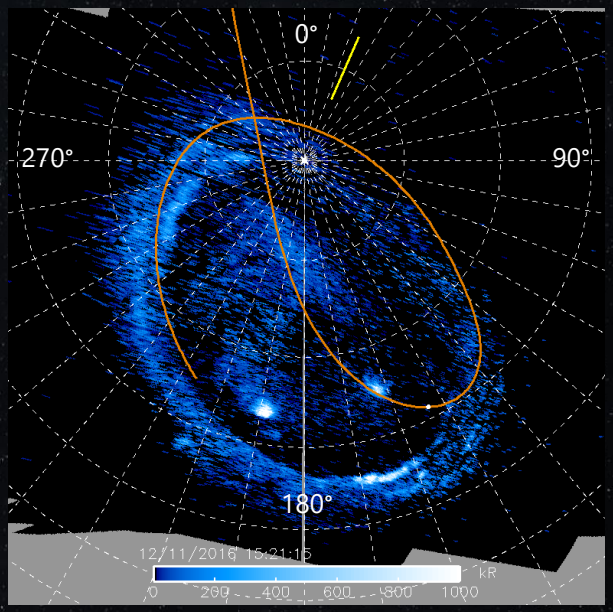
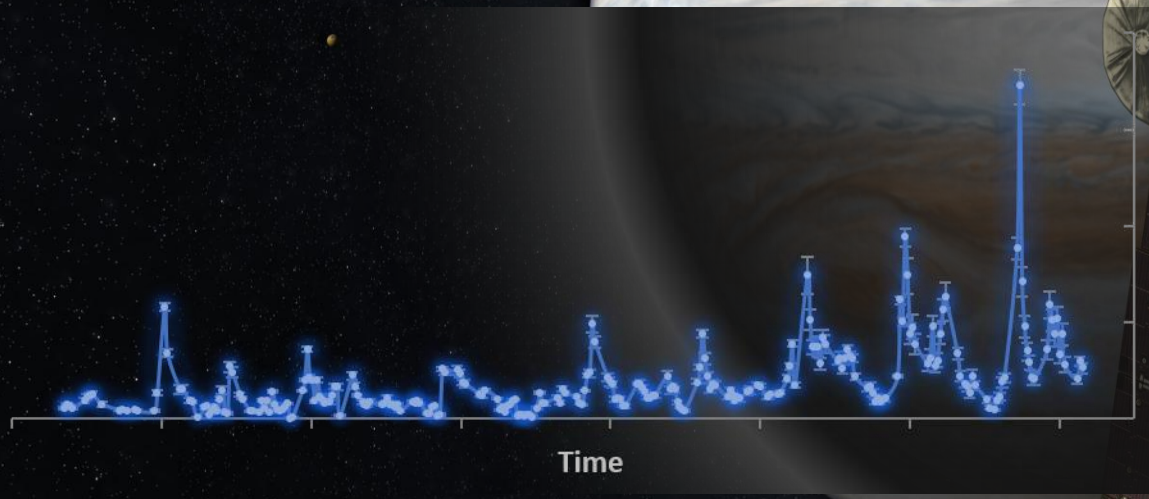
EGU General Assembly 2020 Online | 4–8 May 2020

Jupiter's polar auroral bright spots as seen by Juno-UVS





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Key points

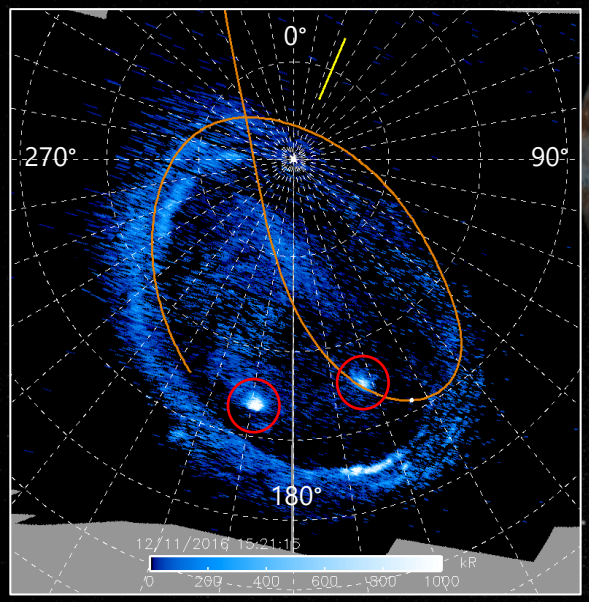
- Tens to a hundred of gigawatts (GWs)
- Various positions and local times in polar regions:
  - **Northern:** localized
  - **Southern:** scattered
- Usually observed at the boundary of the swirl region
- Quasiperiodic behaviors:
  - ~2-40 minutes of time interval between two consecutive emissions
- Does not statically map to noon, probably not a cusp feature

