

# Alternative Filters for Imaging Planets

UV, IR, Methane

-Bill Warden

# Alternative Filters for Imaging Planets

UV, IR, Methane

- Most opaque to visible light
- avoid refractors
- best in RC's/reflectors
- can get away with SCT's
- uncoated barlow for UV

# UV

-Venus

-UltraViolet light shows rapidly moving clouds, thought to be composed of sulfuric acid and aerosols([wikipedia](#))

# UV

- Baader U filter
  - 350nm, bandwidth 60nm
  - (320-380nm)
  - \$
- Astrodon discontinued
  - back as Farpoint/OSI
- Stack Violet and IR block

# UV

- many coatings block UV
- consider no barlow or uncoated?
- but it's really bright...

# IR

Red+IR

- more signal, less contrast
- possibly Mars
- haven't used

# IR Pass Filters

- near IR  $<1000$  nm
- most amateur cameras  
insensitive to IR above  
1000nm

# IR

- resistant to poor seeing
- limit resolution due to larger spot size
  - mitigated by larger aperture
  - blue channel theoretically sharper than red (sure)



# IR

- bring out contrast in blue structures
  - base line planet image is white
  - vs DSO black
- Mars 2018

# IR Pass Filters

**Baader IR 685nm (-1000)**

Astronomik IR 742

**Astronomik IR 807**

ZWO IR 850

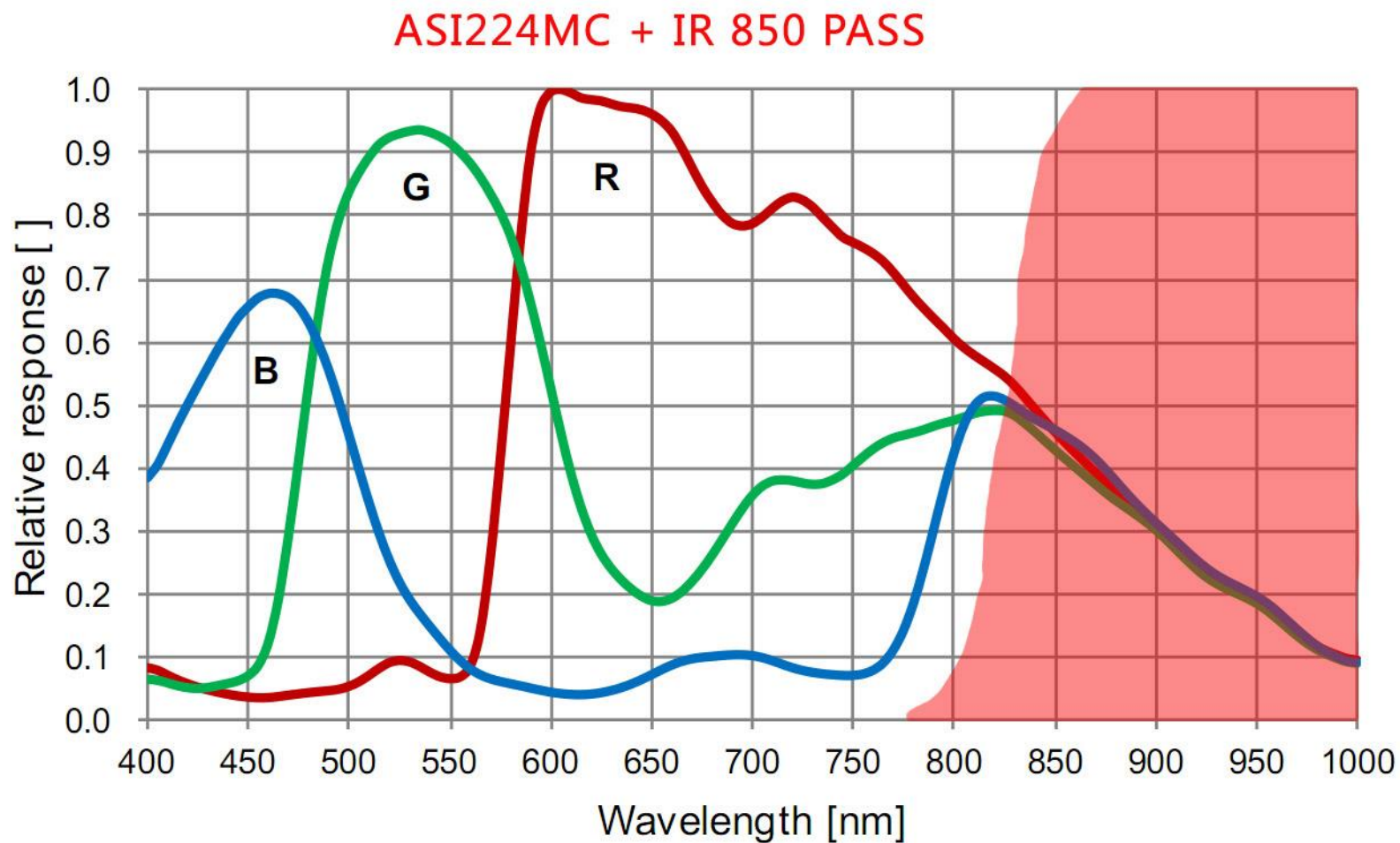
RG1000 1000 nm long pass  
>1000nm

# IR

ZWO IR 850

- color filters on OSC camera pass IR (IR/UV block filter recommended)
