

# Auroral emission at Jupiter *through Juno's UVS eyes*

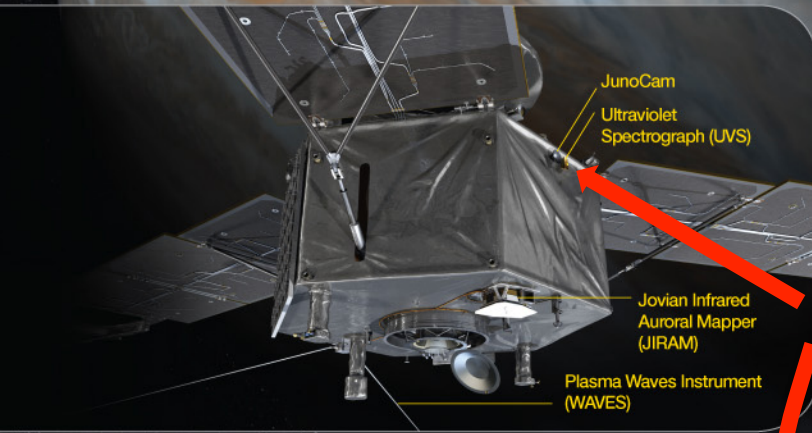
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# Juno Spacecraft



## SPACECRAFT DIMENSIONS

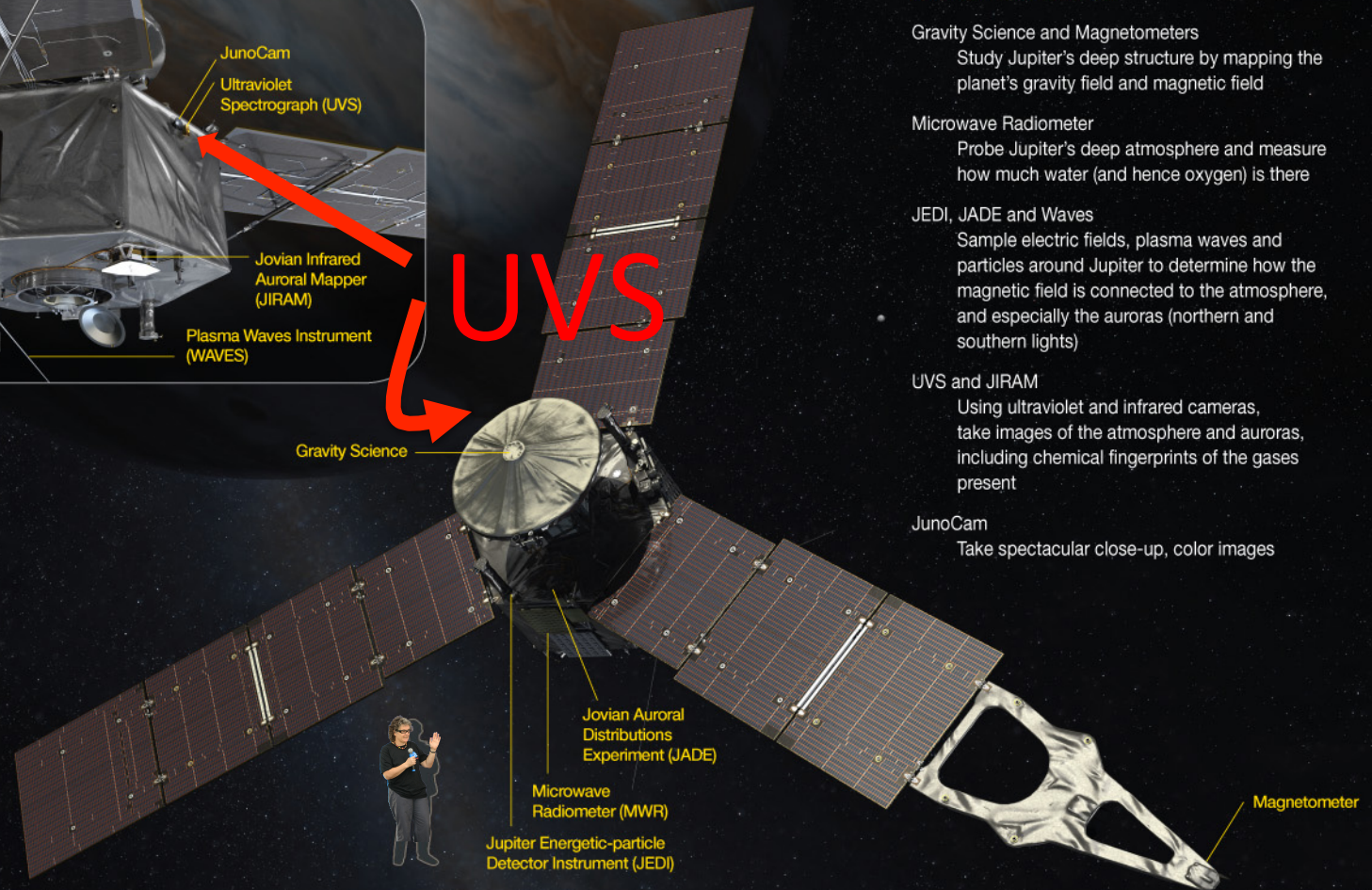
Diameter: 66 feet (20 meters)  
Height: 15 feet (4.5 meters)

For more information:  
[missionjuno.swri.edu](http://missionjuno.swri.edu) &  
[www.nasa.gov/juno](http://www.nasa.gov/juno)

National Aeronautics and Space Administration

Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California

[www.nasa.gov](http://www.nasa.gov)



## Juno's Instruments

### Gravity Science and Magnetometers

Study Jupiter's deep structure by mapping the planet's gravity field and magnetic field

### Microwave Radiometer

Probe Jupiter's deep atmosphere and measure how much water (and hence oxygen) is there

### JEDI, JADE and Waves

Sample electric fields, plasma waves and particles around Jupiter to determine how the magnetic field is connected to the atmosphere, and especially the auroras (northern and southern lights)

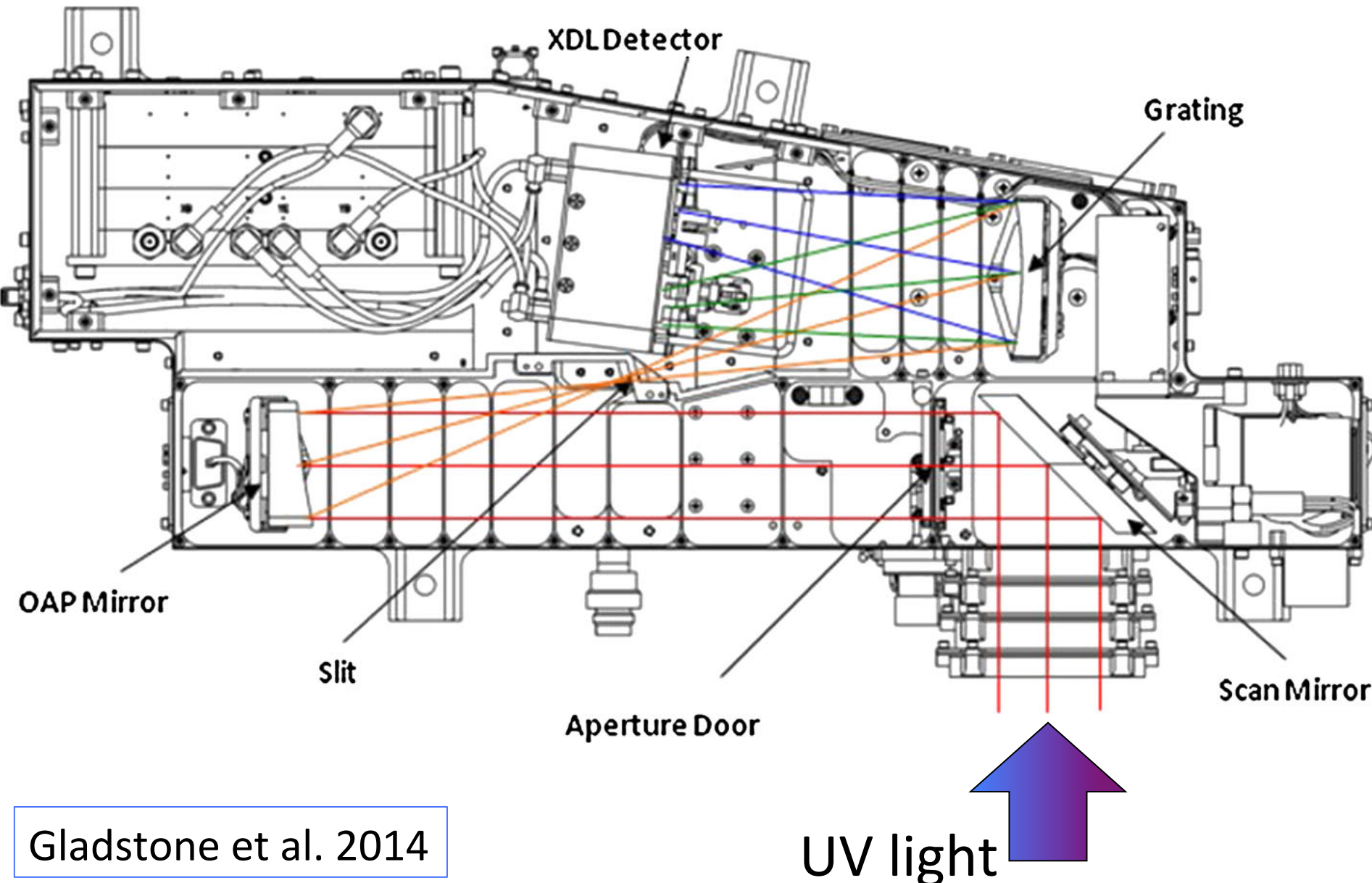
### UVS and JIRAM

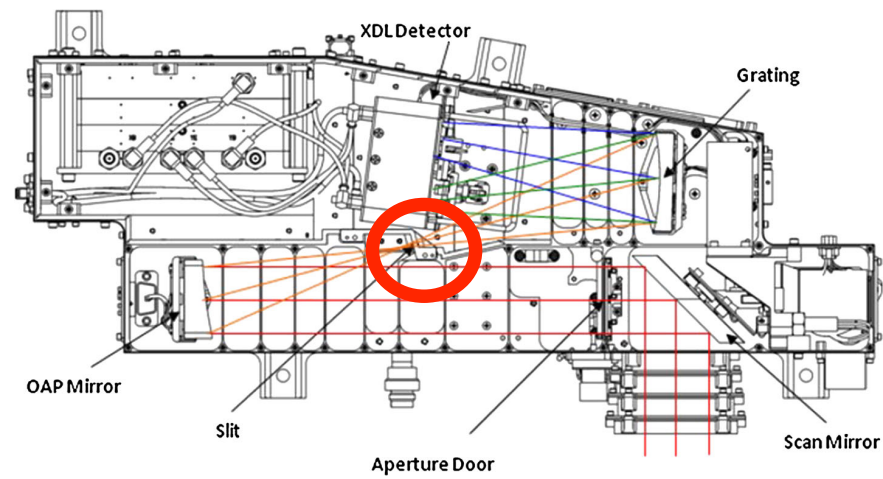
Using ultraviolet and infrared cameras, take images of the atmosphere and auroras, including chemical fingerprints of the gases present

### JunoCam

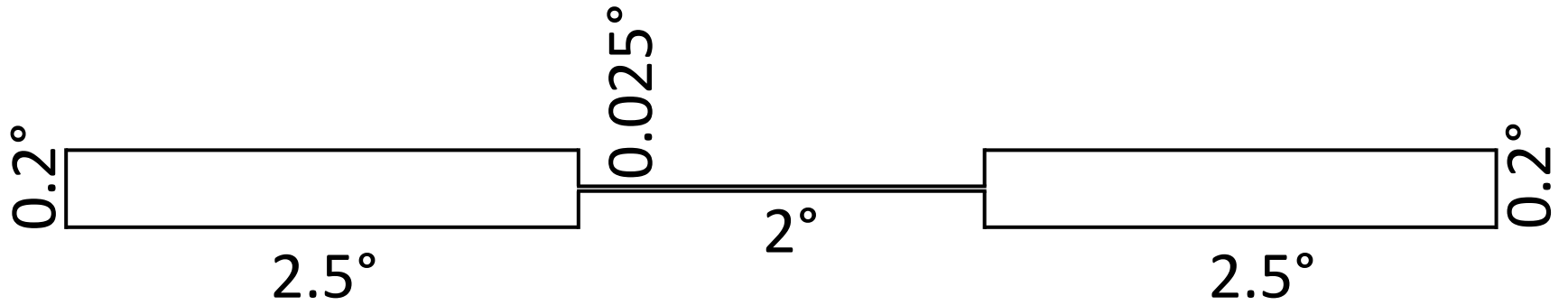
Take spectacular close-up, color images

# Juno UltraViolet Spectrograph UVS (PI: G.R. Gladstone)





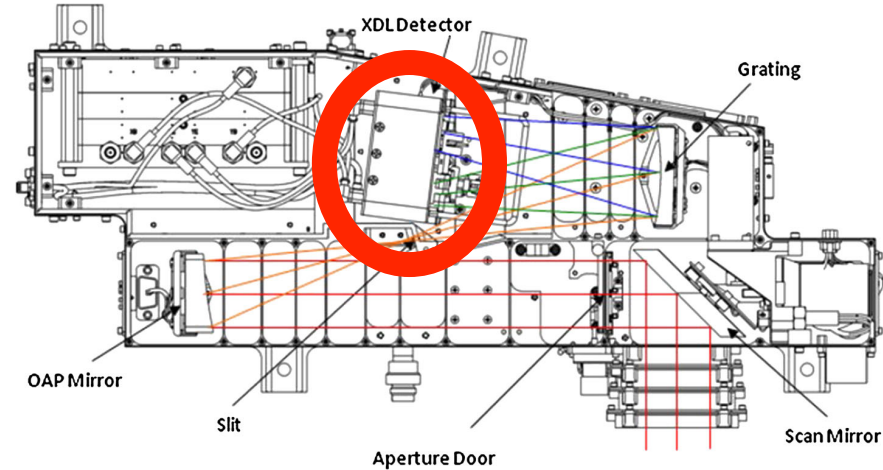
## Dog bone shaped slit



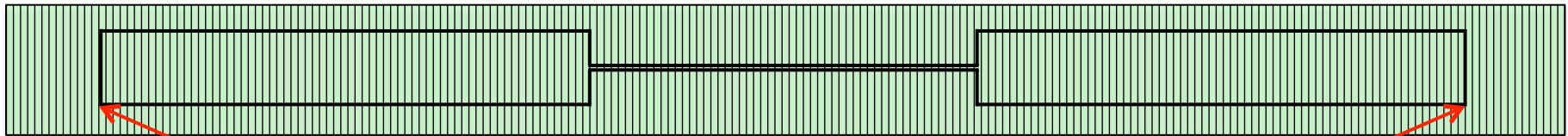
# Slit projected onto XDL MCP detector

256 "pixels" (spatial) / 2048 pixels (spectral)

electronically digitized pixels



<- 256 px ->



higher spatial res.

