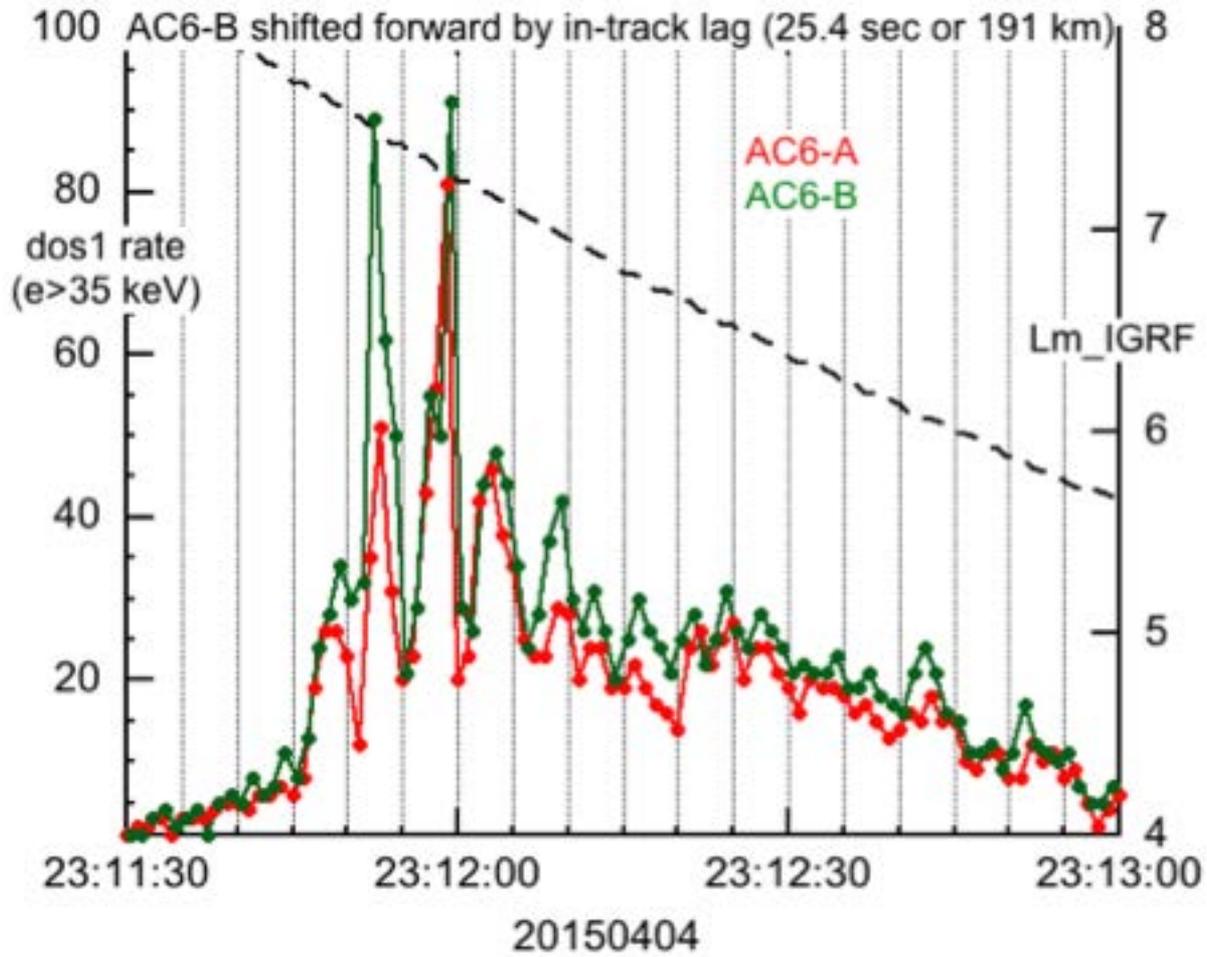
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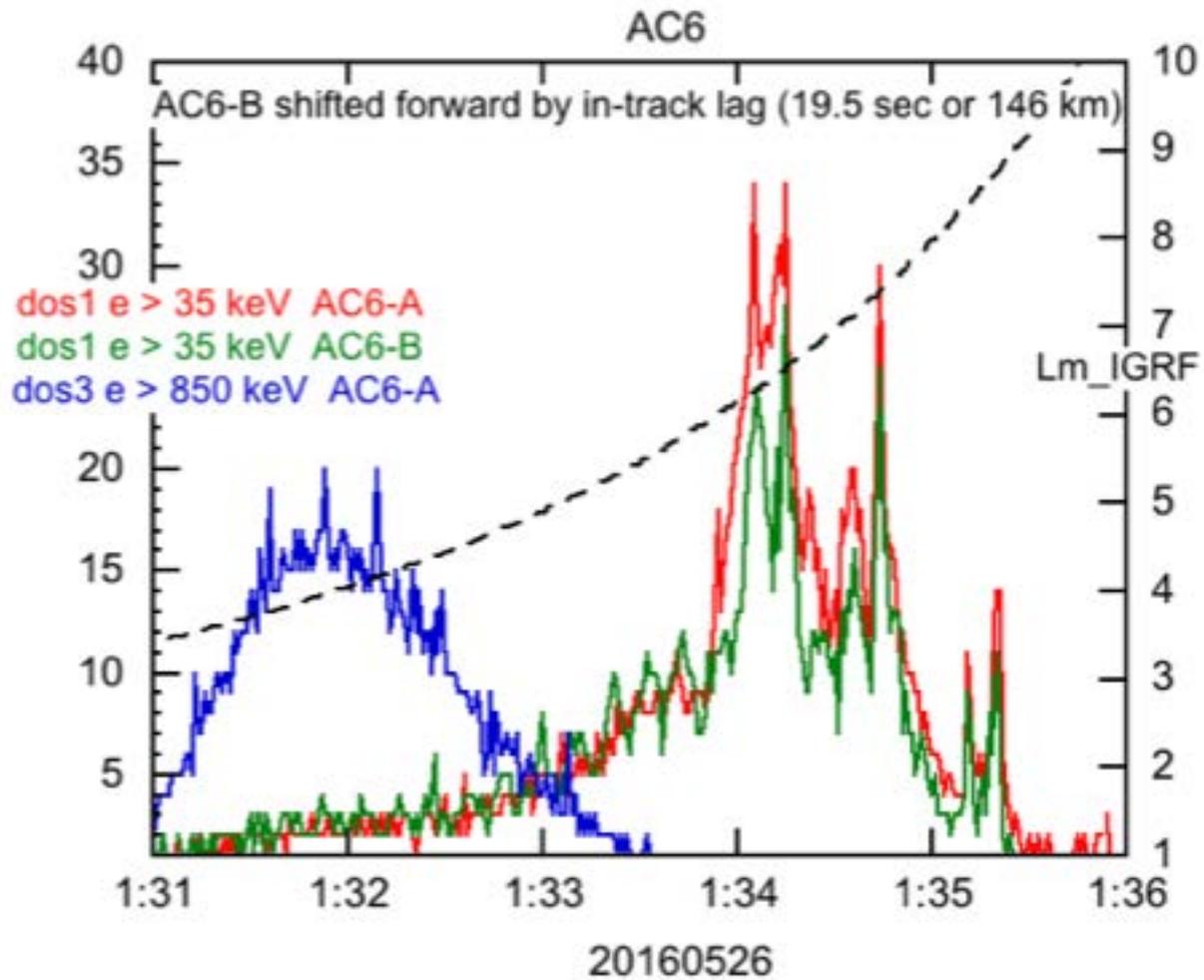
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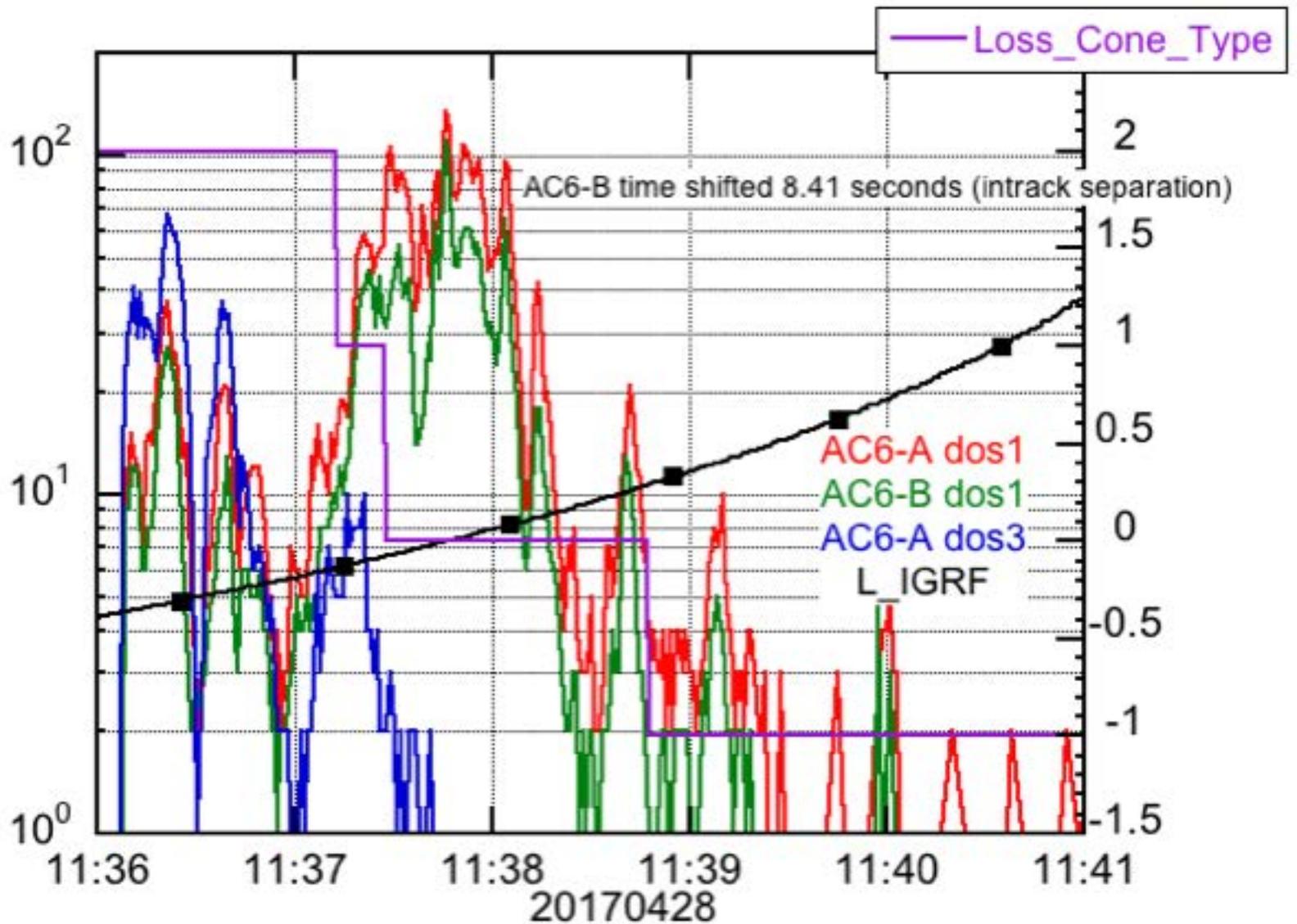