- can use with ZWO OSC color camera as mono with IR pass filter
- inexpensive

# ZWO IR 850



# Which IR Filter?

**Baader IR 685nm (-1000)**

Astronomik IR 742

**Astronomik IR 807**

ZWO IR 850

RG1000 1000 nm long pass  
>1000nm

# Which IR Filter?

Depends on Seeing

For me IR 807  $\geq$  IR 685 despite

- longer exposure times

- capturing fewer frames.

Except Mars

- very short exposure mitigated seeing?

# Methane

- Methane in the atmosphere of gas giants absorbs red
- filters target 889 nm absorption band in IR

# Methane

- There is methane everywhere in gas giants
- absorption less when there is a reflective element higher up in the atmosphere
- proxy for height of clouds.
- higher clouds, brighter signal (less absorption 2x distance)



# Methane

- faint signal requires longer exposure, and/or binning, less magnification
- limits planetary imaging techniques to compensate for seeing distortions

# Methane which filter?

- 889 nm with 50, 20, 8 nm band width
- narrower better contrast
- price inversely correlated with width
- ZWO 20 nm
- Baader 8 nm

# Mercury

- rock

  - no color

  - no atmosphere

- seeing is the only concern

  - dominated by atmospheric distortion at low altitude

# Mercury

IR longer wavelength the better

-**Astronomik IR 807**

-consider ZWO 850

-only role for RG 1000 nm

# Mercury

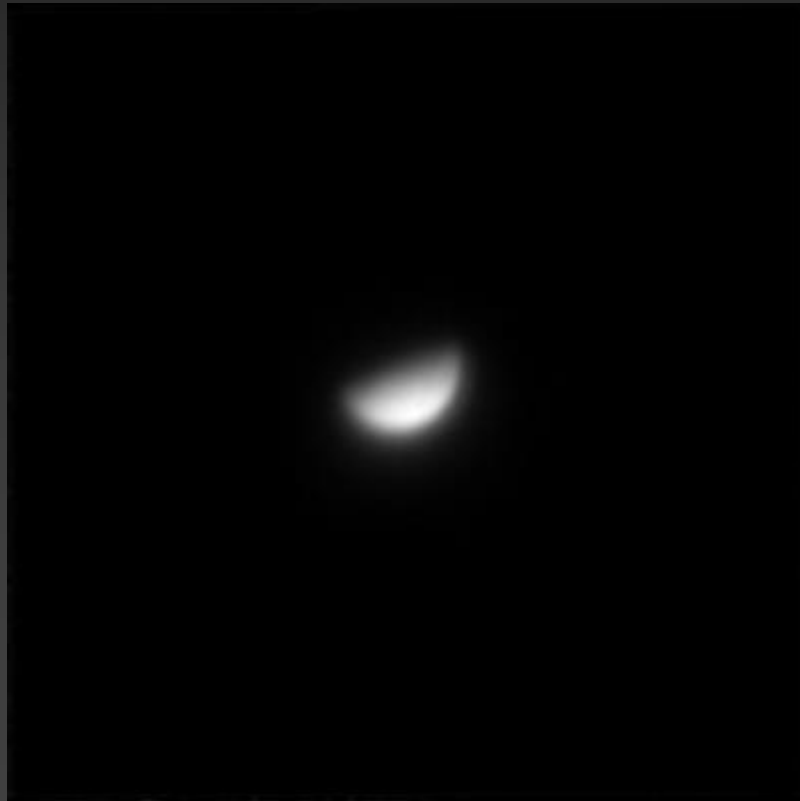
Is mid-day imaging possible?