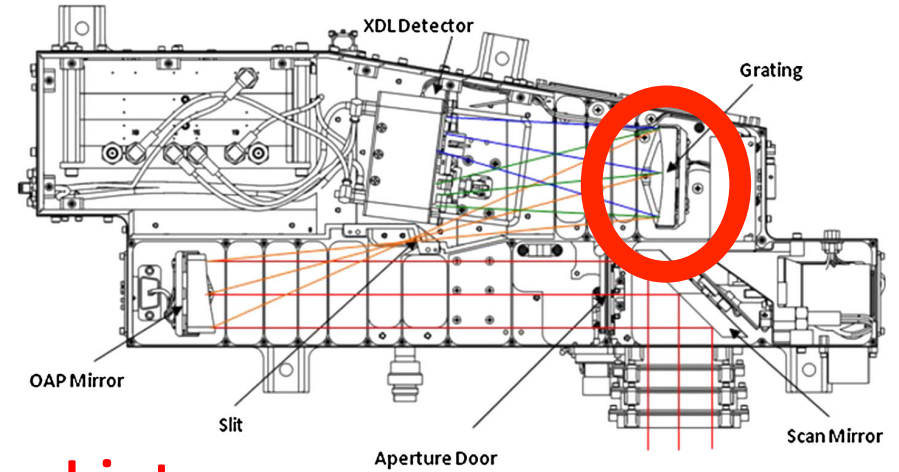
200 illuminated pixels

# Slit projected onto XDL MCP detector

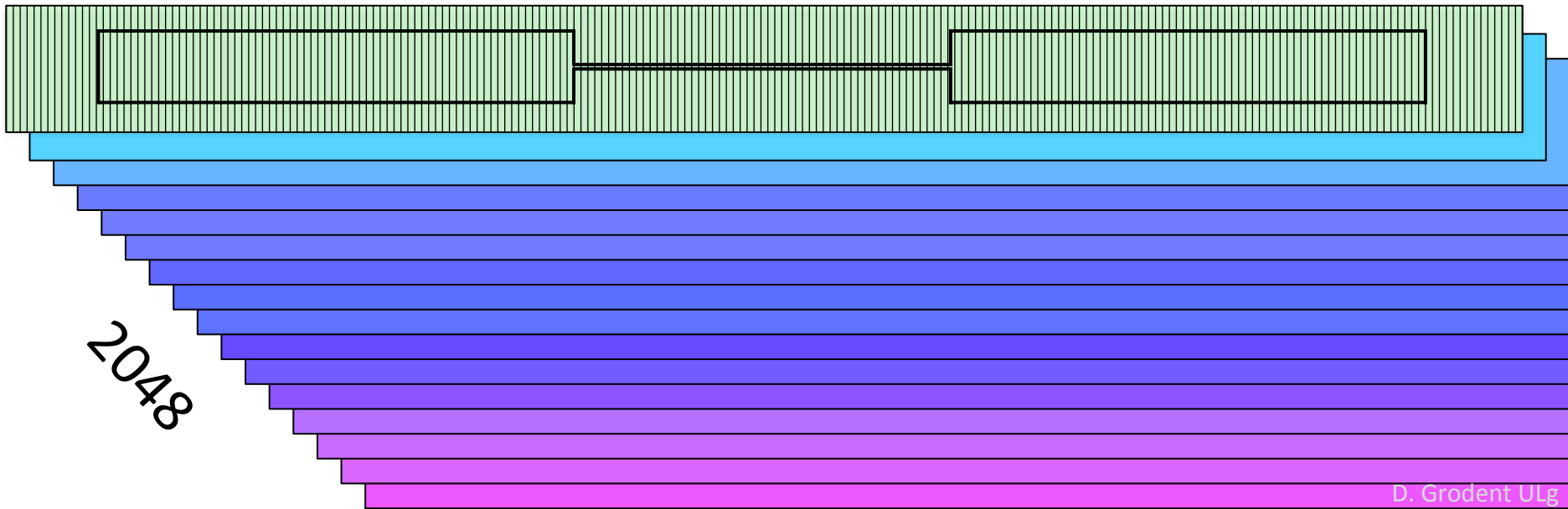
256 "pixels" (spatial) / 2048 pixels (spectral)

Toroidal diffraction  
grating

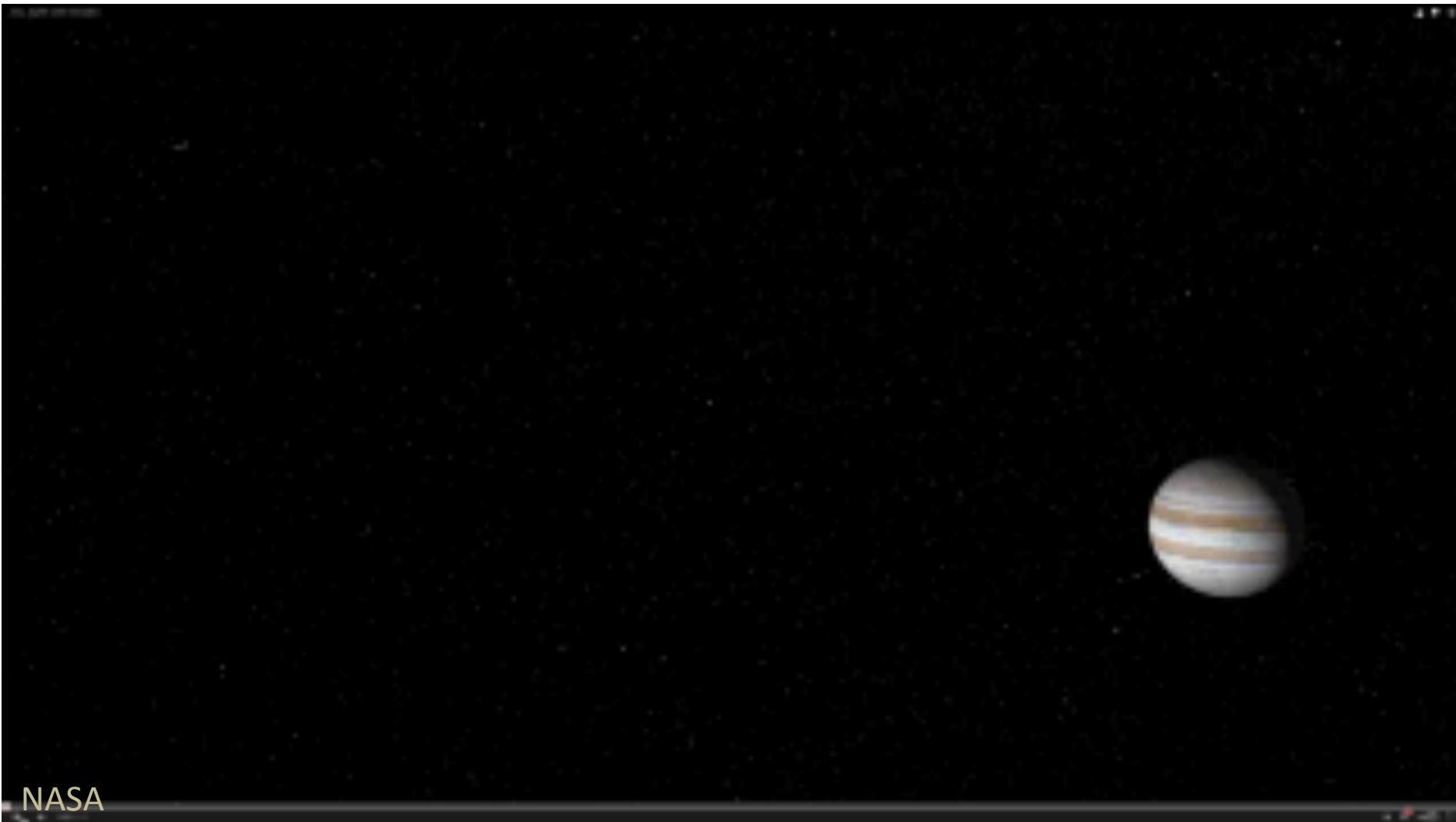
PSF < 0.6 nm



"Data Cube" (x, t,  $\lambda$ ) Events List



# Juno orbit



Inbound  
to JOI

3

18

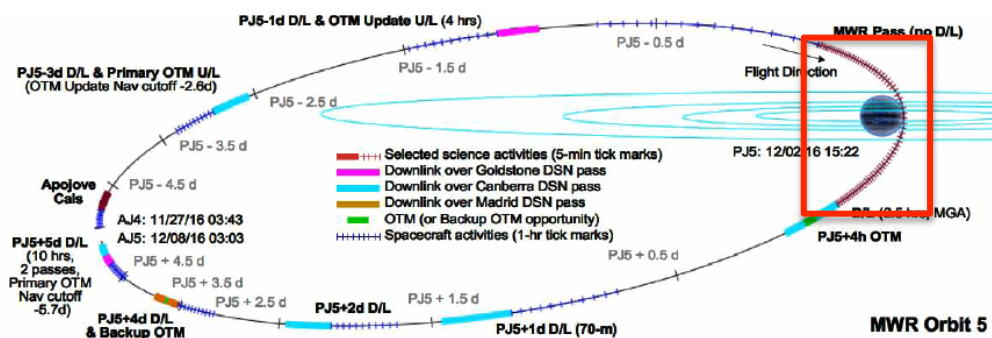
33

Capture  
Orbit

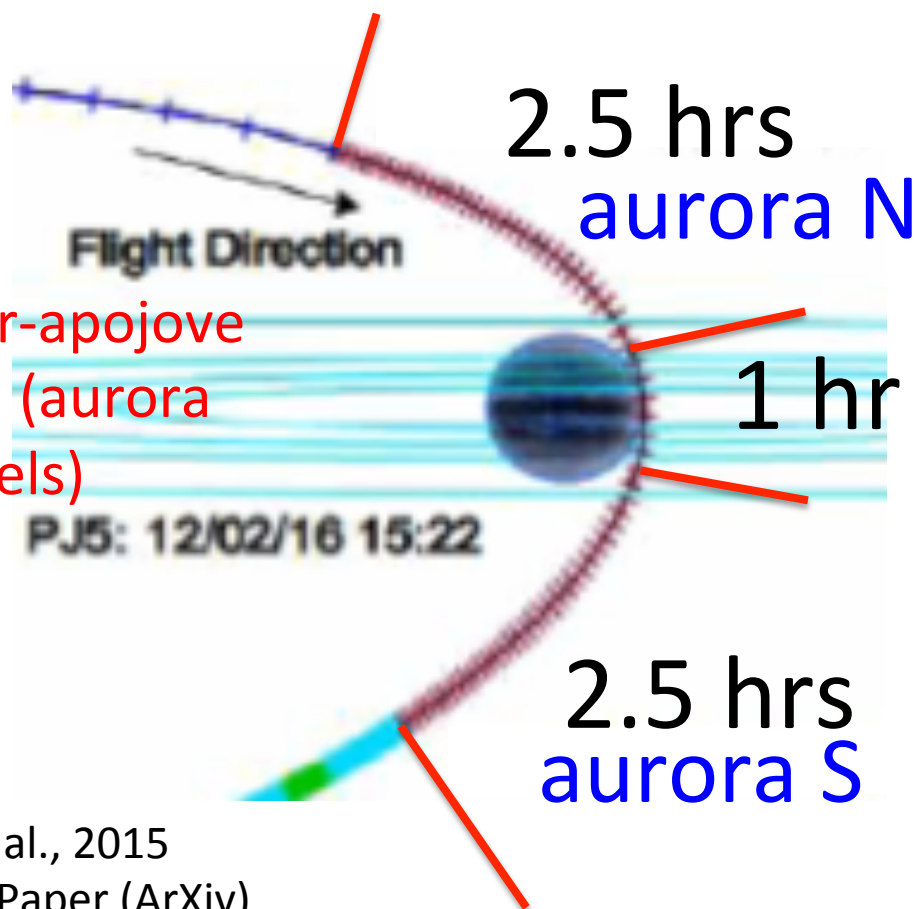
electronic  
(dark) noise  
when in/close  
to radiation  
belts



# 33 14-Day orbits



UVS segment:  
~6 hours of  
continuous  
operations



Also near-apojove  
UVS obs. (aurora  
~few pixels)

UVS observes  
aurora  
< 2% of orbit

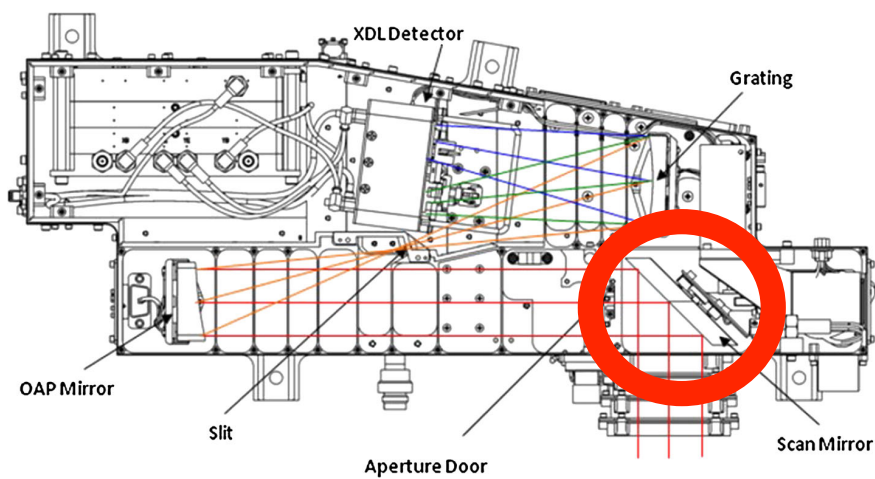
we need HST for  
the rest (> 98%)  
of the time

Grodent et al., 2015  
HST White Paper (ArXiv)