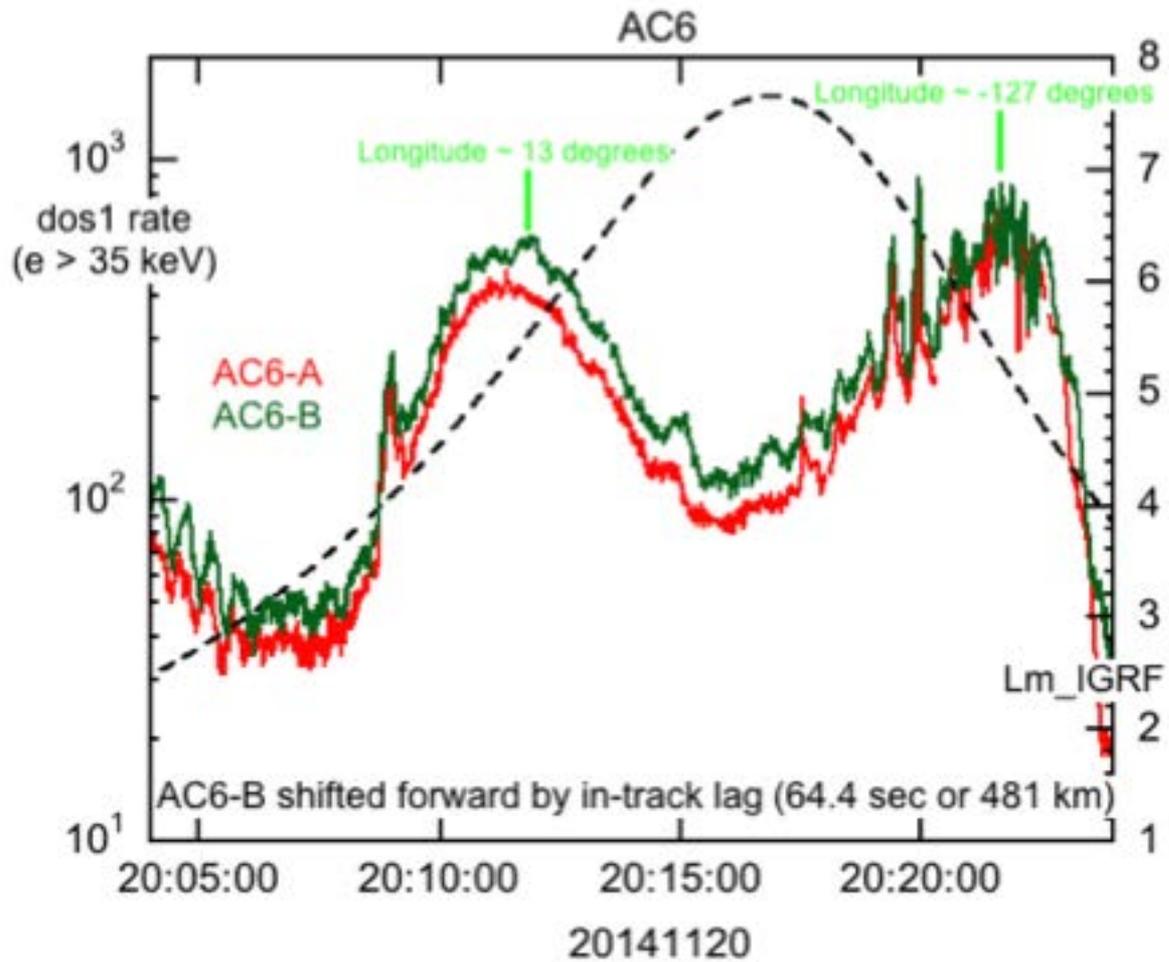


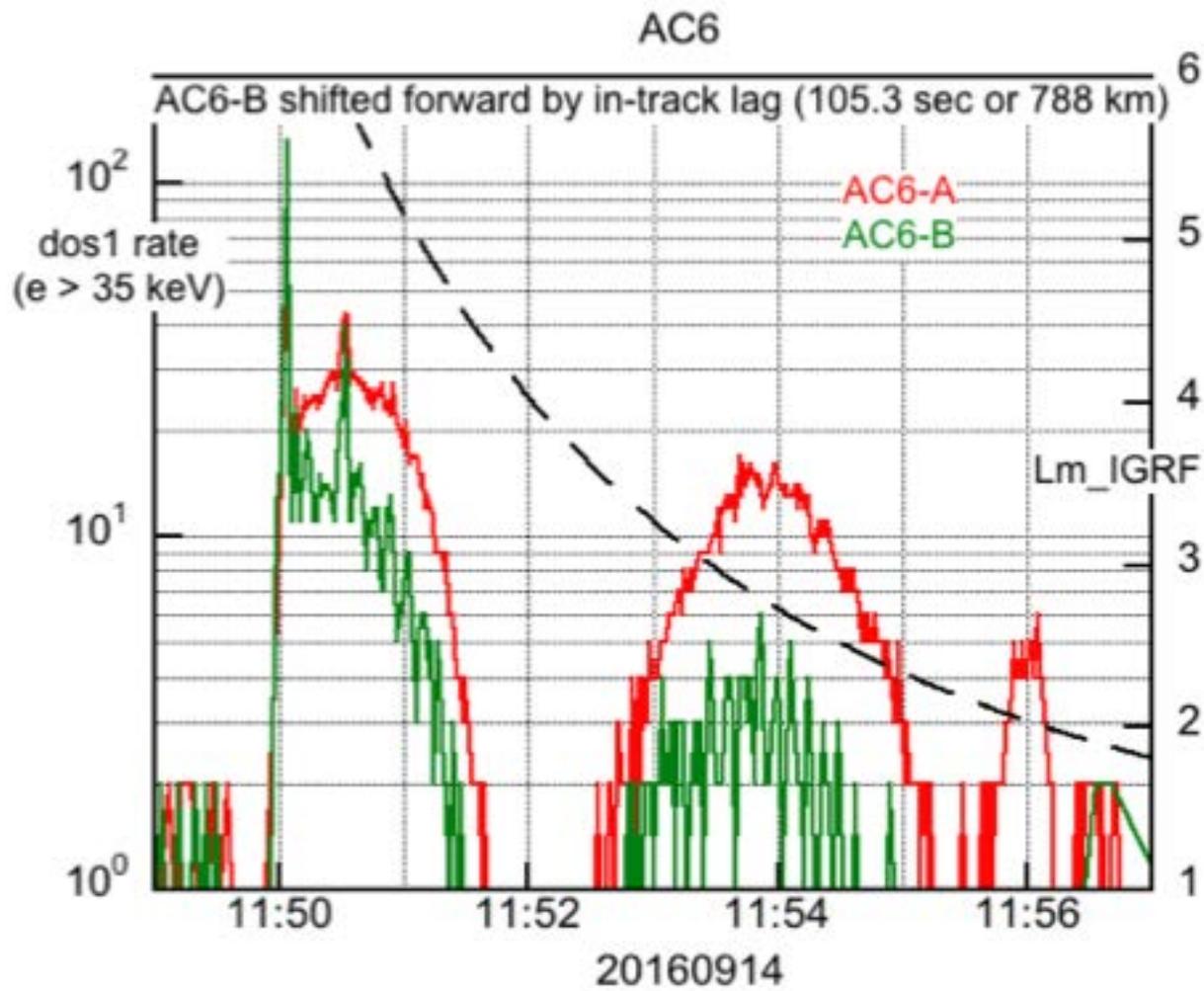














Interpretation

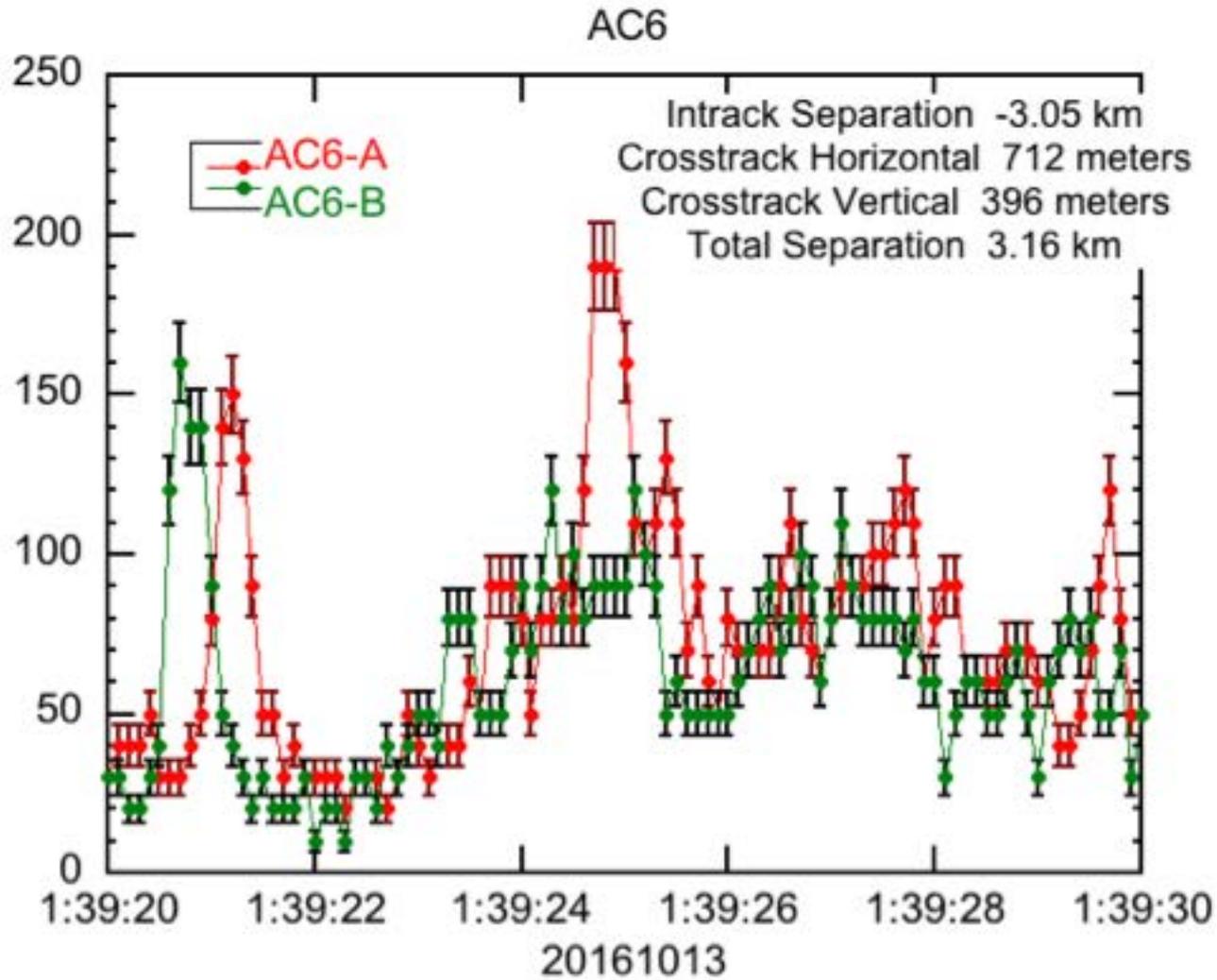
- Wave-particle interactions at high altitude strongly scatter electrons down to LEO altitudes. At LEO altitudes the latitudinal extent of a component of a burst can be only a few km or less
 - *Electrons in the bounce loss cone are lost within seconds*
 - *Electrons in the drift loss cone drift eastwards, often for tens of minutes*
 - *This energy input into the upper atmosphere will be far removed from the scattering longitude*
 - *Electrons in the drift loss cone suffer only Coulomb drag, no other significant scattering*
 - *This process creates latitudinal curtains of electron precipitation that can be seen by sensors aboard LEO satellites*