2006 RGB C8 toucam



# Mercury

2018 IR C11 ZWO 290-MM



# Mercury

2018 IR C11 ZWO 290-MM 2x Barlow



# Mercury

Improvements:

- mid day?
- more disk visible
- multiple shots to confirm rotation
- reflector?



# Venus

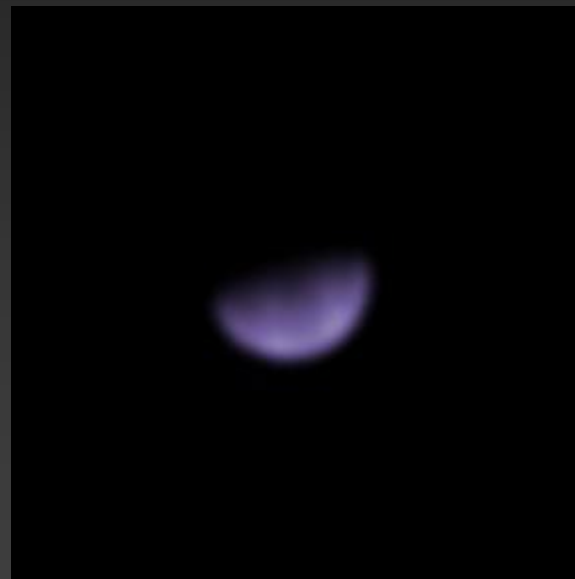
- UltraViolet light shows rapidly moving clouds, thought to be composed of sulfuric acid and aerosols([wikipedia](#))
- Subtle bands in IR possible

# Venus

- higher than Mercury
- can be captured mid day

# Venus

2018 UV C11 ZWO 290-MM 2x Barlow



# Venus

Improvements:

- mid day?
- more disk visible
- multiple shots to confirm rotation
- reflector?

# Mars

-IR

-fight poor seeing

-enhance contrast of blue surface  
detail

**-penetrate martian dust**

# Mars

-IR

-shorter wavelength (685 vs 807) seemed as effective or better than longer

-extremely bright

-very short exposures

minimize seeing effects?

-red + IR?

# Mars, Bringer of....Dust

Ironically, approaching 2018 opposition surface detail completely obscured by planet wide dust storm.