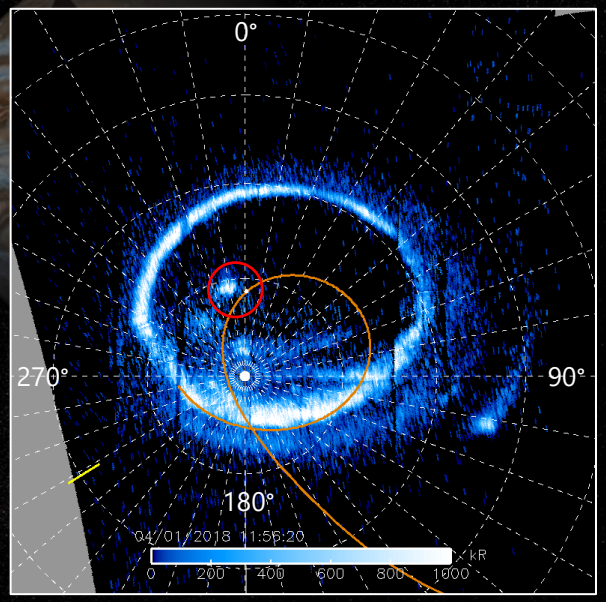
Haewsantati et al. (2020, in preparation)

Jupiter's bright spot emissions

The bright spot features:

- The emissions in Jupiter's polar auroras
- Spot/compact shape
- Very dynamic and very bright in UV aurora



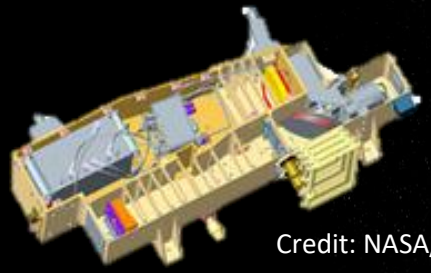


Red circles highlight bright spots observed by Juno-UVS in Northern hemisphere (left) and in Southern hemisphere (right).

Haewsantati et al. (2020, in preparation)

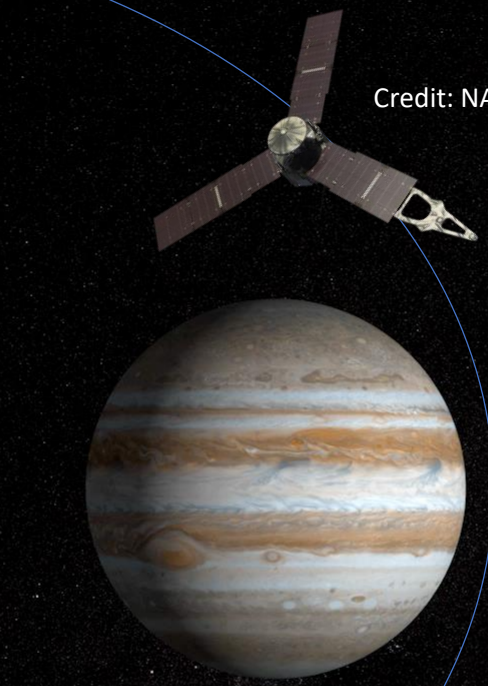
Observation

- Ultraviolet Spectrograph (UVS) instrument on board the Juno spacecraft
- 68-210 nm wavelength range with dog bone-shaped slit
- Acquired a Jupiter's aurora image every 30 seconds as Juno's spin period
- Aug 27, 2016 to May 29, 2019
- PJ1 - PJ20



Credit: NASA/JPL

Ultraviolet Spectrograph (UVS) instrument



Credit: NASA/JPL

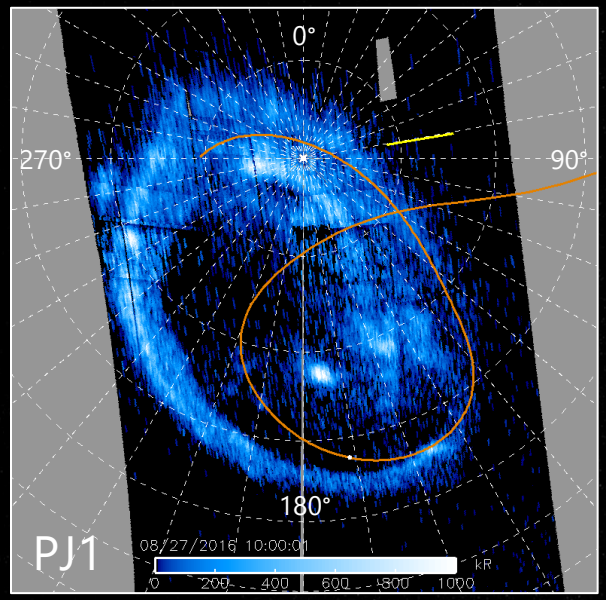
Haewsantati et al. (2020, in preparation)