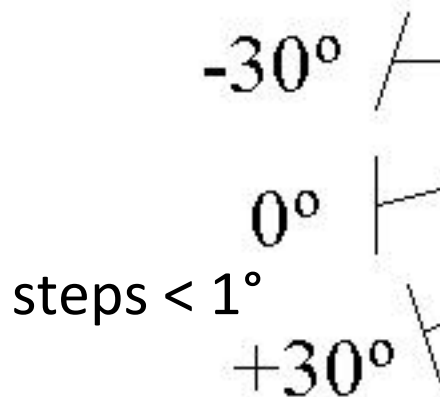
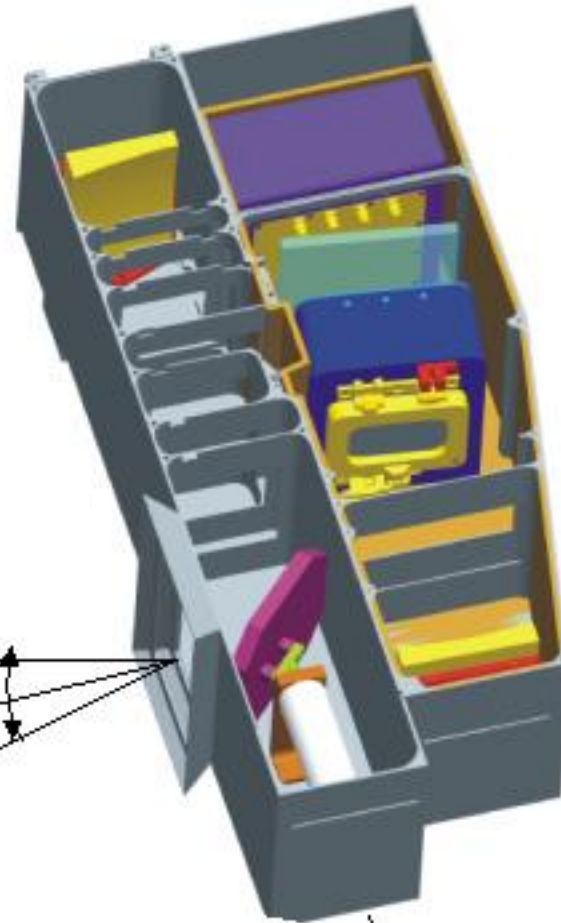
Juno is spin stabilized at 2 RPM: 1 rotation every 30 seconds in a plane containing the UVS boresight



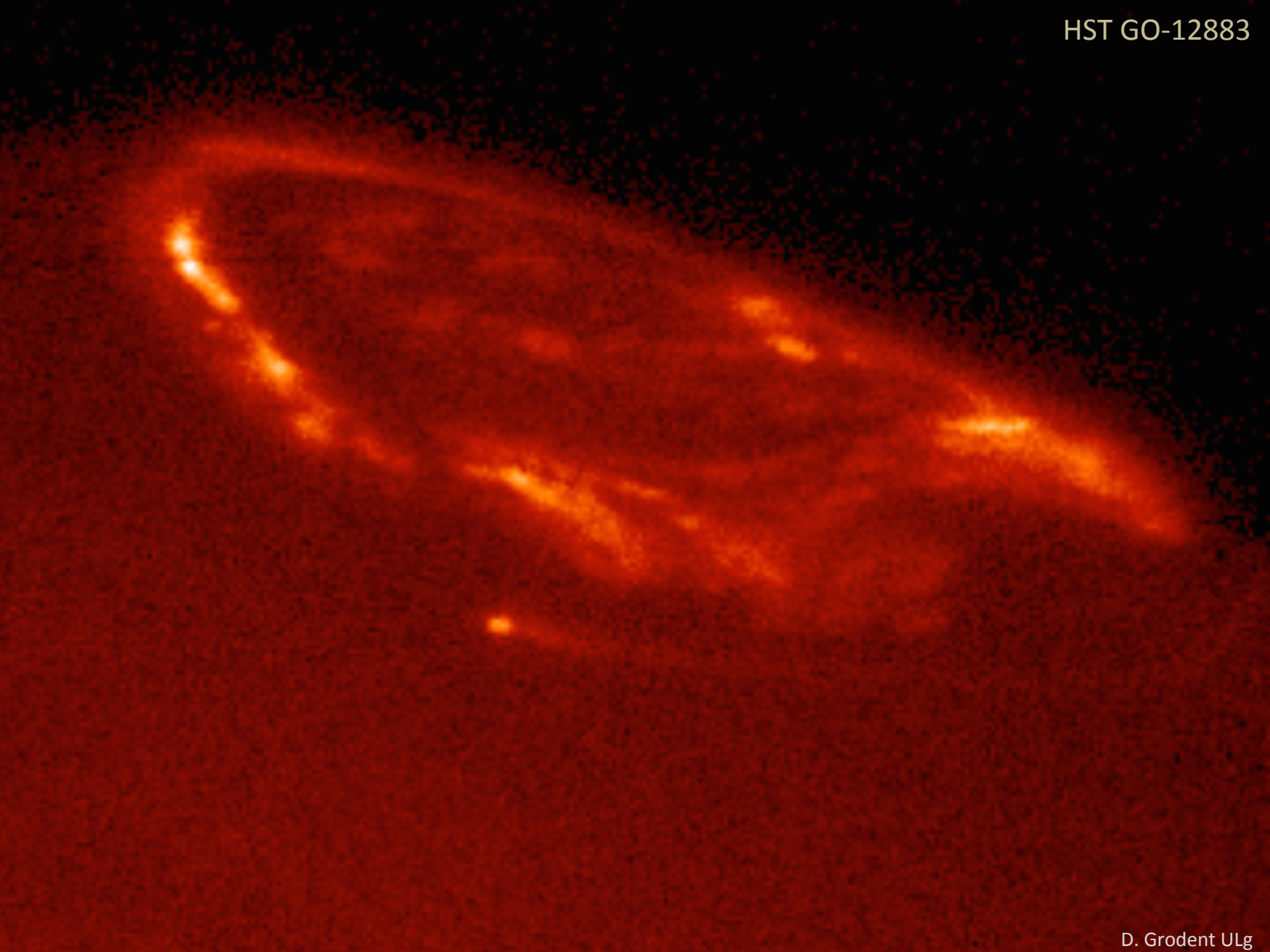
Use this rotation to scan the auroral region



# Scan Mirror



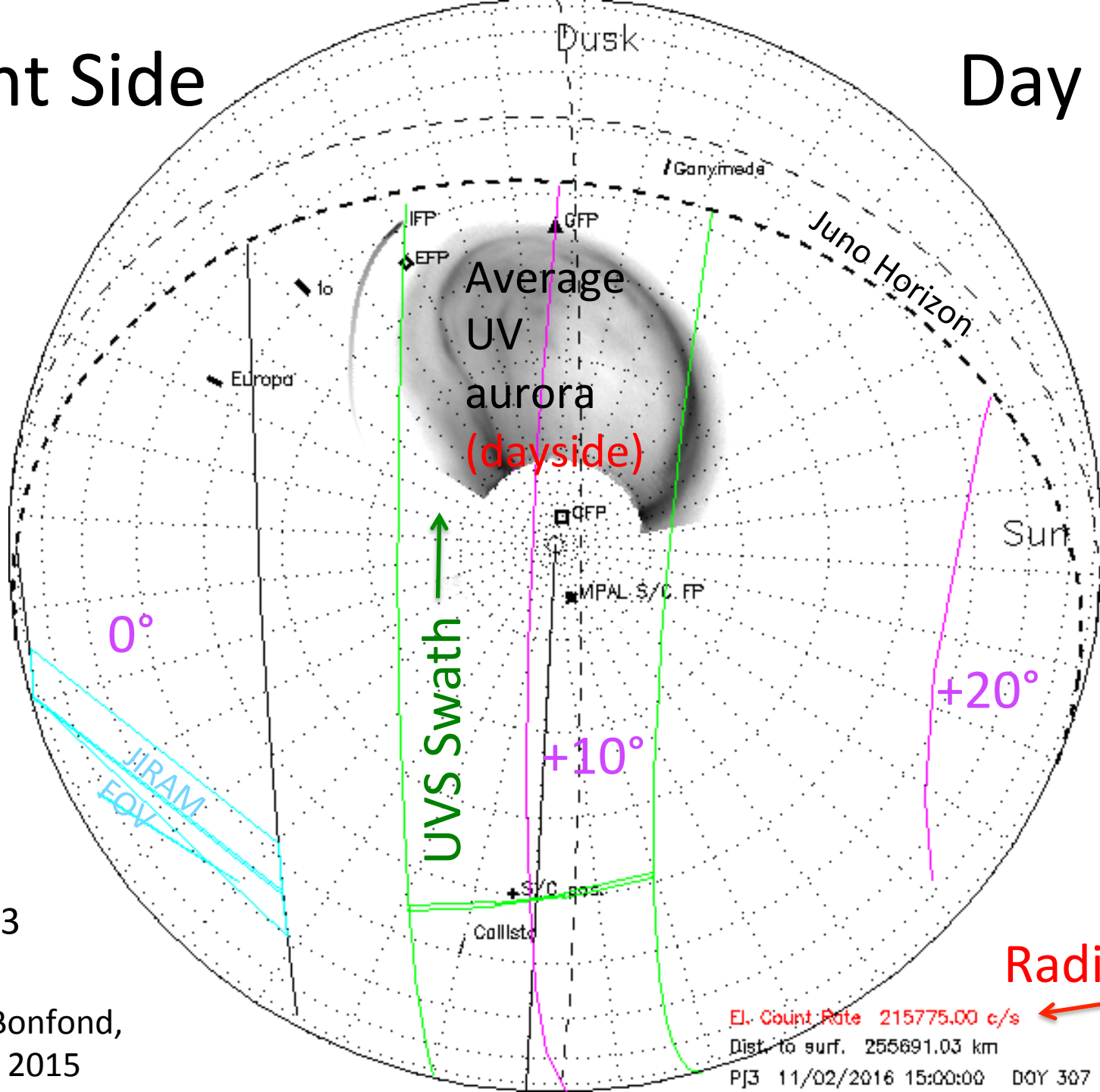
Mirror Rotation Axis



Night Side

Day Side

North,  
Observer  
at  $\infty$

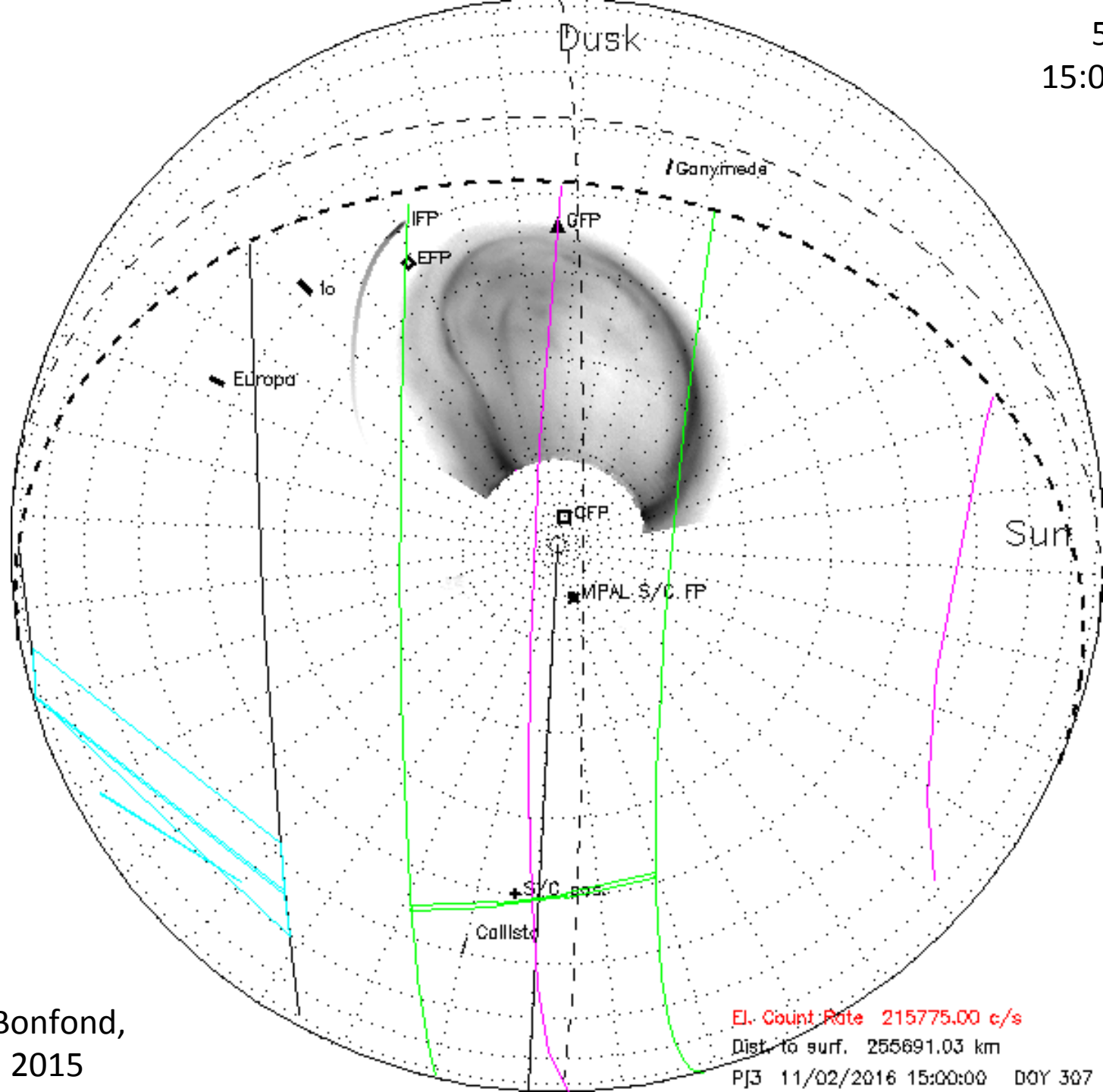


Orbit PJ3

Credit: B. Bonfond,  
LPAP-SwRI 2015

El. Count Rate 215775.00 c/s  
Dist. to surf. 255691.03 km  
PJ3 11/02/2016 15:00:00 D0Y 307 D. Grodent ULg