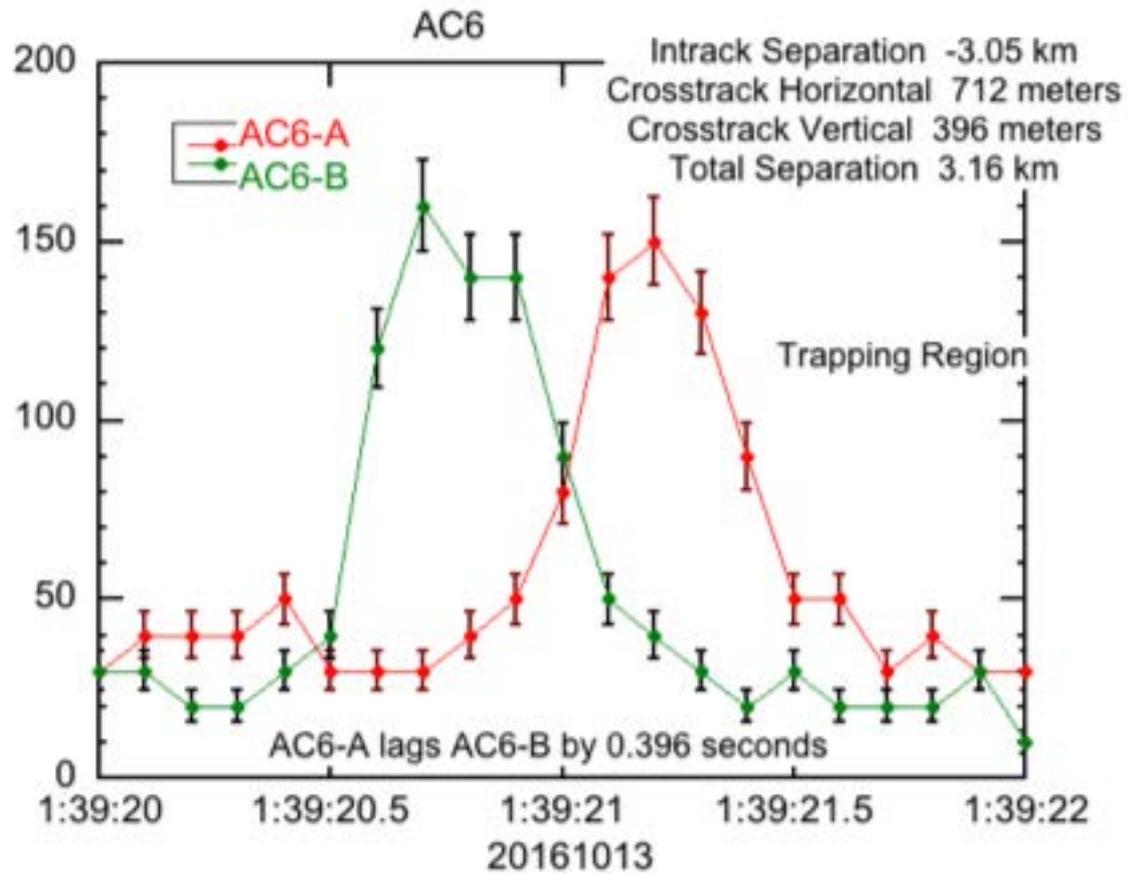


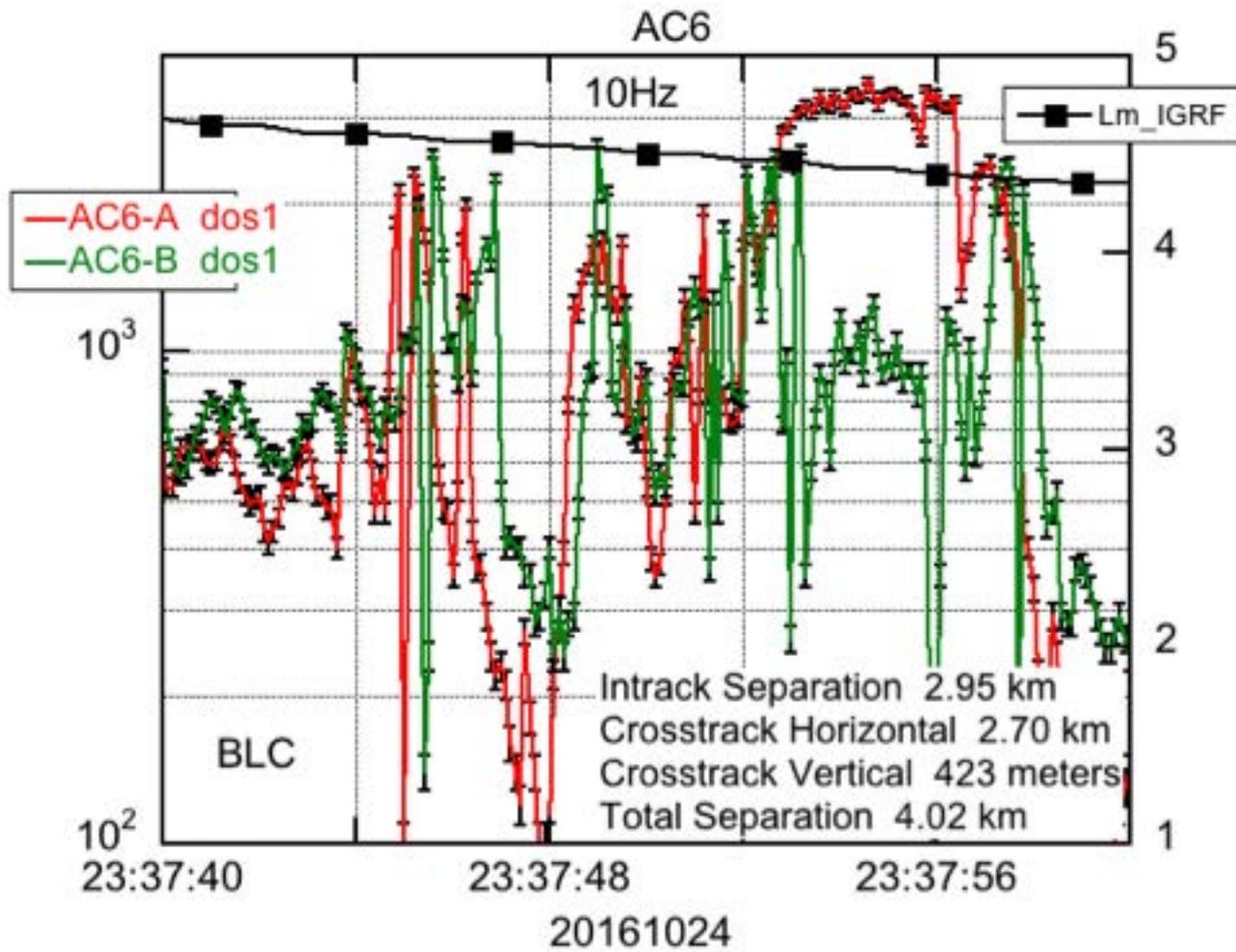
Close Proximity Observations

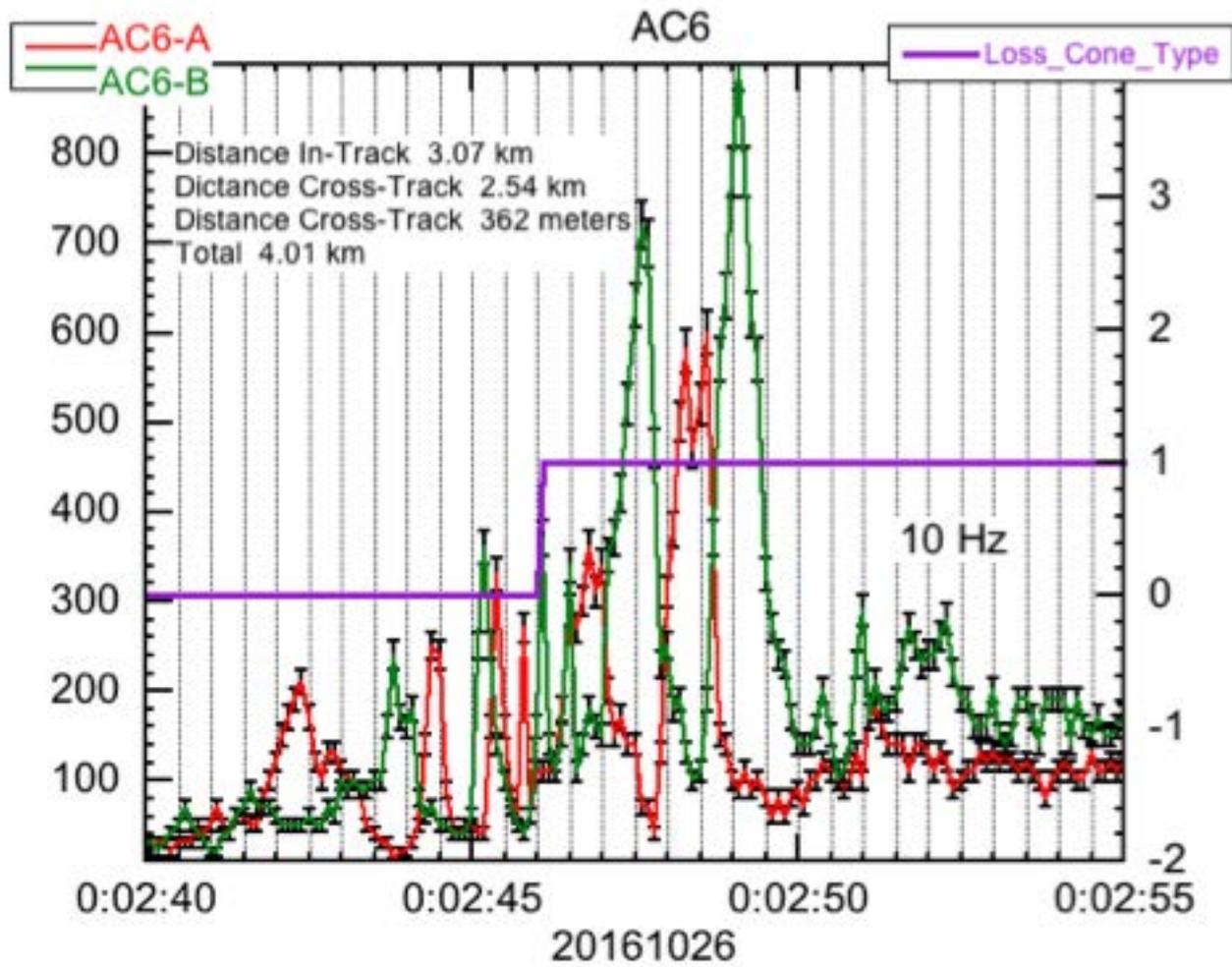