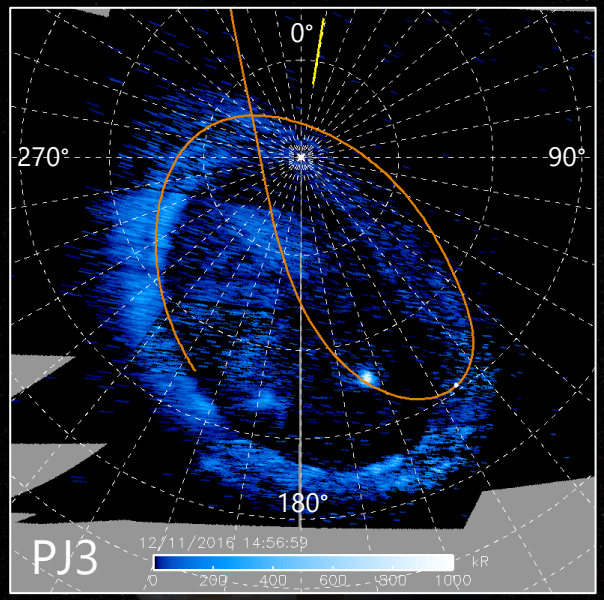
Methodology

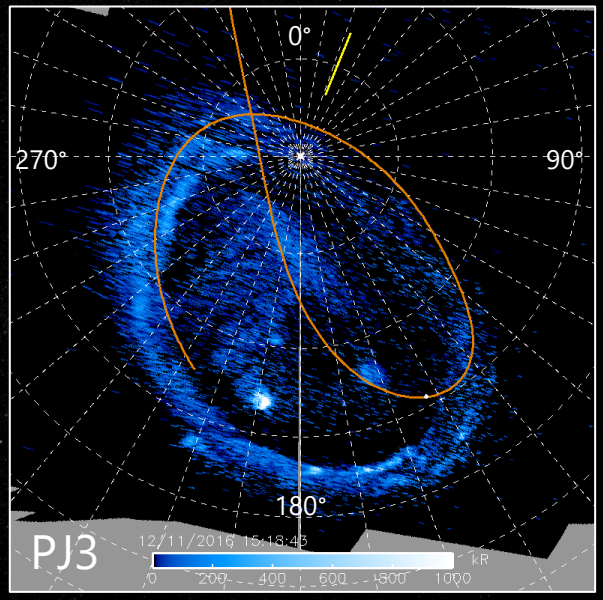
- Image processing and data analysis via Interactive Data Language (IDL)
- Main discussions:
  - The emitted power
  - The ionospheric and magnetospheric positions
  - Quasiperiodic behaviors

Haewsantati et al. (2020, in preparation)

Results: in Northern hemisphere







PJ1: Three bright spot emissions within 30 min, appeared nearly the same system III position

PJ3: Two distint bright spot emissions appeared at different SIII longitudes

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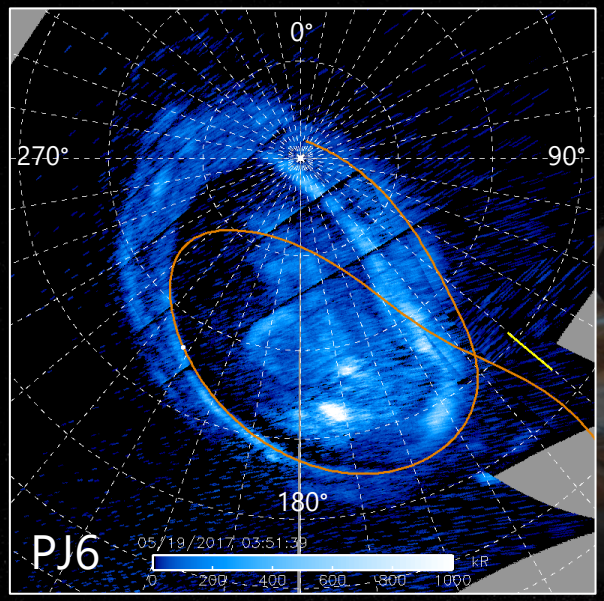
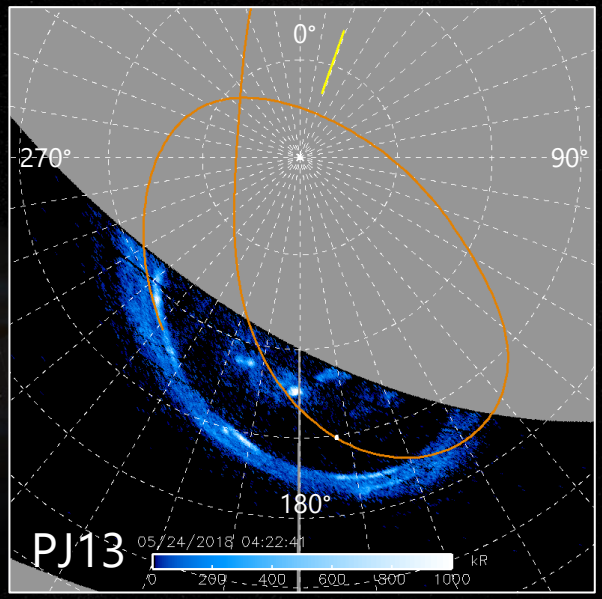
Results: in Northern hemisphere