Began to clear at closest approach

IR dramatic increase in surface detail/contrast

# Mars, Bringer of....Dust

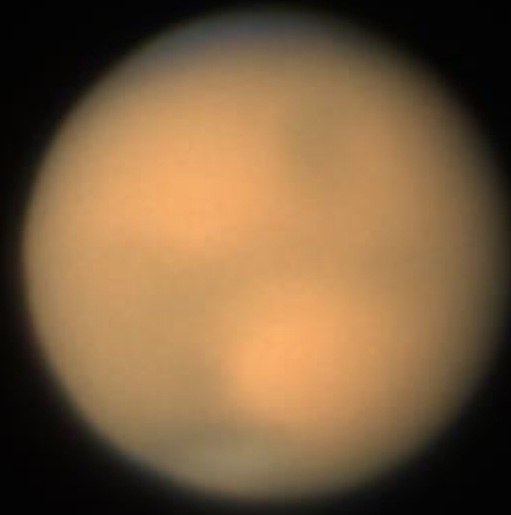
2 weeks before closest approach

7/14/2018 08:00 UTC

RGB



IR-RGB





# Mars, Bringer of....Dust

4/20/2014 RGB

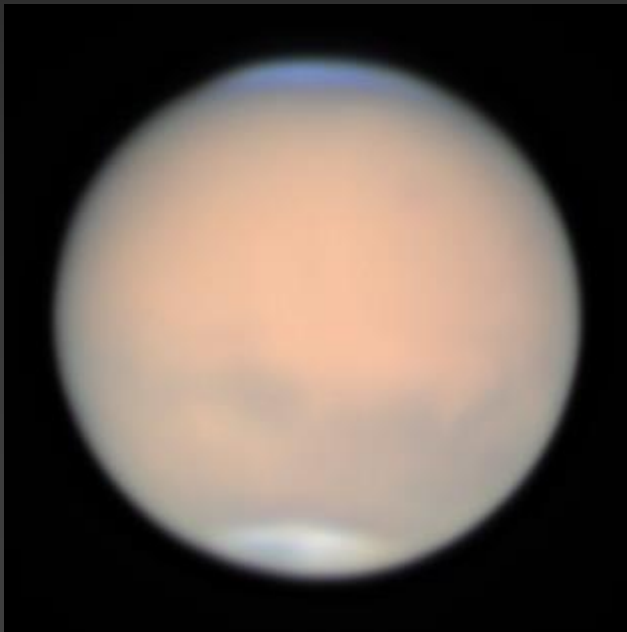


# Mars, Bringer of....Dust

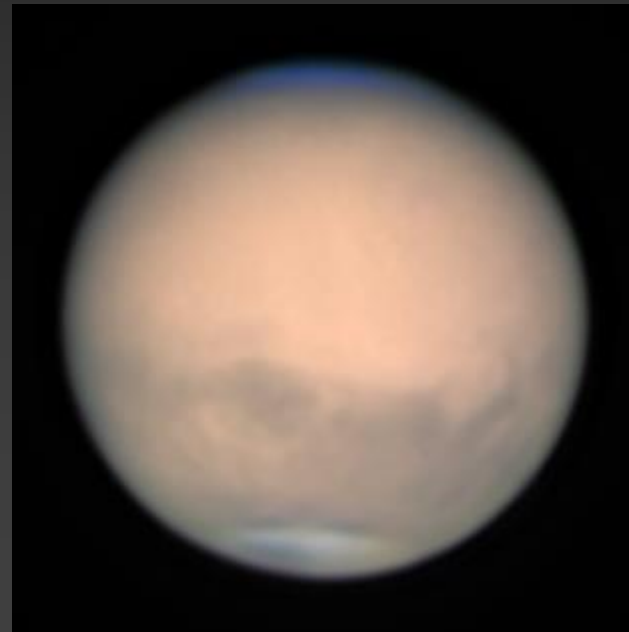
closest approach

7/31/18 8:21 UTC

RGB

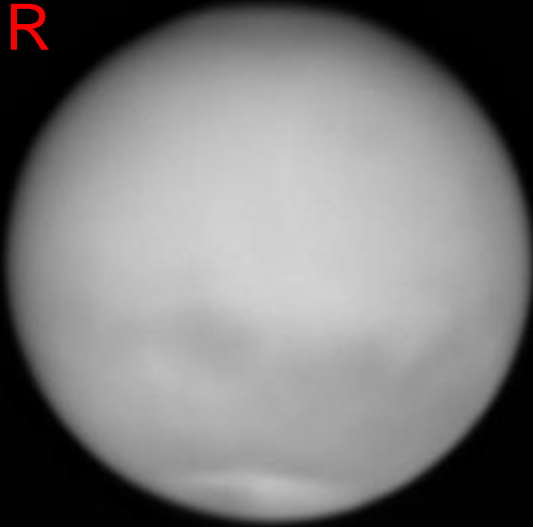


IR-RGB

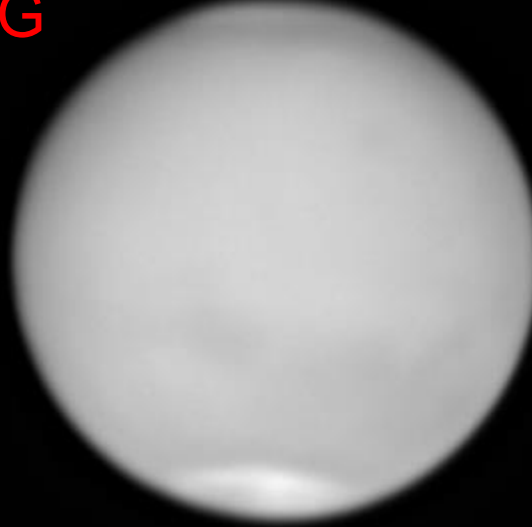


# Mars, Bringer of....Dust

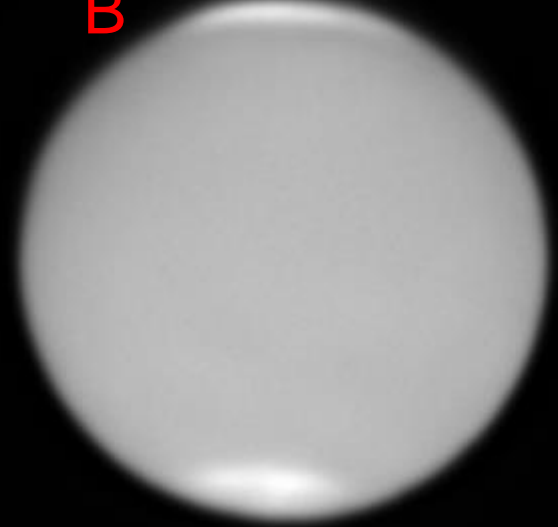