Total separation less than 5 kilometers

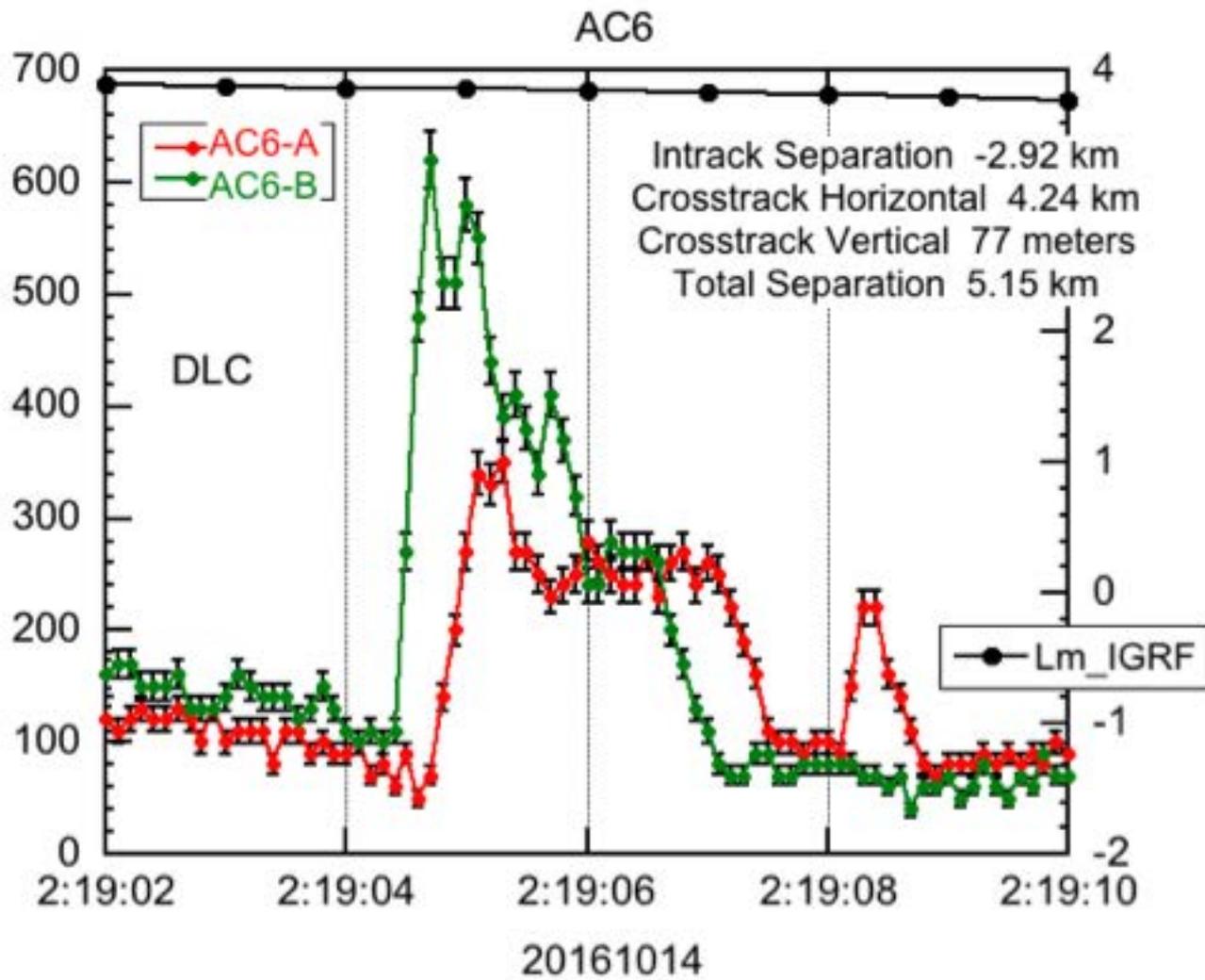
In-track, cross-track horizontal, and cross-track vertical given