PJ6: Large bright spot emissions

PJ13: Two bright spot emissions

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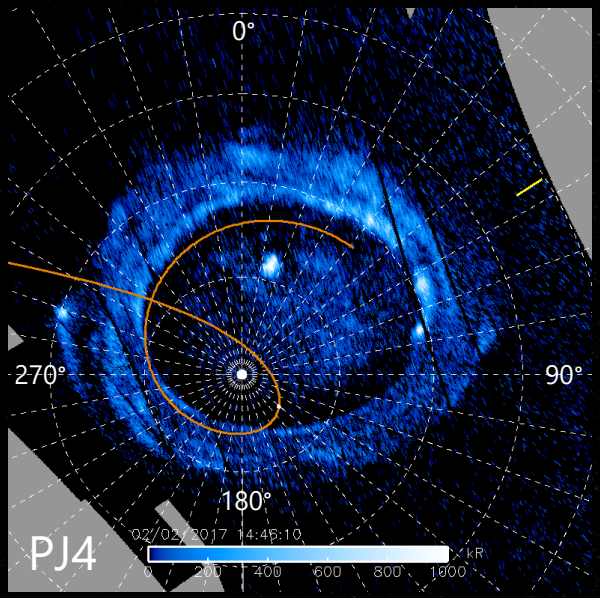
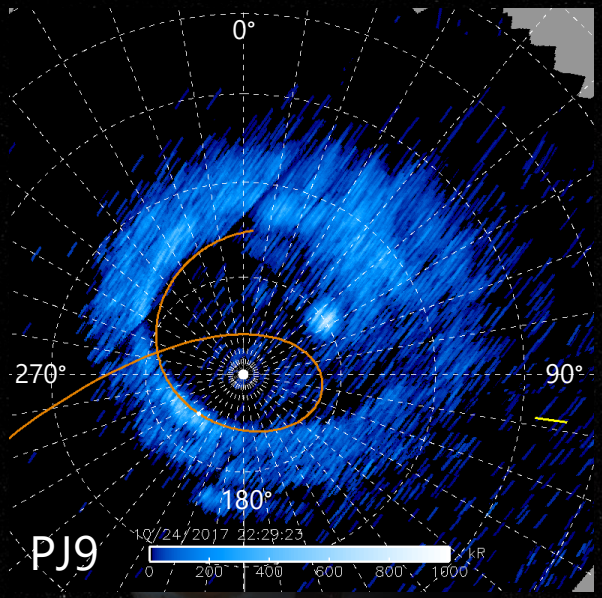
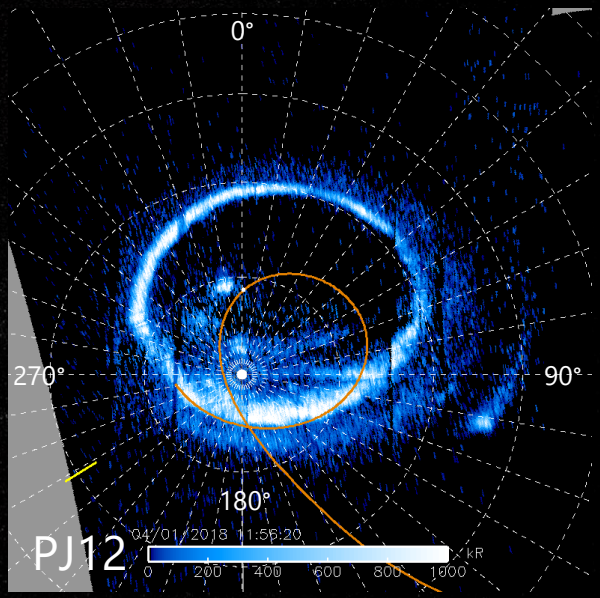
Results: in Southern hemisphere







PJ4: Six bright spot emissions during ~4-hour observation time, quasiperiodic behavior

PJ9: Bright spot emissions with clear evolution to change in SIII longitude

PJ12: Two bright spot emissions appeared at different SIII longitudes

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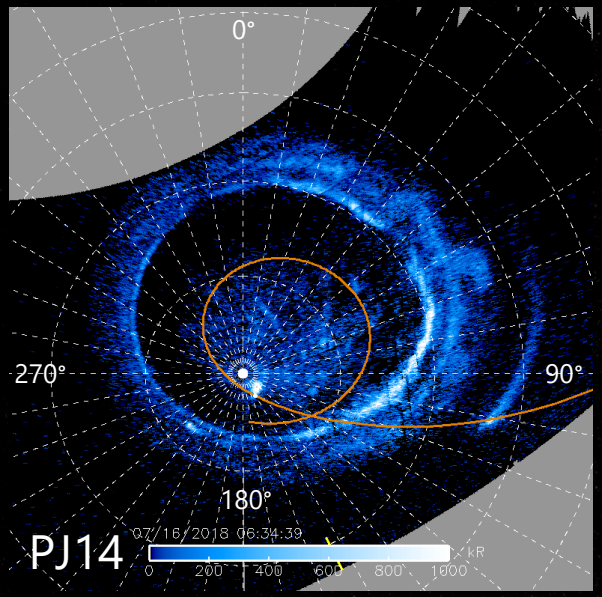
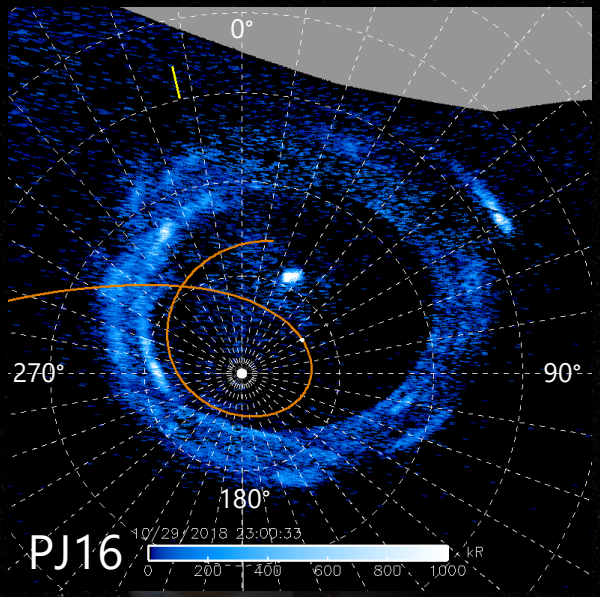
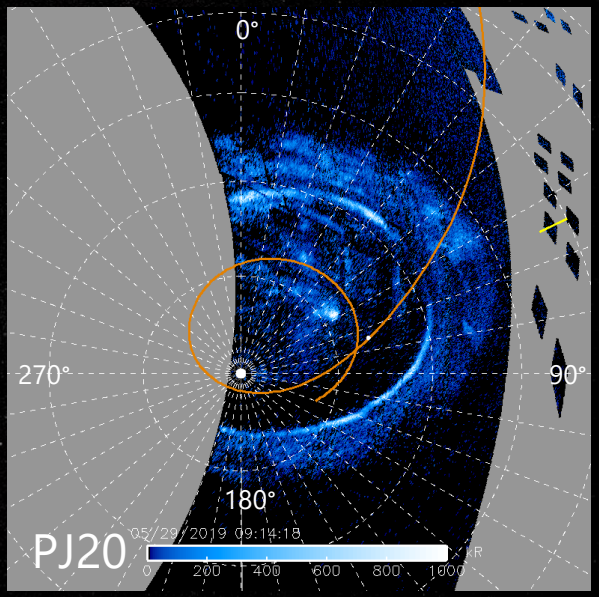
Results: in Southern hemisphere