5-min steps  
15:00 to 21:00



EI. Count Rate 215775.00 c/s

Dist. to surf. 255691.03 km

PJ3 11/02/2016 15:00:00 DOY 307 D. Grodent ULg

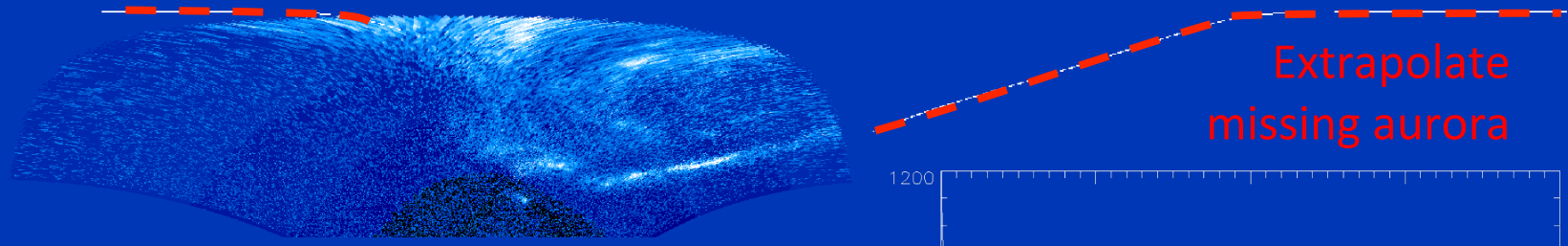
Credit: B. Bonfond,  
LPAP-SwRI 2015

latitude ↑

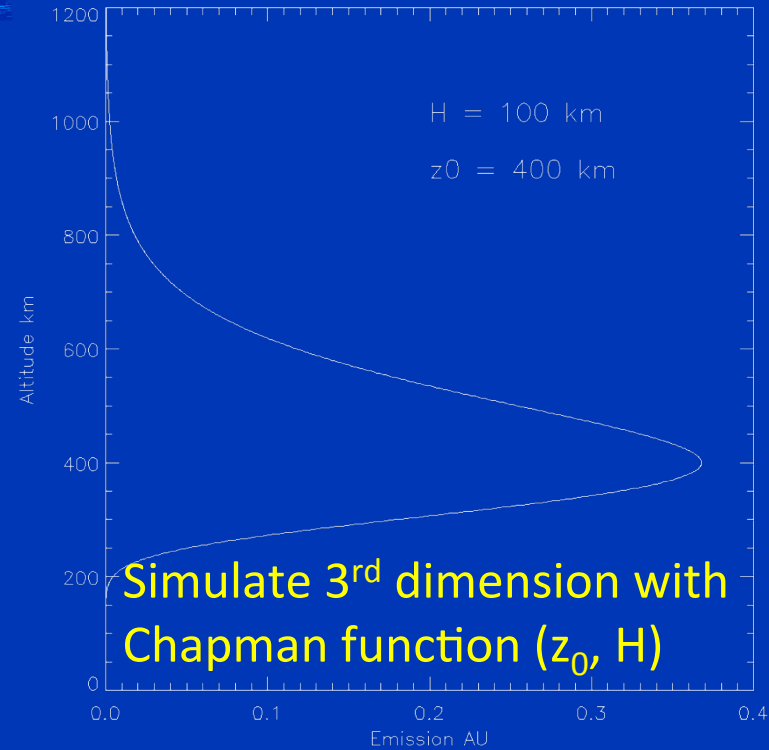
longitude (S3) →

2D map of HST aurora

⇒ Build 3D map



Extrapolate missing aurora



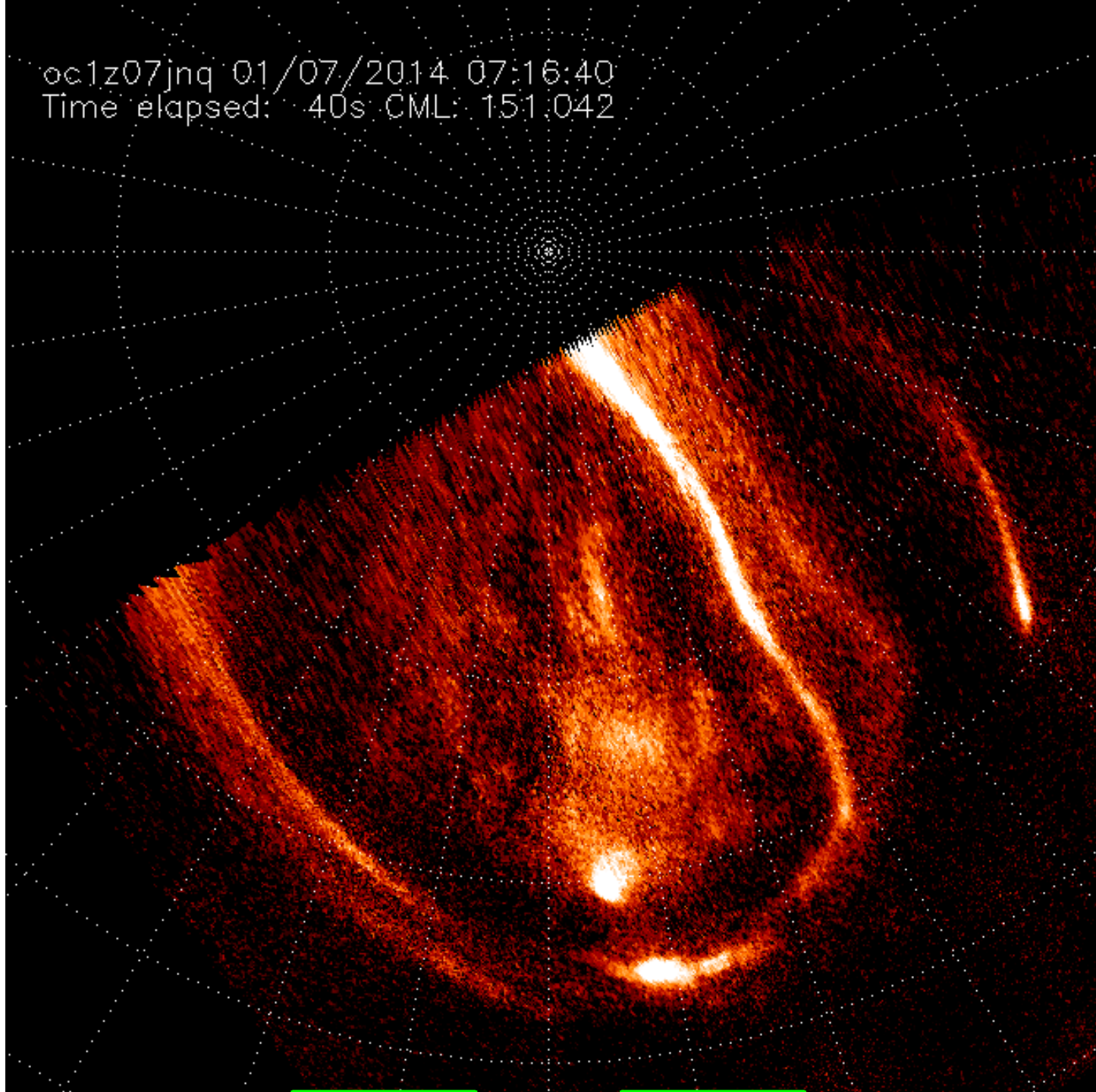
Use 143 maps accumulated for 10 sec (STIS ttag)

⇒ 4D

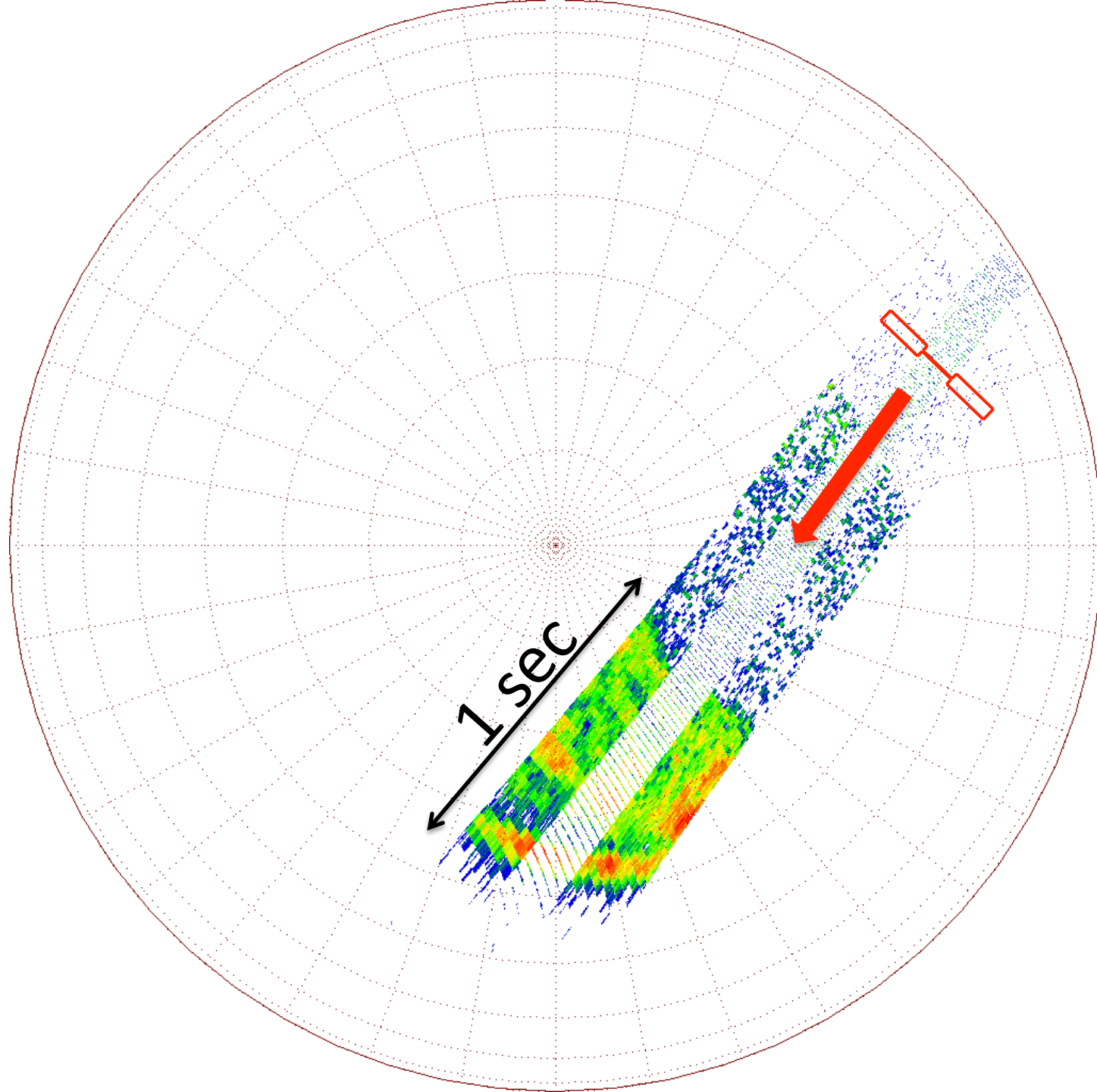
Build  $\text{H}_2$  spectrum for each pixel

⇒ 5D

oc1z07jng 01/07/2014 07:16:40  
Time elapsed: 40s CML: 151.042



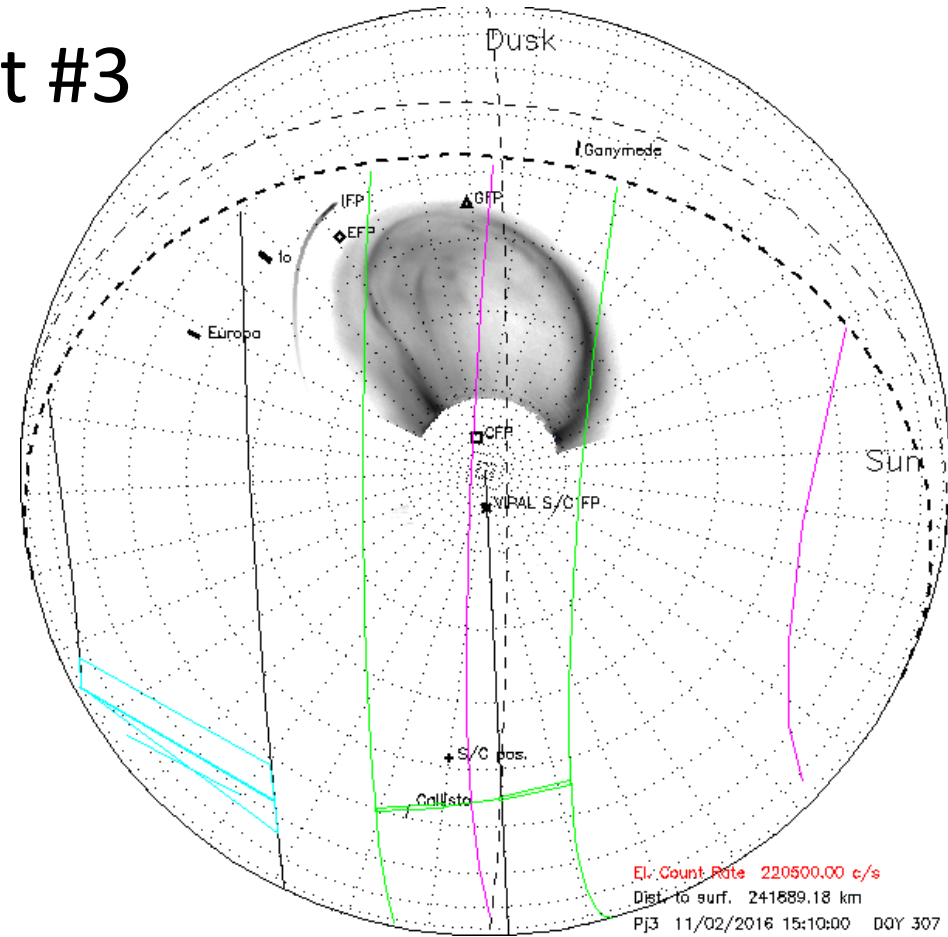
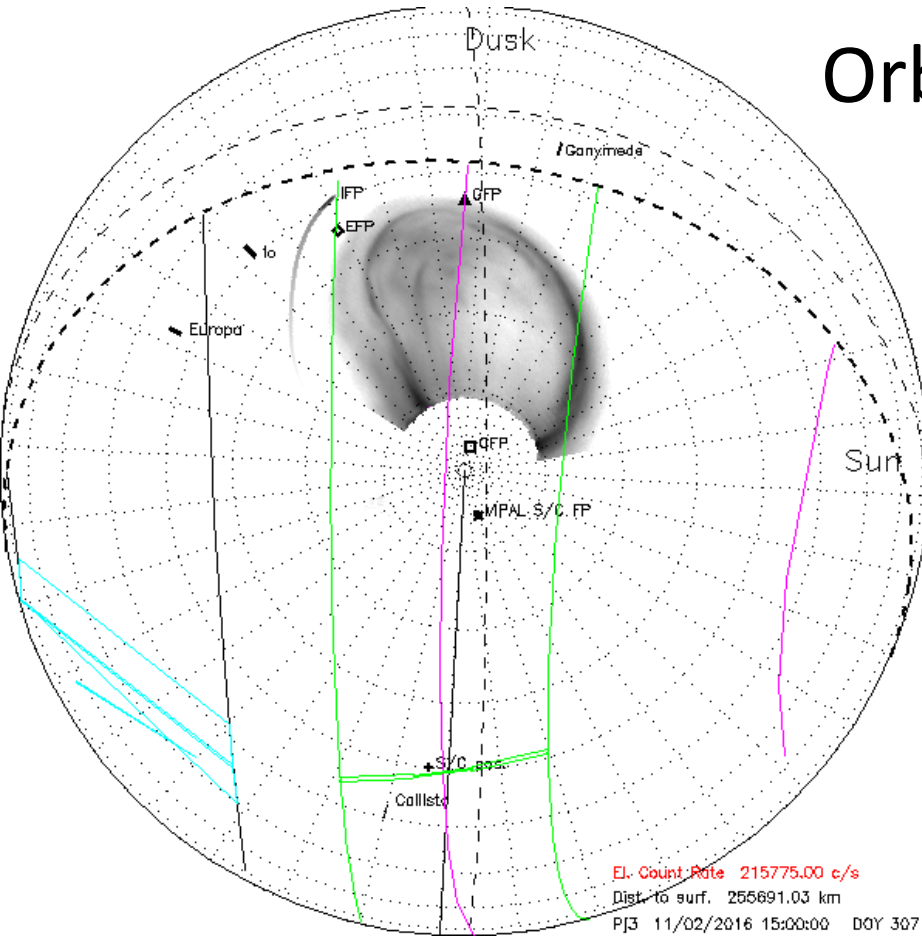