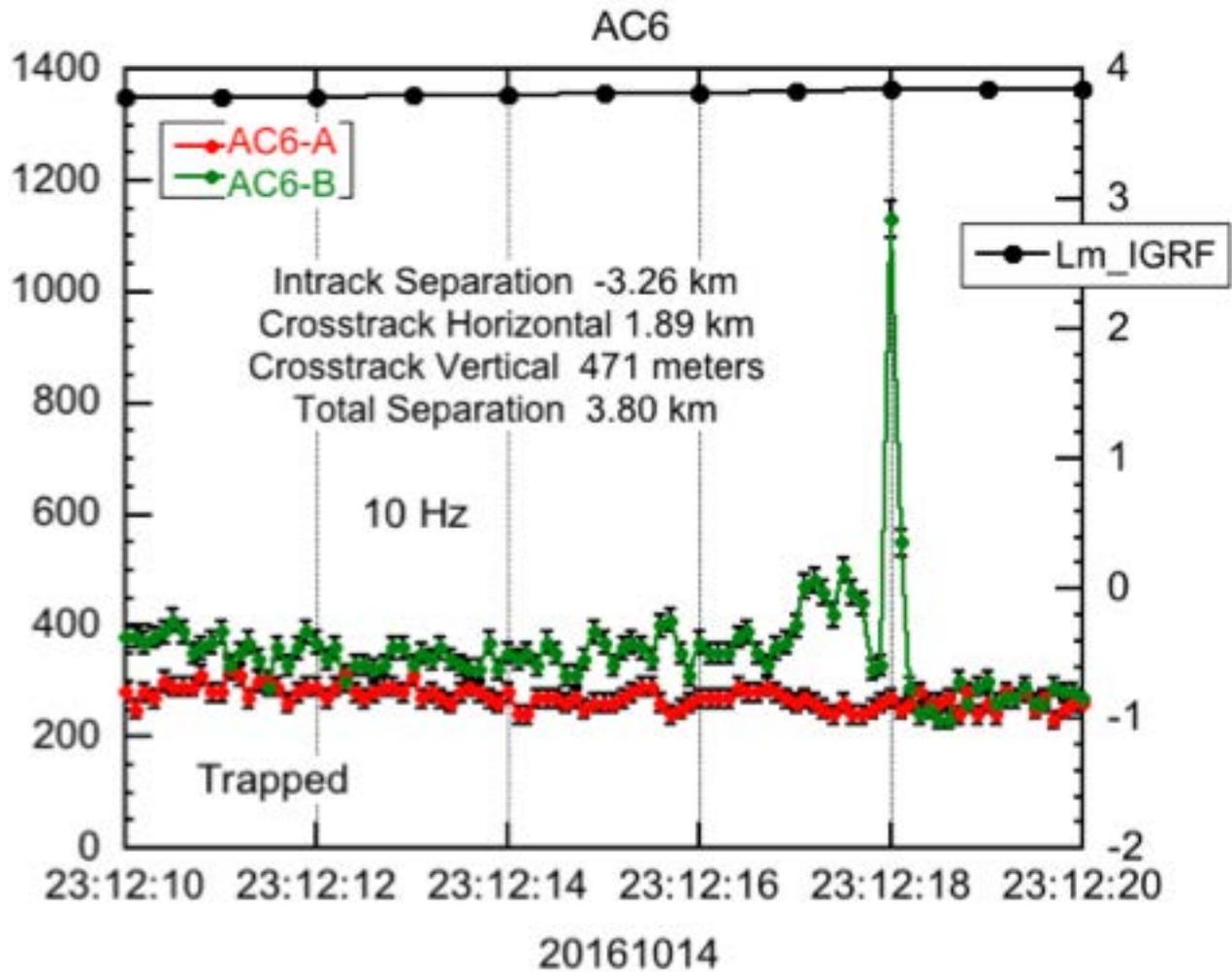


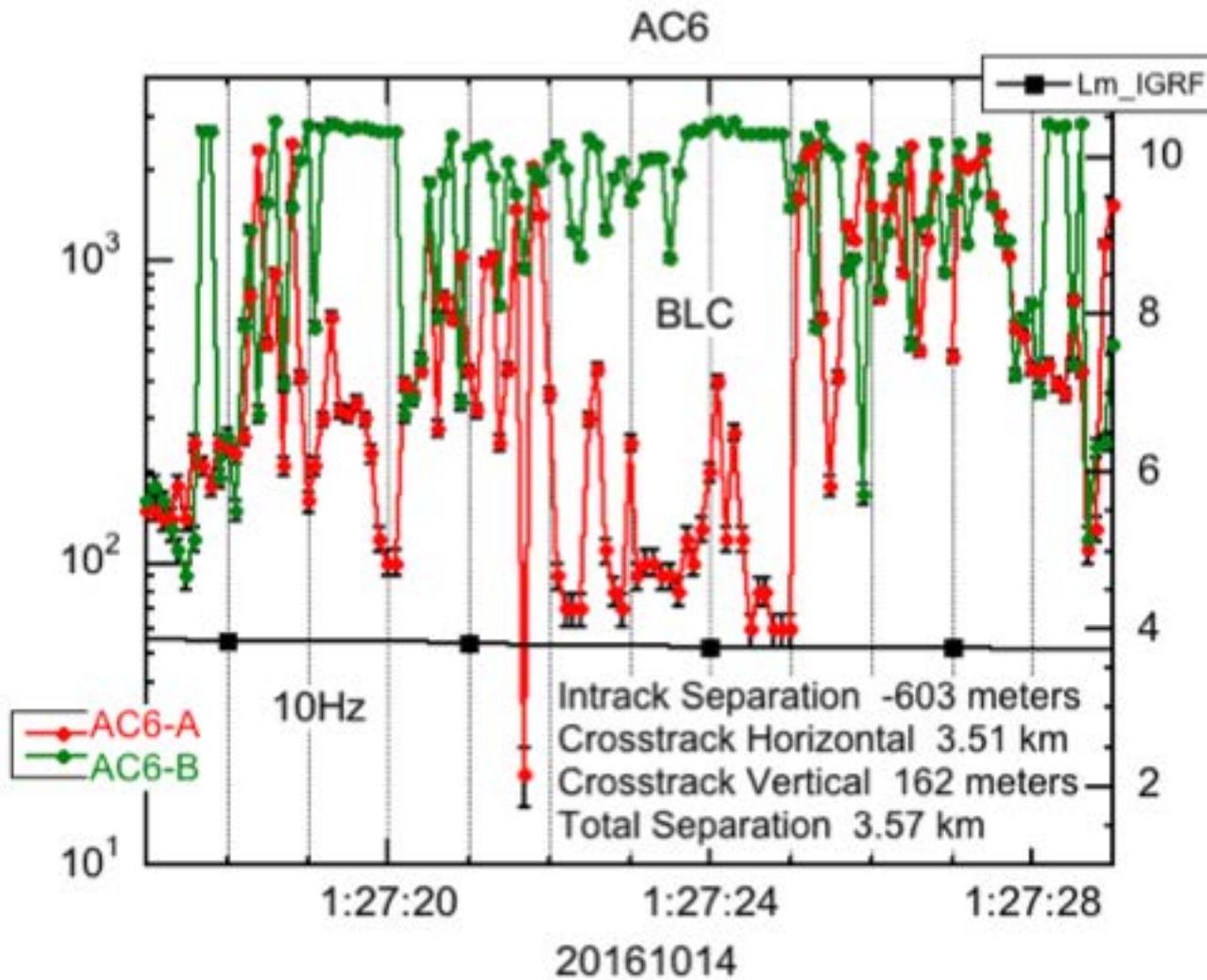


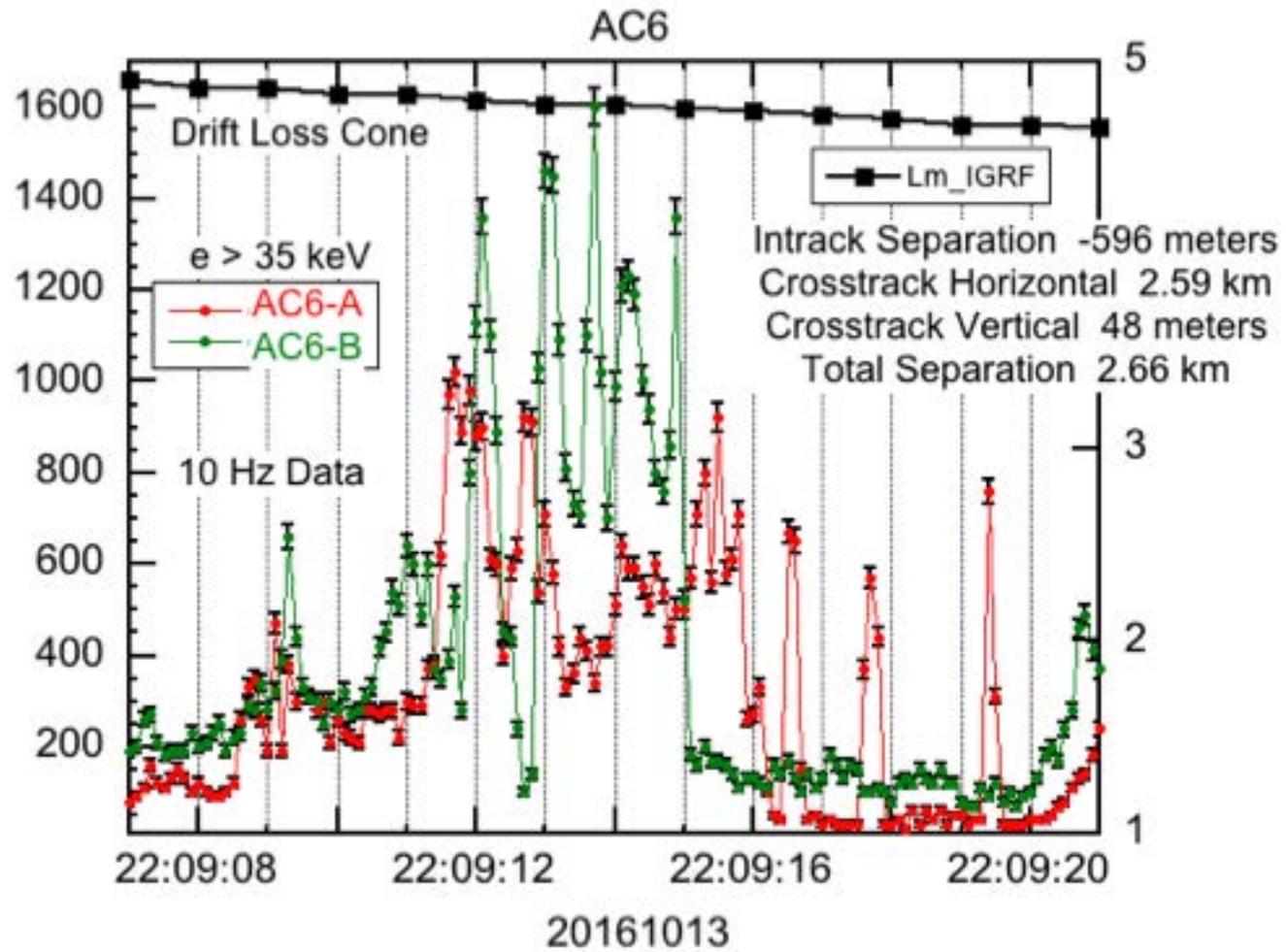


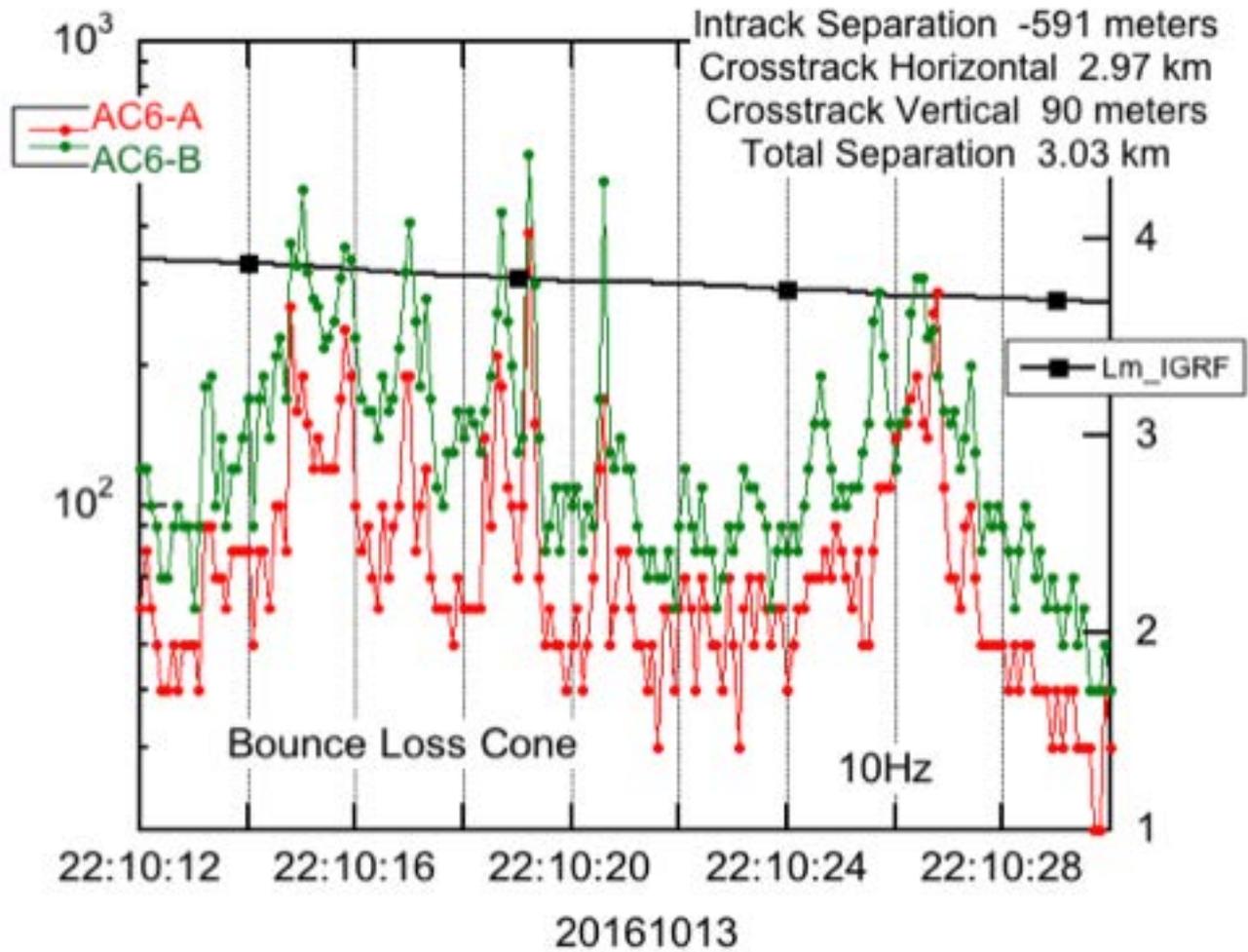


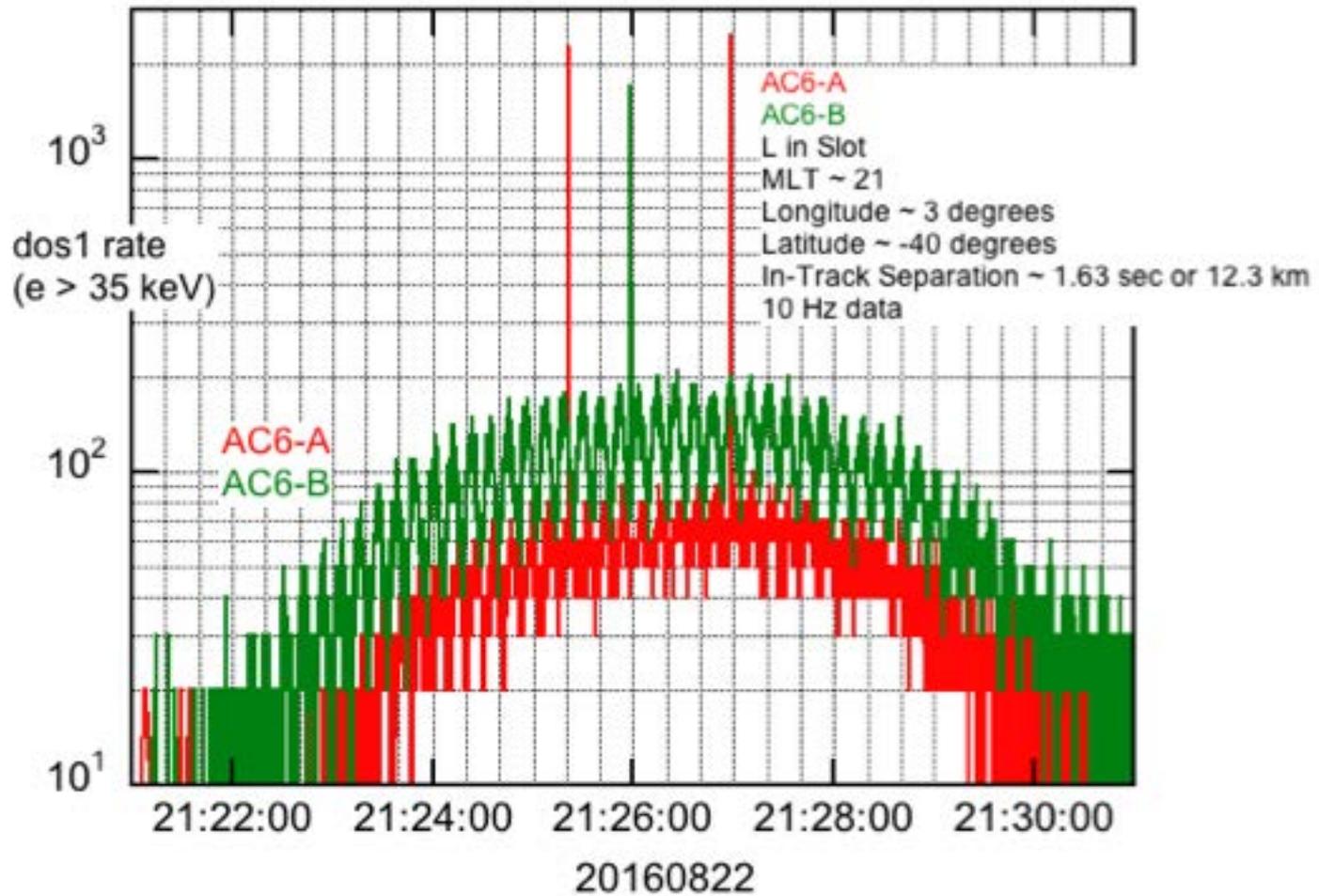












Summary



- AC6 mission has revealed fine spatial structure in bursty precipitated energetic electrons
 - *Several examples shown where separation of the two s/c was no more than 5 km*
 - *Structure is highly variable*
 - *"Quasi-stationary" curtains are a persistent feature*
- CubeSats enabled observations by two closely spaced satellites in a common orbit
 - *A multiple s/c mission probably was prohibitively expensive if employing the usual technology*
- ACX in development: sample at 30Hz to 50Hz with a geometric factor ~100 times larger