PJ14: Many emissions within 30 min of selected time window

PJ16: Seven bright spot emissions with quasiperiodic behavior

PJ20: Four bright spot emissions during 1-hour of selected time interval

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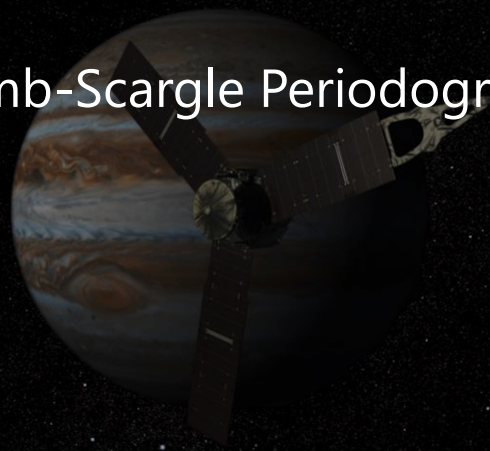
The Emitted power

- Range from tens to a hundred of gigawatts (GWs)
- Based on the ellipse fits from bright spot images to images in the same perijove
- Time interval between peak (image that appears bright spot emissions): ~2-40 min
- Period analyzed from Lomb-Scargle Periodogram: 13-46 min



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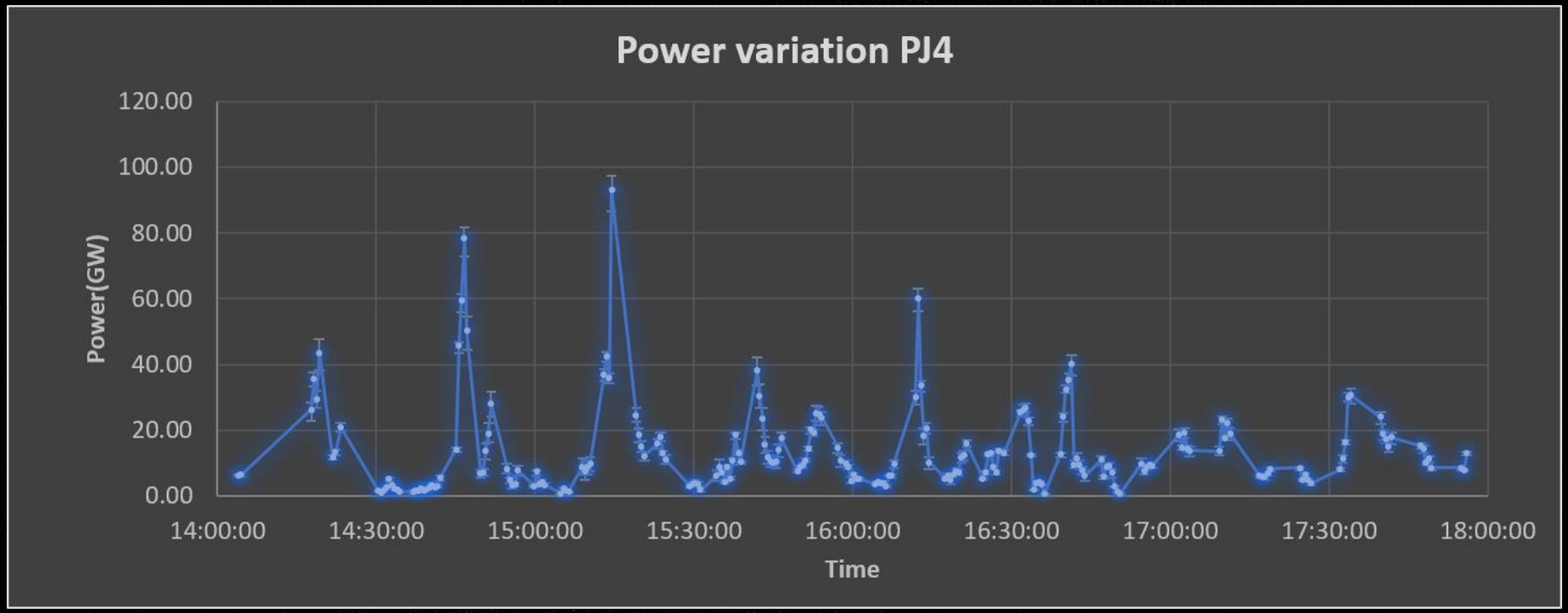
The Emitted power