Start: 02 Nov 2016 15:00:04

End: 02 Nov 2016 15:10:34

# Orbit #3

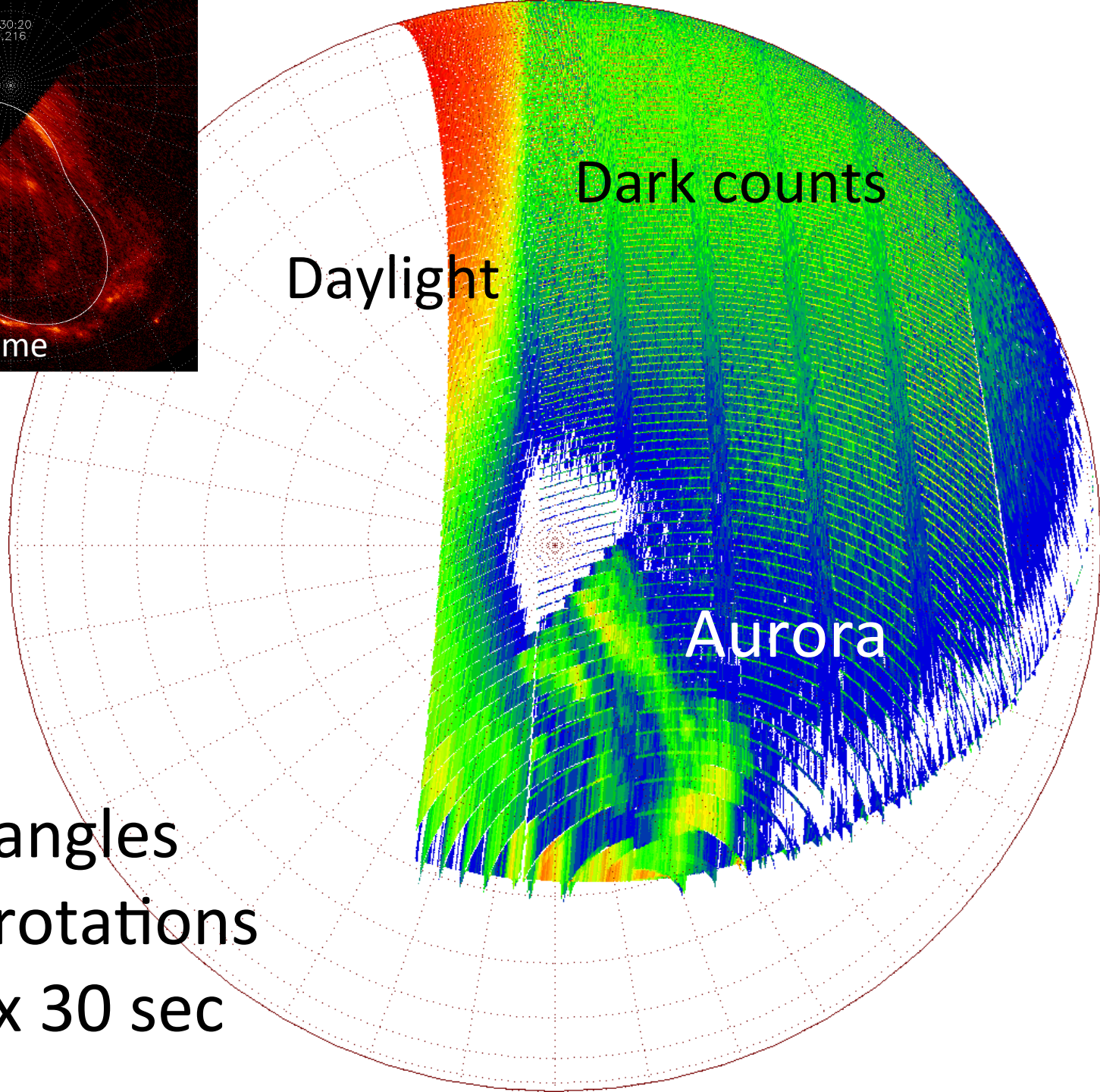
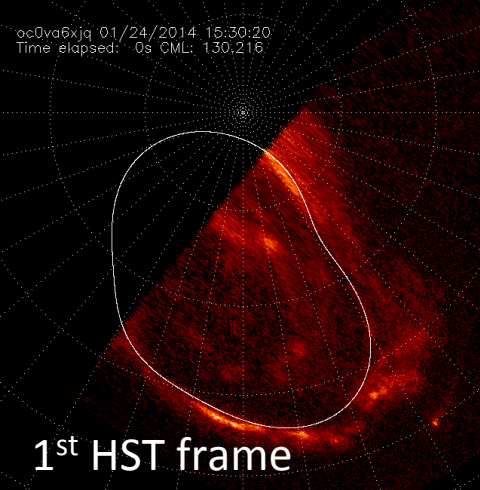


Aurora sitting on dayside terminator  
(50% night-50% day)

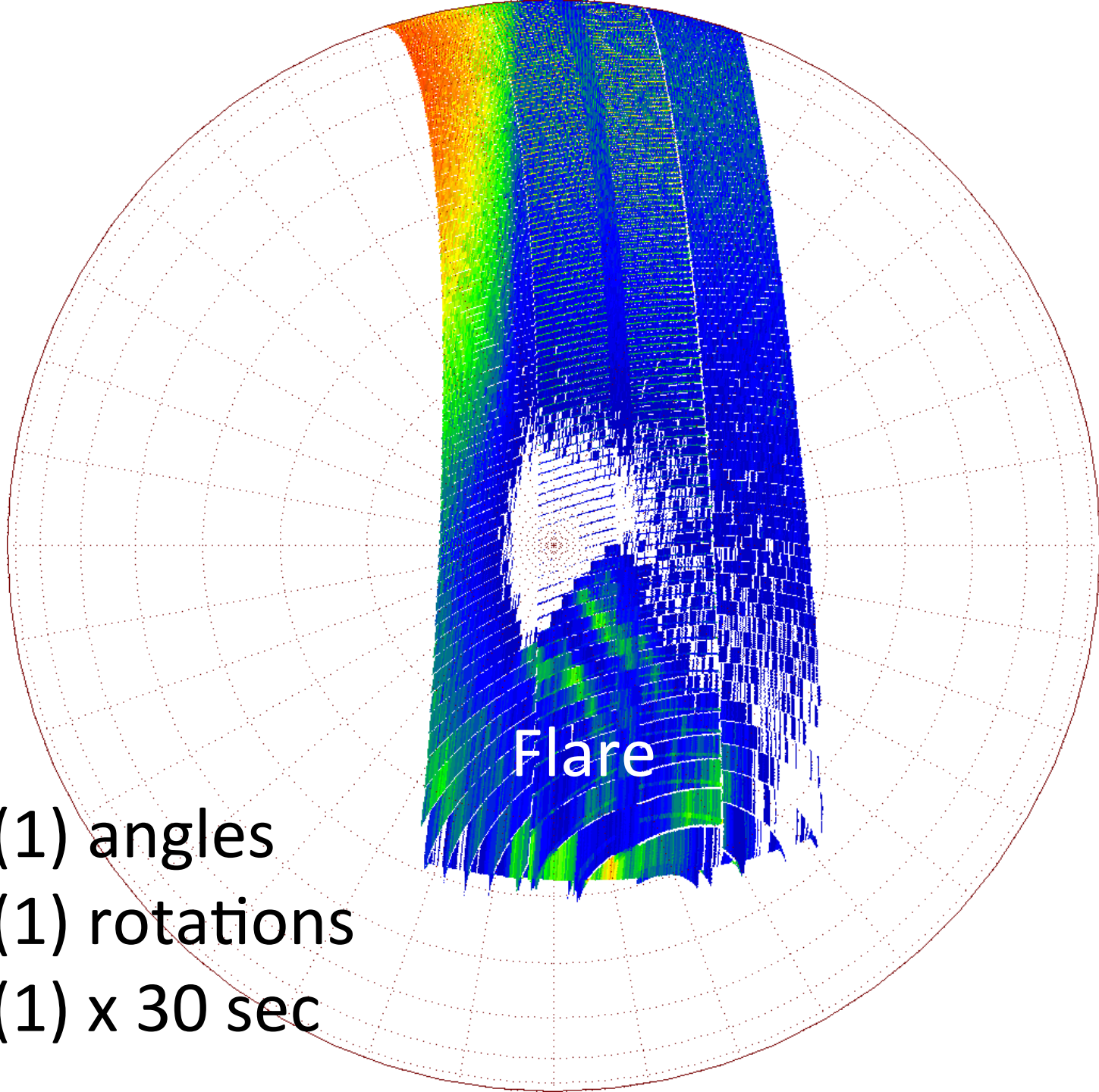
Altitude<sub>start</sub> = 3.6 R<sub>J</sub>

Instantaneous spat. res. ~ 156 km x 893 km / pix<sup>2</sup>

Dark count rate ~ 216 kC/s



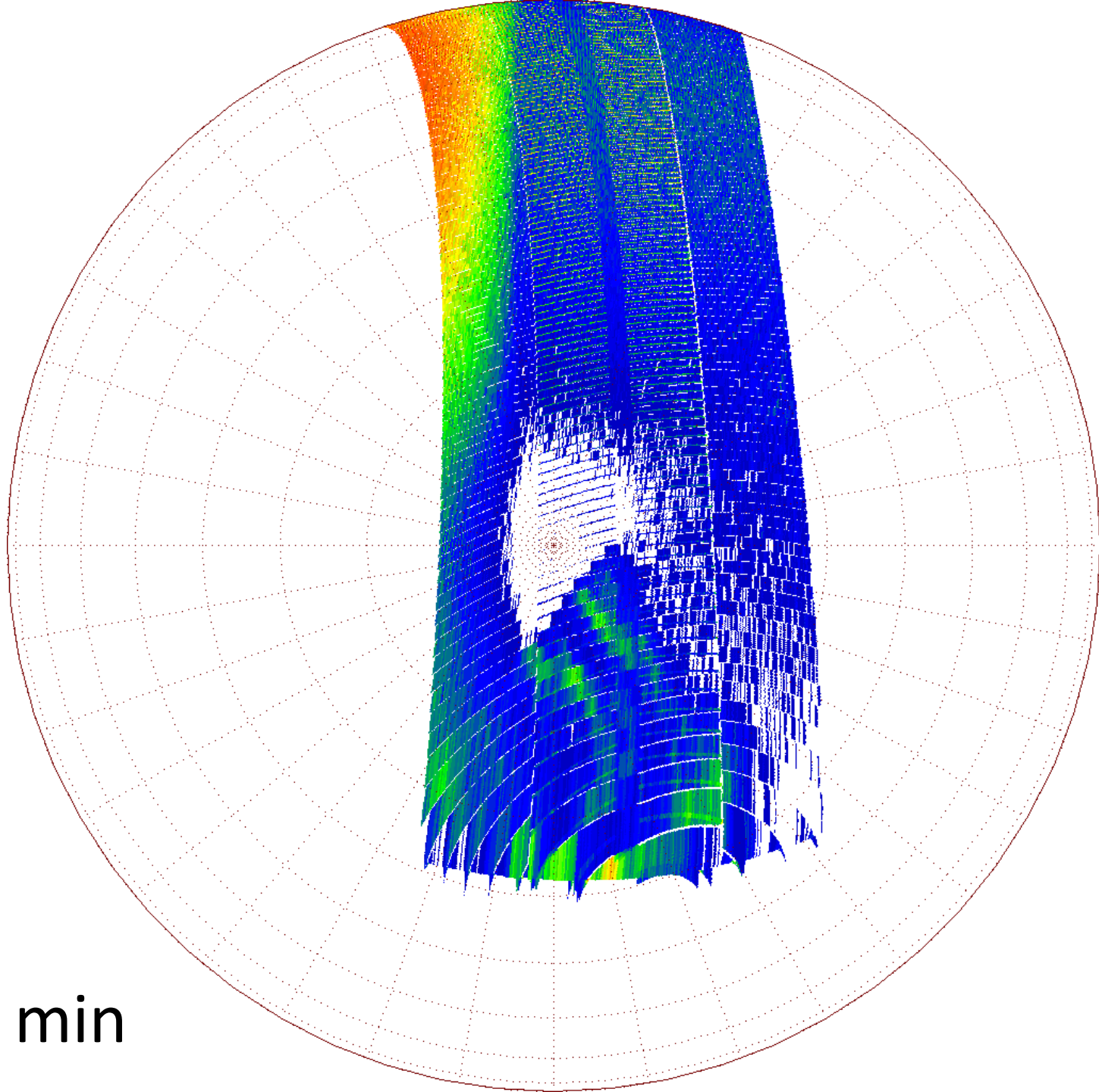
= 5 angles  
= 5 rotations  
= 5 x 30 sec