- Power plot of PJ4 :

  => time interval between peak: ~ 30 min

  => evidence of quasiperiodic behaviors (period ~28 min)



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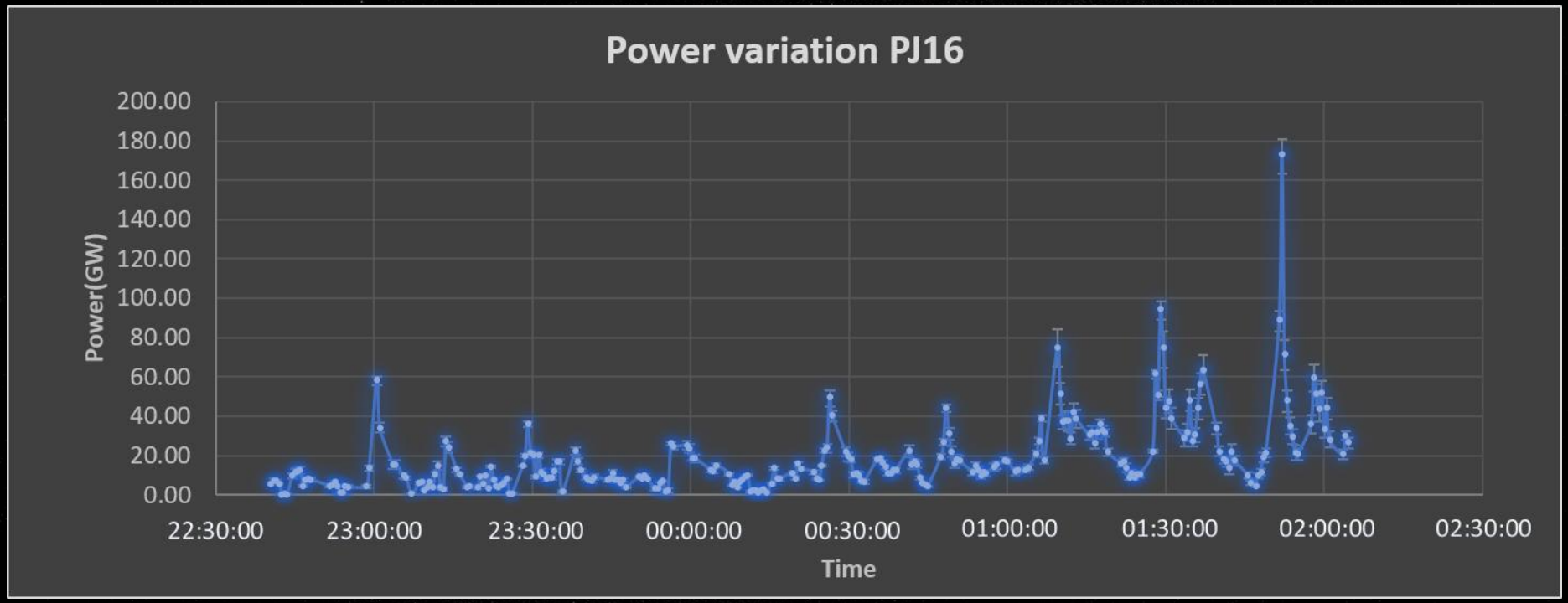
The Emitted power

- Power plot of PJ16:

  => time interval between peak: ~ 30 min

  => evidence of quasiperiodic behaviors (period 22-23 min)



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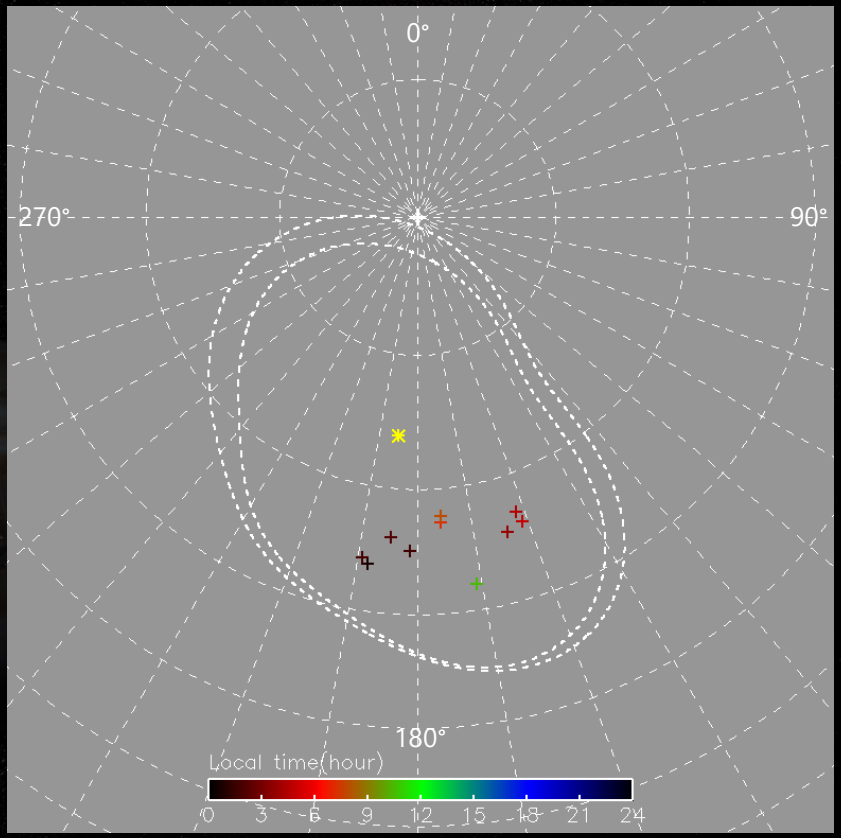
The system III positions and local times