= 2 (1) angles

= 2 (1) rotations

= 2 (1) x 30 sec

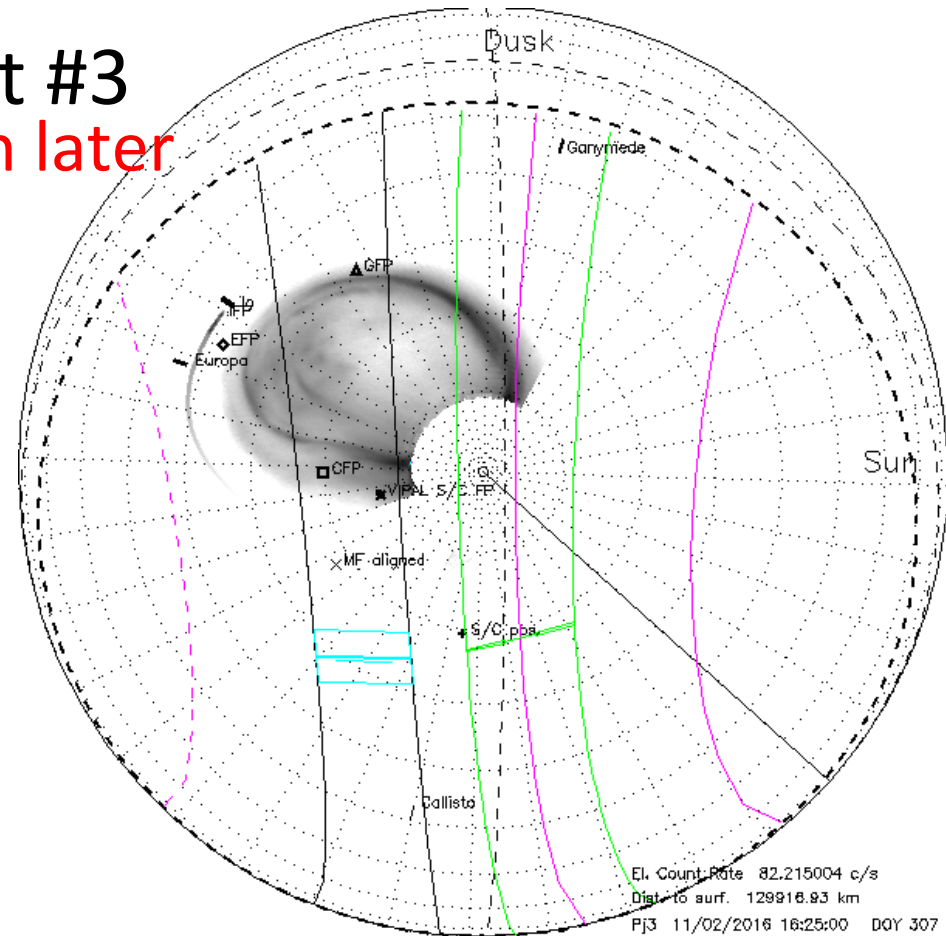
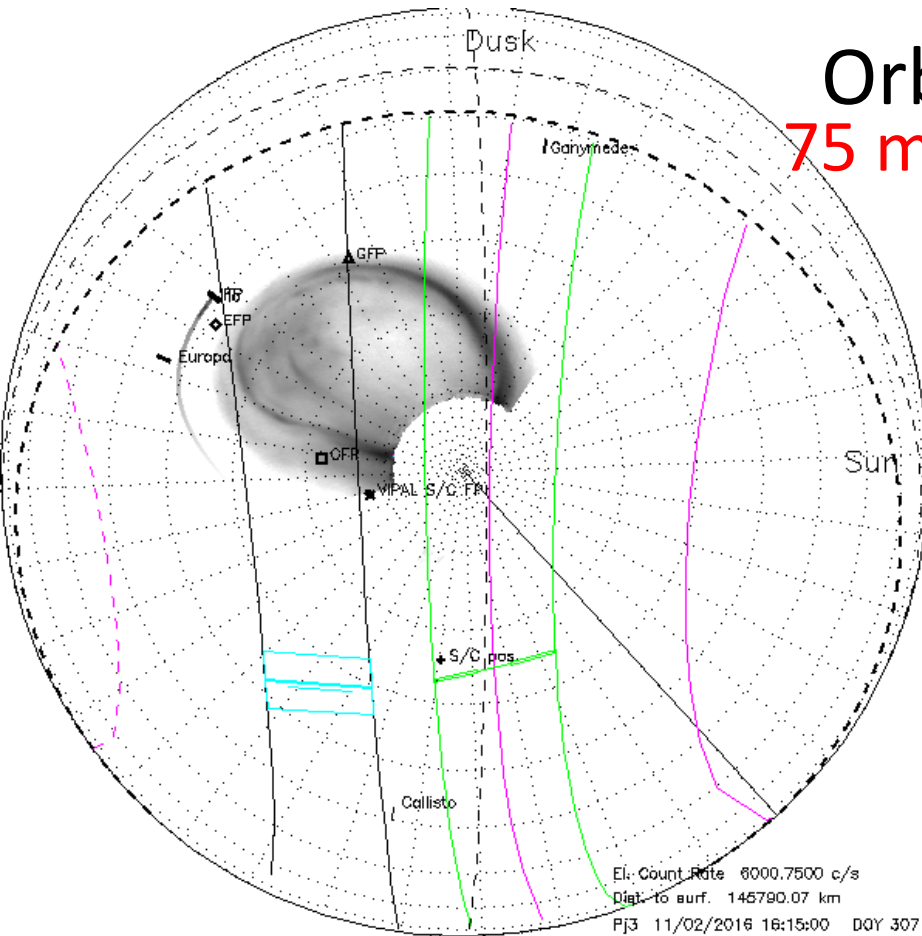


10.5 min

Start: 02 Nov 2016 16:15:04

End: 02 Nov 2016 16:23:04

# Orbit #3 75 min later

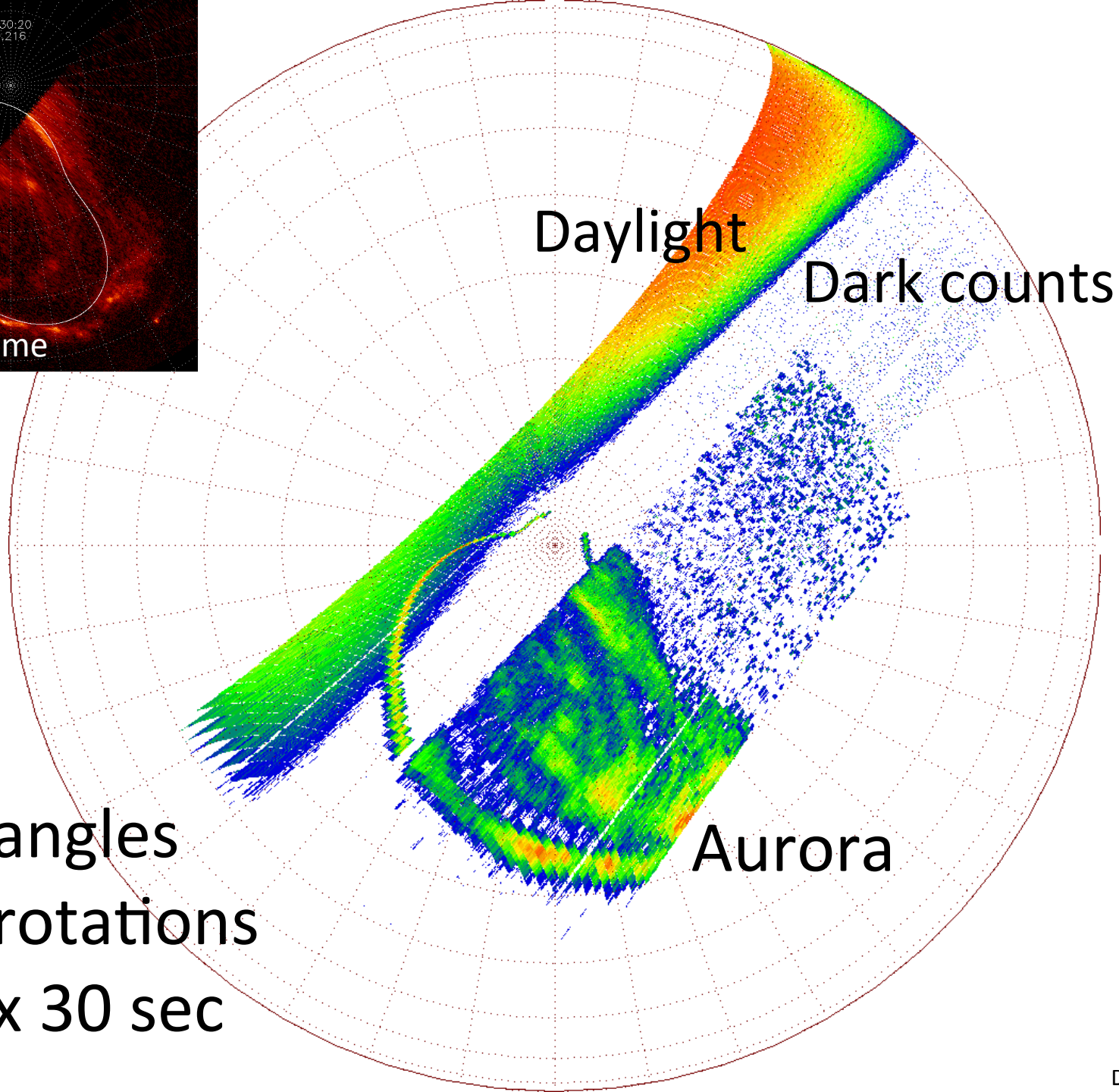
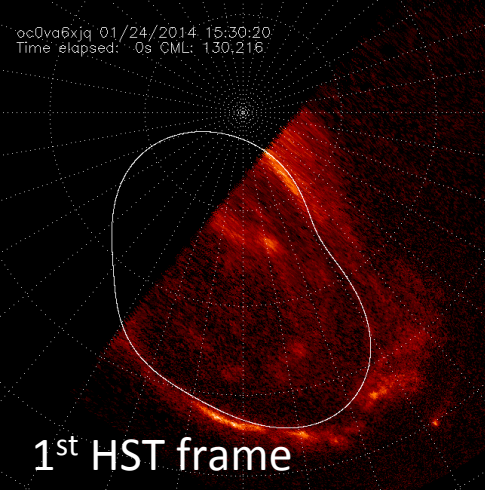


Altitude<sub>start</sub> =  $2.04 R_J$

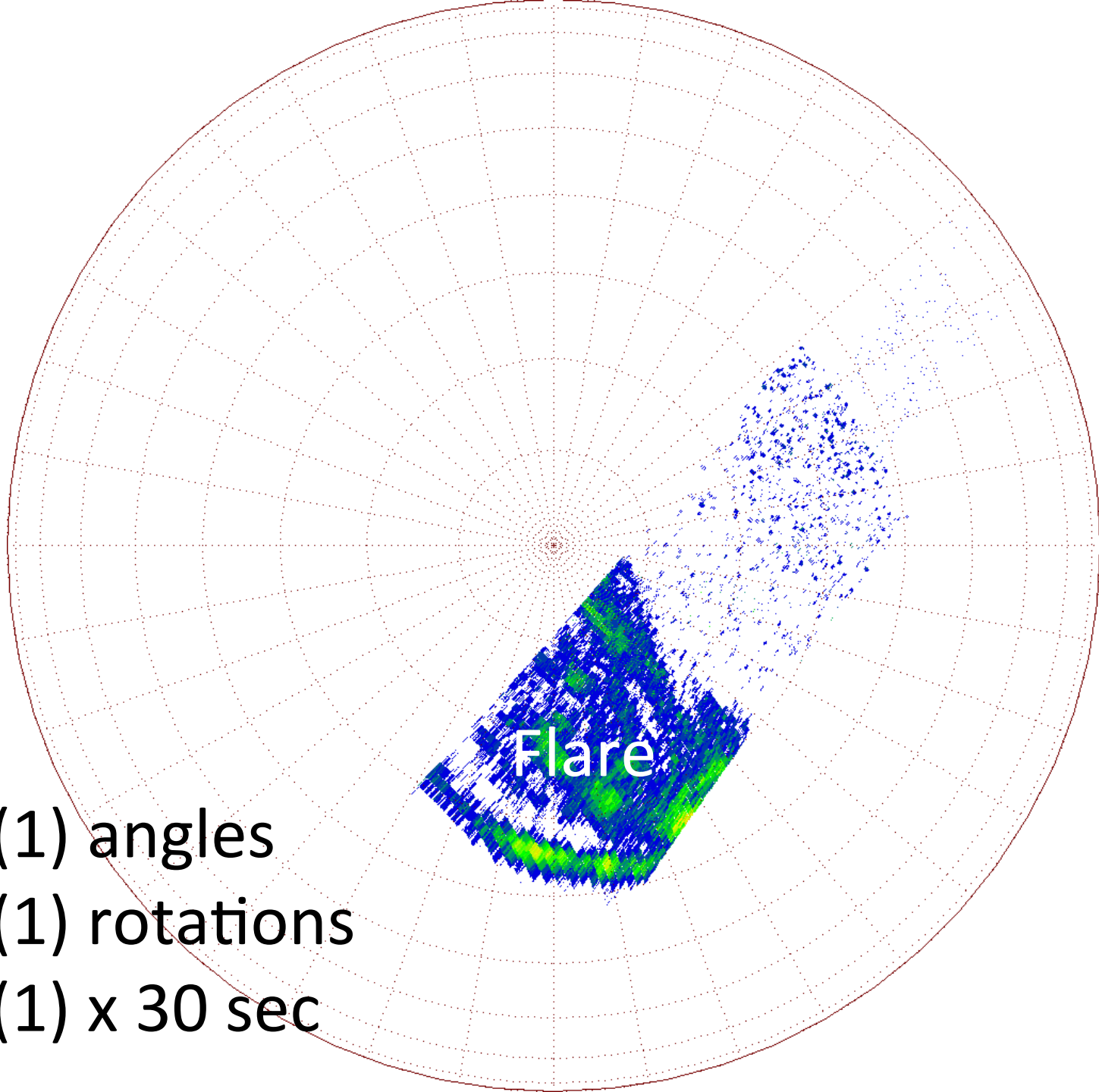
Instantaneous spat. res.  $\sim 89 \text{ km} \times 509 \text{ km} / \text{pix}^2$