- 60°-70° latitude, 160°-190° SIII longitude
- Analogous to X-ray hot spot region
- Approximate local time: Midnight – morning
- Vogt's mapping model:
  - >110 R_J in magnetosphere, dawn time
  - Unmapped for > 90% of spot data

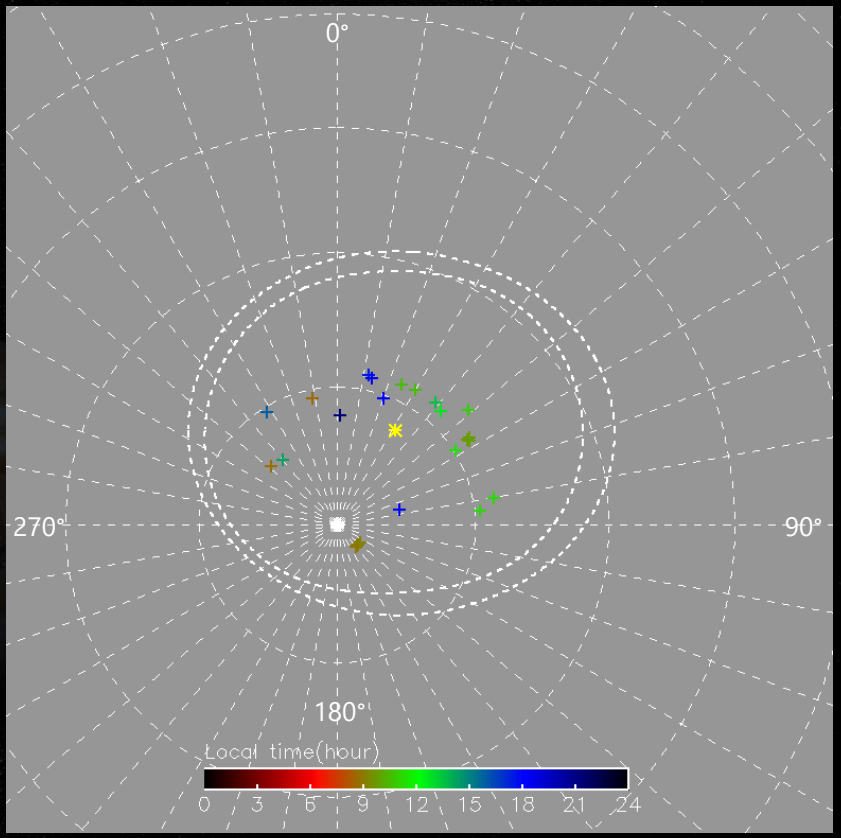


Polar plot shows bright spot found in northern hemisphere (plus sign). The color presents the approximated magnetic local time. A star plot shows a referenced magnetic pole(Bertrand et al. 2015)

Haewsantati et al. (2020, in preparation)

The system III positions and local times

- Scattered over the polar region
- Approximate local time: Morning - Night
- Vogt's mapping model:
  - >110 R_J in magnetosphere, dawn time
  - Unmapped for > 90% of spot data



Polar plot shows bright spot found in southern hemisphere (plus sign). The color presents the approximated magnetic local time. A star plot shows a referenced magnetic pole(Bertrand et al. 2015)