Dark count rate  $\sim 6 \text{ kC/s}$

Aurora almost fully in nightside



= 5 angles  
= 5 rotations  
= 5 x 30 sec

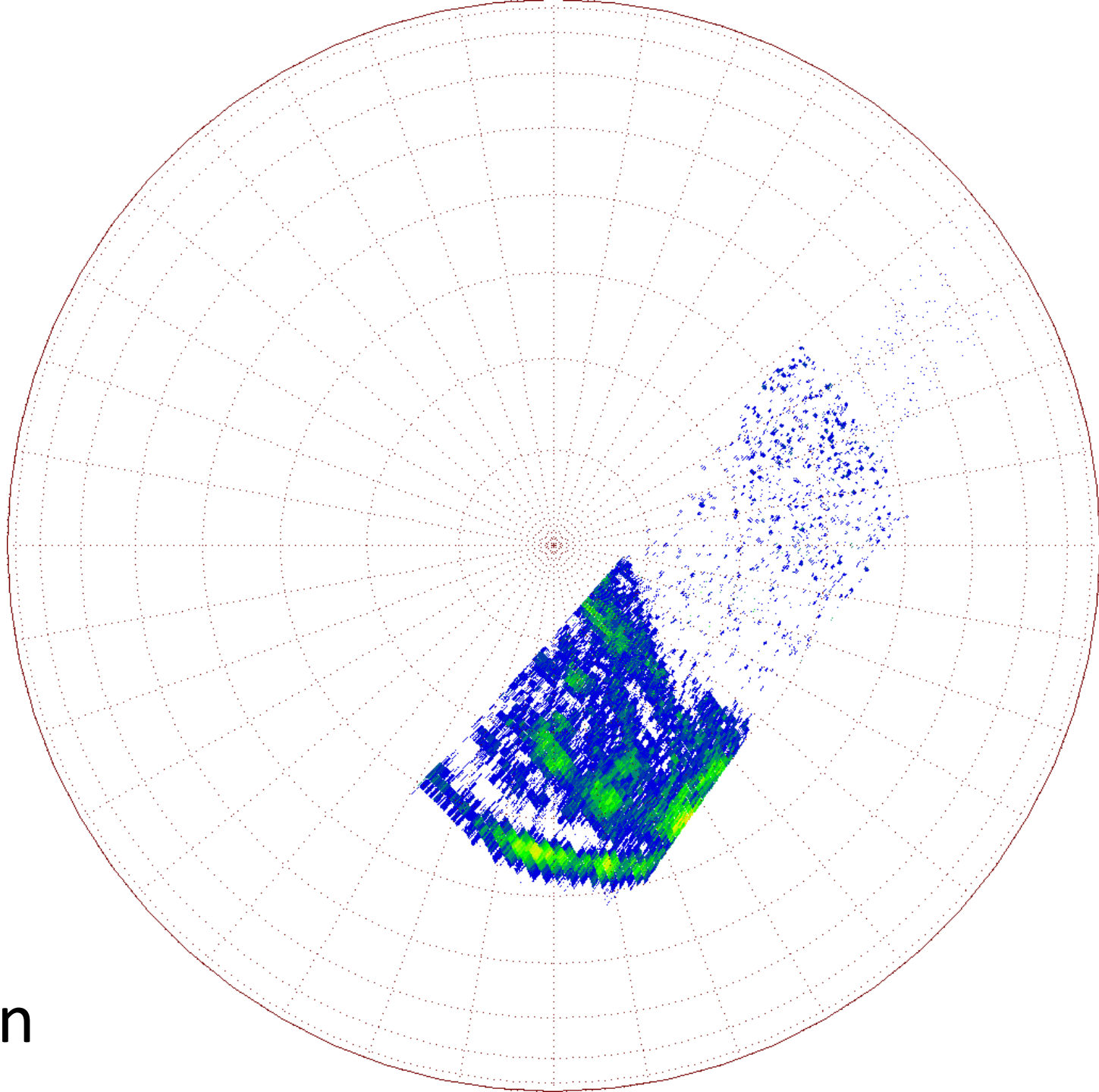


= 2 (1) angles

= 2 (1) rotations

= 2 (1) x 30 sec



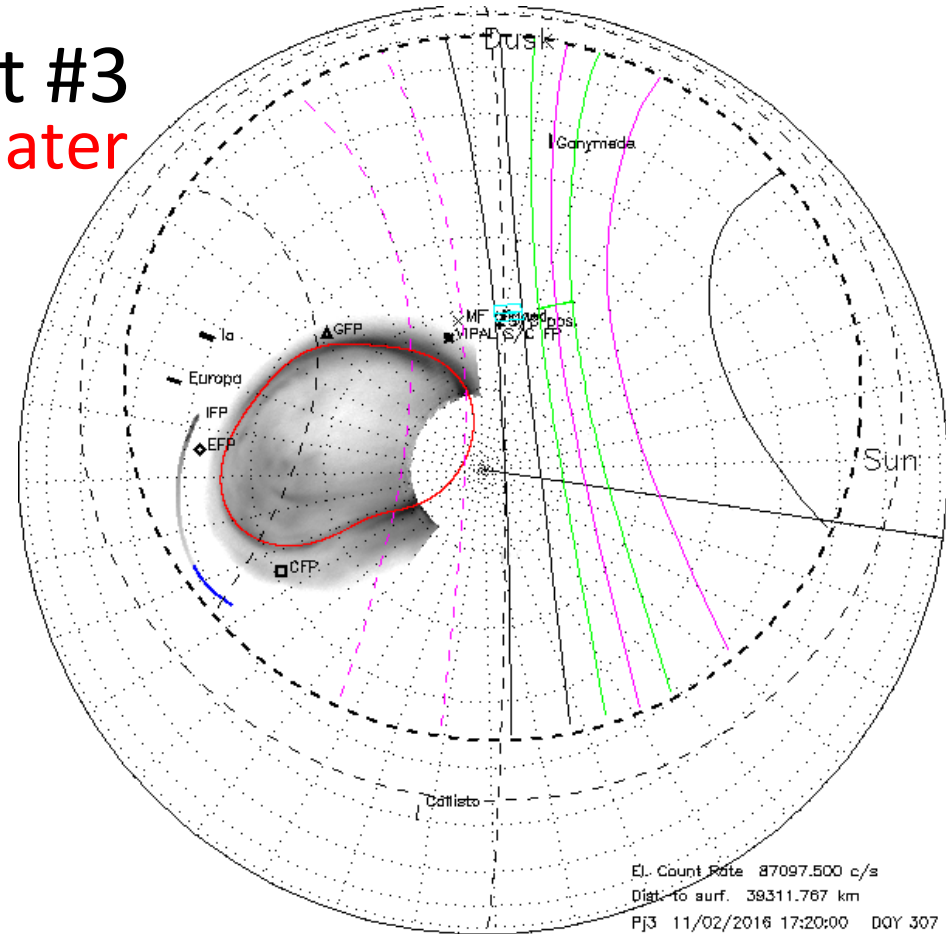
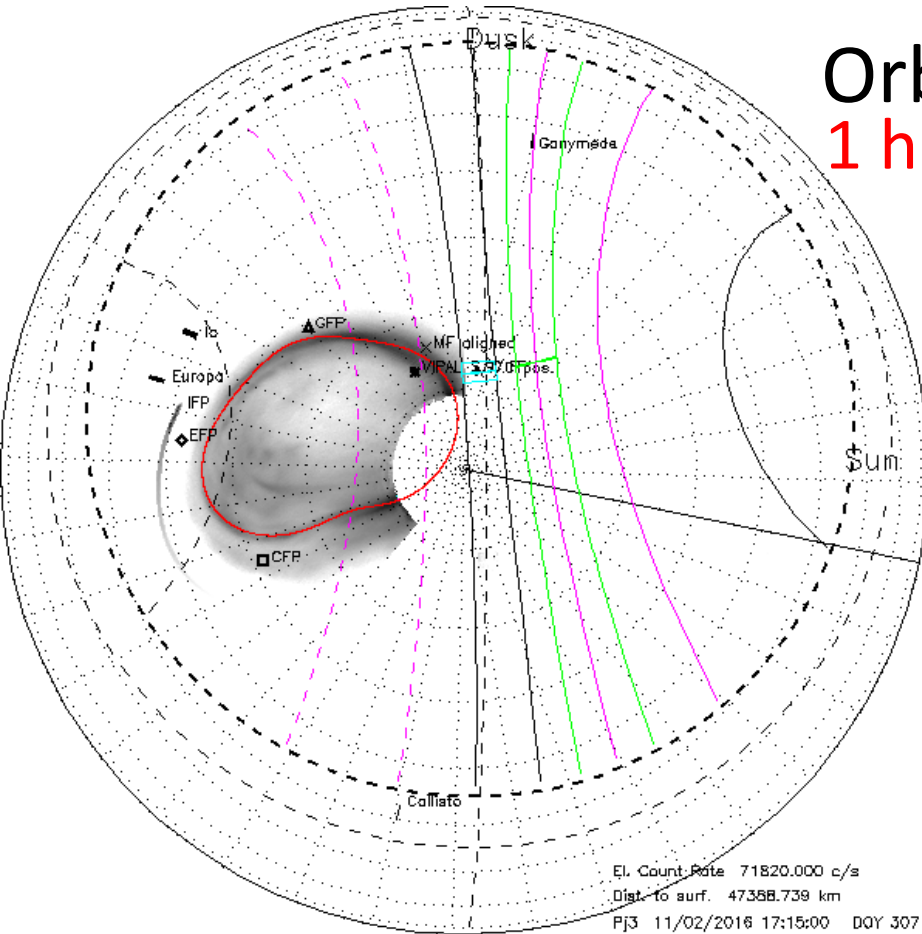


8 min

Start: 02 Nov 2016 17:15:04

End: 02 Nov 2016 17:19:04

# Orbit #3 1 hr later



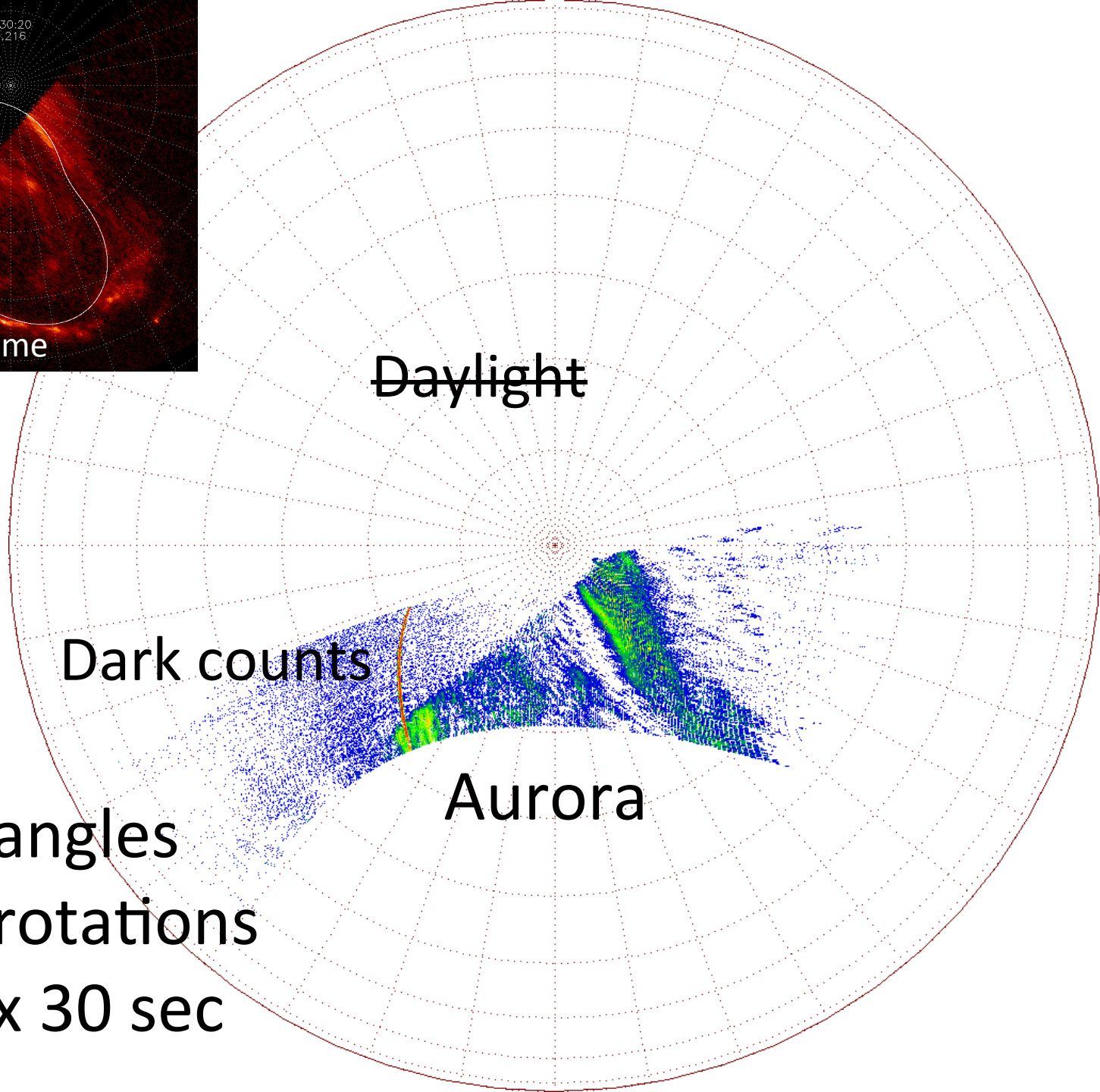
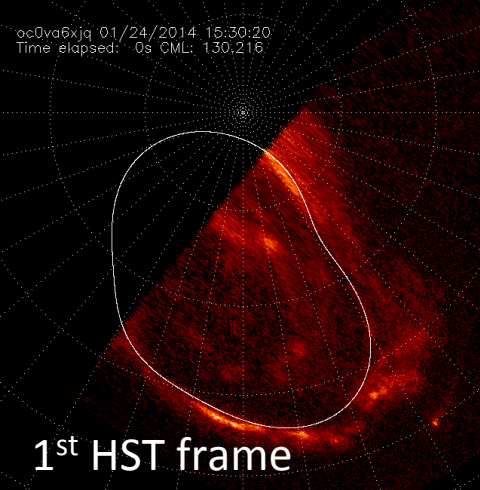
Aurora fully in nightside