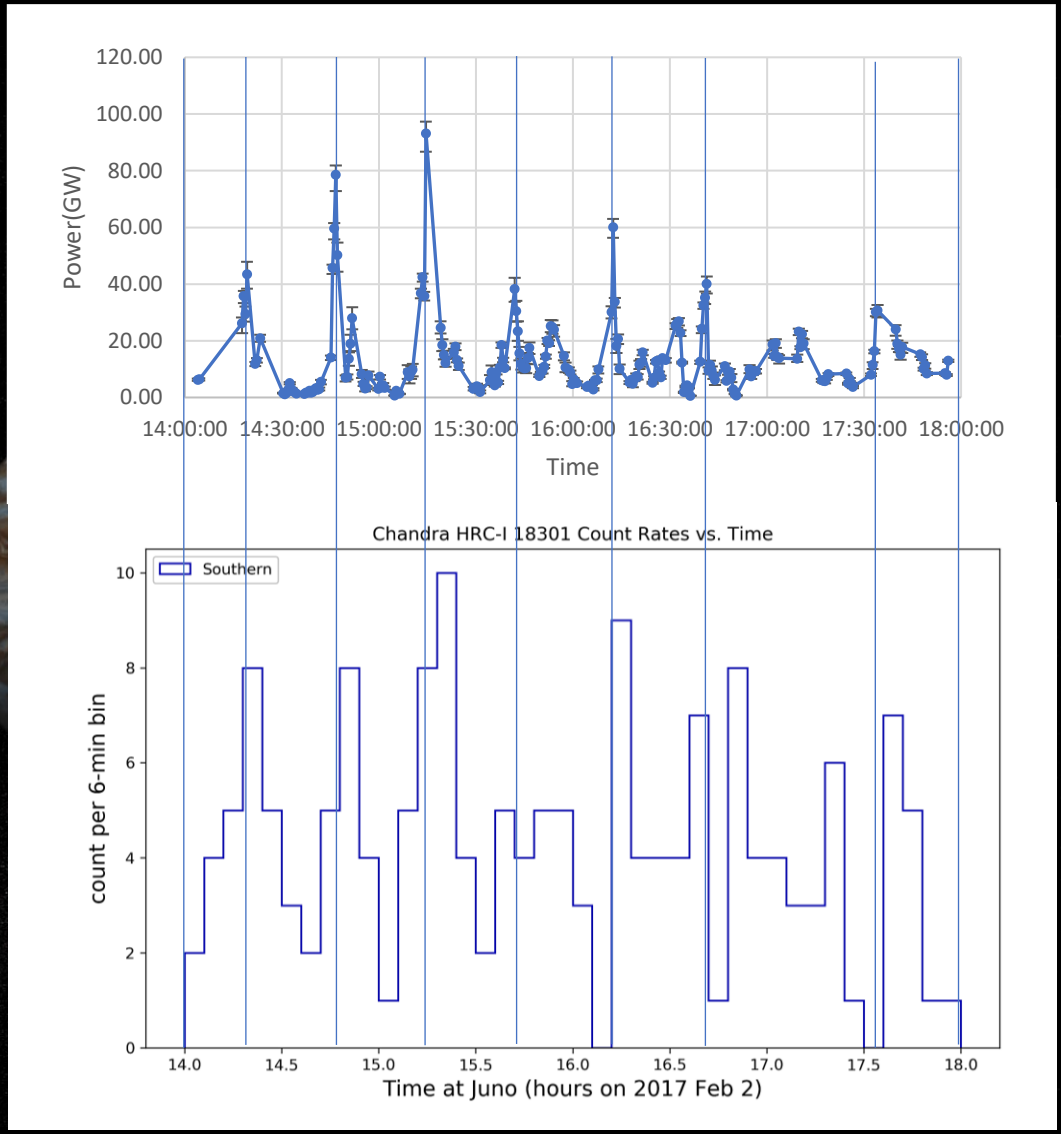
Haewsantati et al. (2020, in preparation)

Results: comparison with X-ray observations

- PJ4 VS Chandra observation

  => peak in UV nearly the same time with peak in X-ray light curve

  => under discussion



Haewsantati et al. (2020, in preparation)

Summary

- Occurrence from both N&S hemispheres
- The emitted power is tens GWs, some bright spot emissions can reach up to a hundred GWs.
- Reappearance of bright spot emissions within a Juno perijove in the same system III position, indicative of quasiperiodic pulsations
- The time interval between two consecutive brightening: ~2-40 minutes, same range as X-ray pulsed emissions
- The system III positions of bright spots:
  - **Northern hemisphere:** region around 175° system III longitude and 65° latitude.
  - **Southern hemisphere:** scattered around the polar region
- Bright spot emissions can be seen at any local times, contrast from previous studies and probably not associate with cusp process.

Haewsantati et al. (2020, in preparation)

Abstract

The instruments on board the NASA Juno mission provides scientists with a wealth of unprecedented details about Jupiter. In particular, the Ultraviolet Spectrograph (UVS) is dedicated to the study of Jupiter's aurora in the 68-210 nm wavelength range. The images taken by Juno-UVS reveals for the first time a complete view of Jupiter's aurora, including the nightside part hidden from the Earth-orbiting Hubble Space Telescope (HST). This work aims to study Jupiter's polar aurora using images obtained from the UVS instruments. Here we present the systematic analysis of one of the most spectacular features of Jupiter's polar-most aurora, called the bright spot. The emitted power of the bright spots ranges from a few to a hundred GWs. Within a Juno perijove, the spots reappear at almost the same positions in system III. The time interval between two consecutive brightenings is a few tens of minutes, comparable to Jupiter's X-ray pulsation. The comparison of the time interval with X-ray observation is under the investigation. Comparing the difference perijove sequences, the system III positions of bright spots in the northern hemisphere are concentrated in a region around 175 degrees of system III longitude and 65 degrees of latitude. On the other hand, the positions of bright spot aurora the southern hemisphere are scattered all around the pole. Previous studies suggested that the bright spot could correspond to noon facing magnetospheric cusp. However and surprisingly, we have discovered that the bright spots could map to any magnetic local time, putting this interpretation into question.