S/C magnetic footprint on main emission

Altitude<sub>start</sub> = 0.66 R<sub>J</sub>

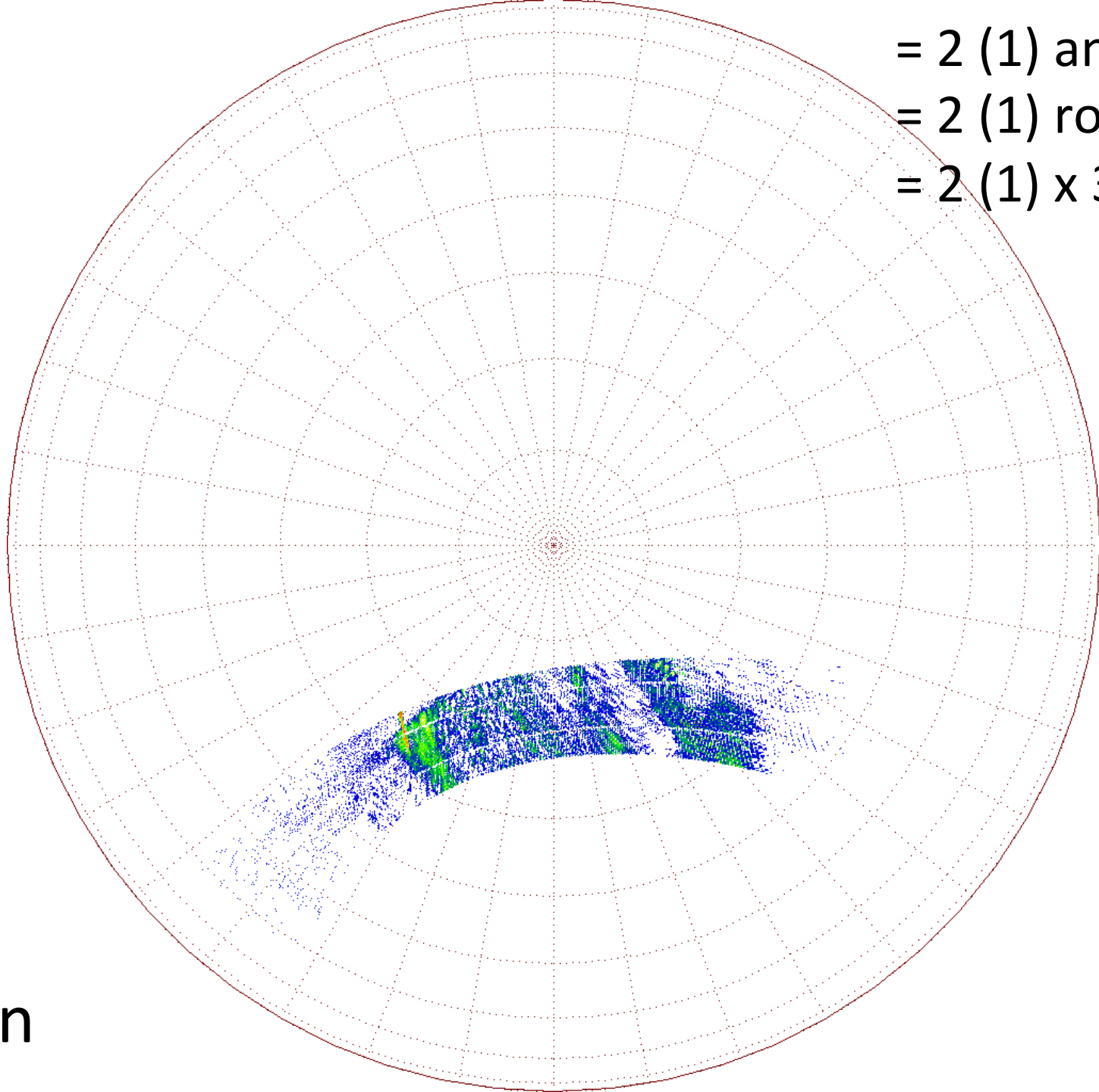
Instantaneous spat. res. ~ 29 km x 165 km / pix<sup>2</sup>

Dark count rate ~ 72 kC/s



- = 7 angles
- = 7 rotations
- = 7 x 30 sec

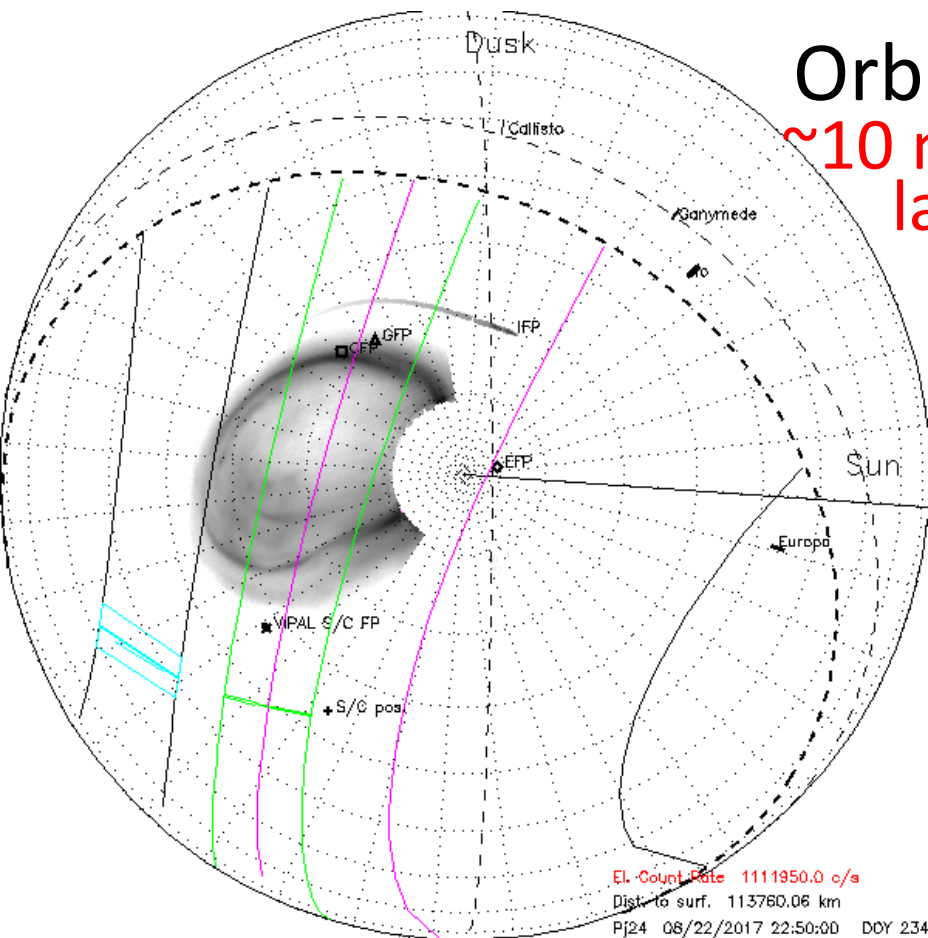
= 2 (1) angles  
= 2 (1) rotations  
= 2 (1) x 30 sec



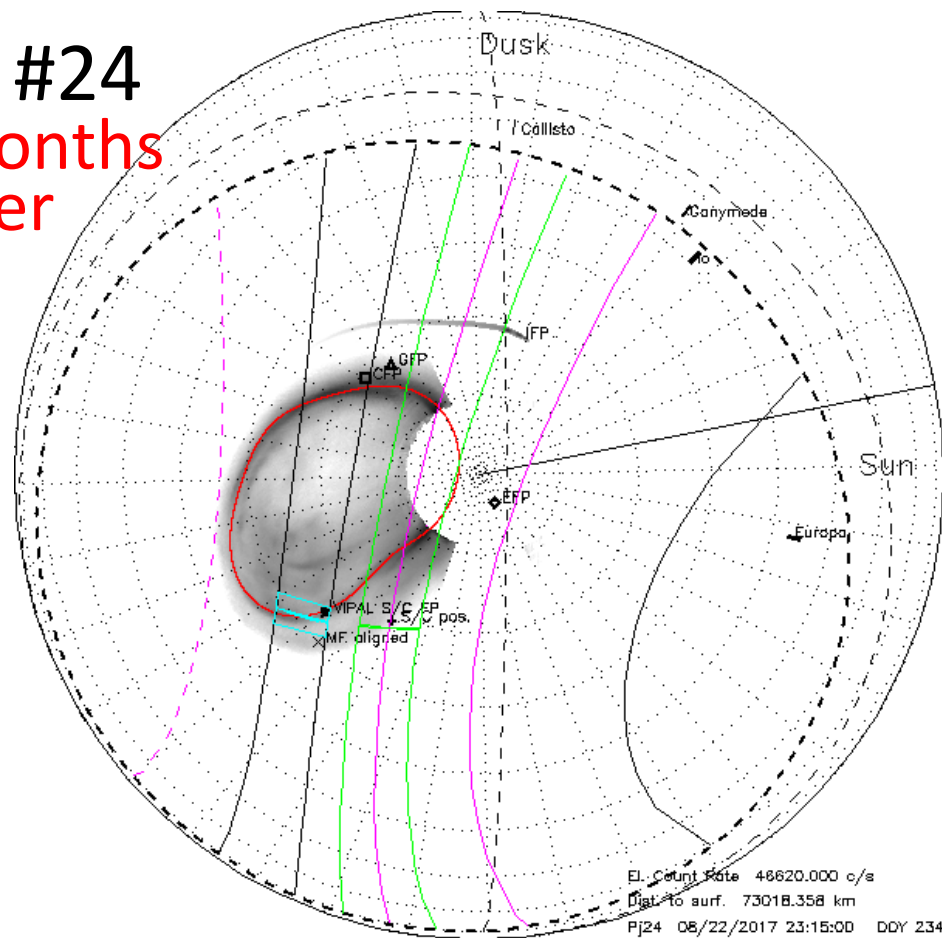
4 min

Start: 22 Aug 2017 22:49:53

End: 22 Aug 2017 23:12:48



Orbit #24  
~10 months  
later



Altitude<sub>start</sub> = 1.6 R<sub>J</sub>

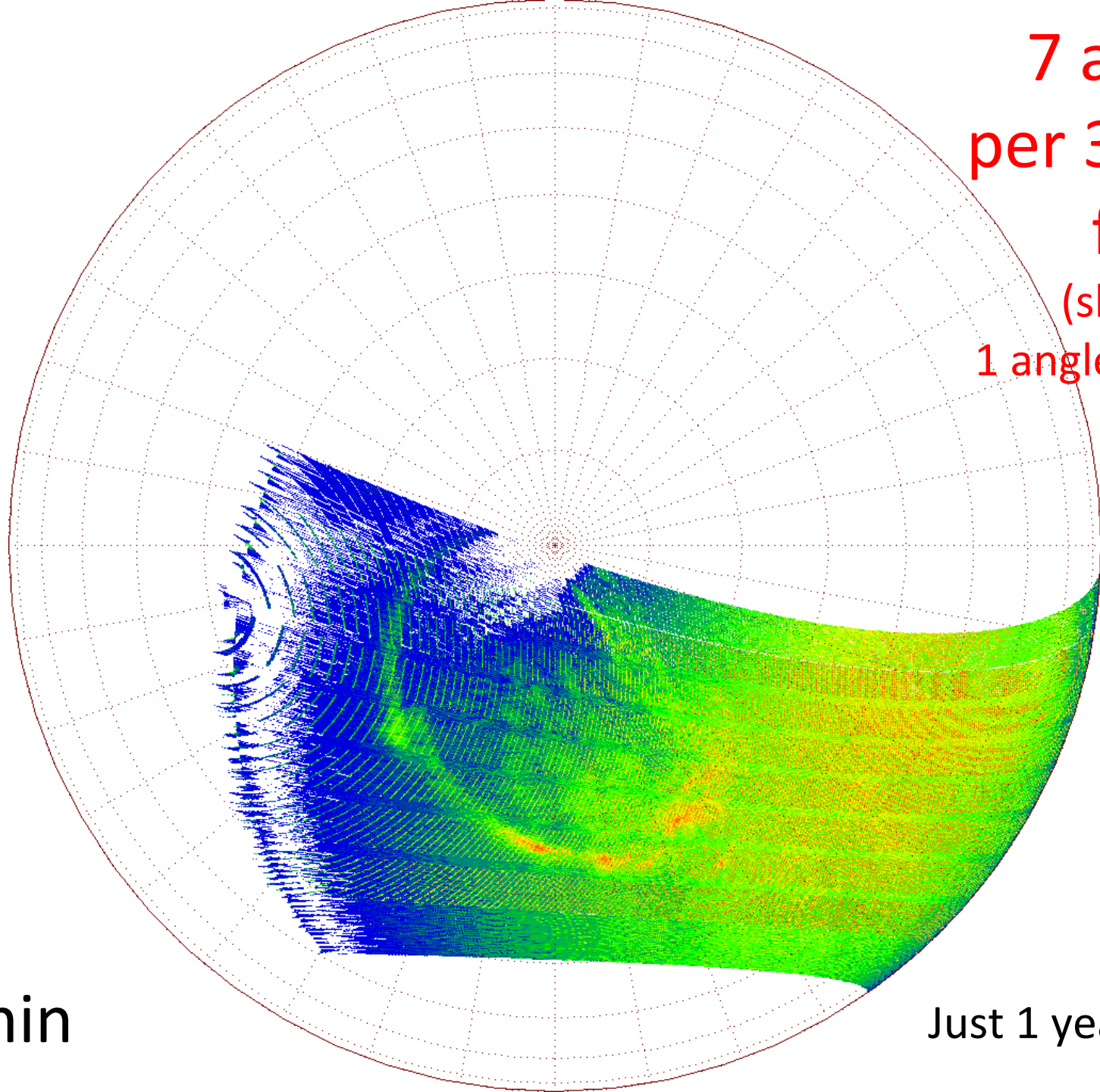
Instantaneous spat. res. ~ 70 km x 397 km / pix<sup>2</sup>

Dark count rate ~ 1112 kC/s ⇒ 40 kC/s

Aurora fully in nightside

S/C magnetic footprint on main emission

7 angles  
per 30 sec  
frame  
(should be  
1 angle/frame)



23 min

Just 1 year to go!



0.017 s