R



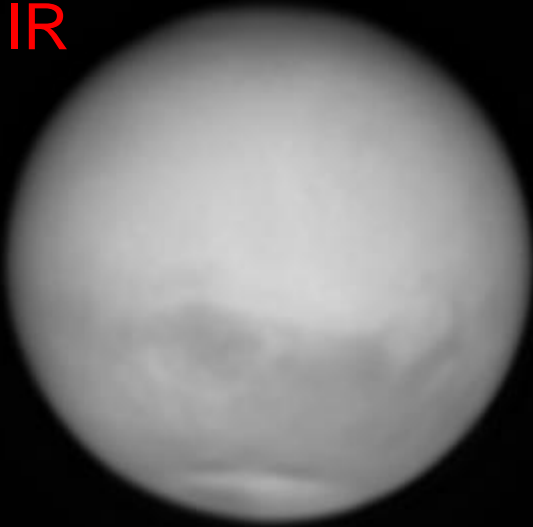
G



B



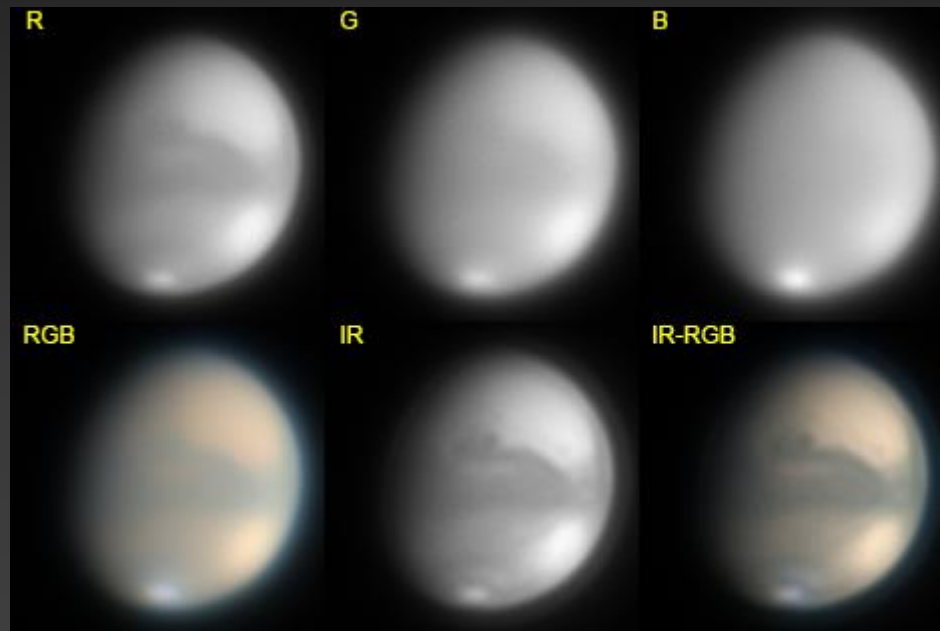
IR



closest approach  
7/31/18 8:21 UTC

# Mars, Bringer of....Dust

10/27/18



# Jupiter

- IR makes GRS, equatorial band brighter
- most detail involves red structures
  - enhanced in blue channel
  - IR not useful as luminance
- IR does bring out detail/contrast in blue festoons

# Jupiter

6/27/19 5:23 UTC



# Jupiter

- imaging all about seeing
- IR filter not that helpful
  - similar to saturation boost

# Jupiter IR comparison

6/23/19 6:49 UTC

RGB



IR-GB

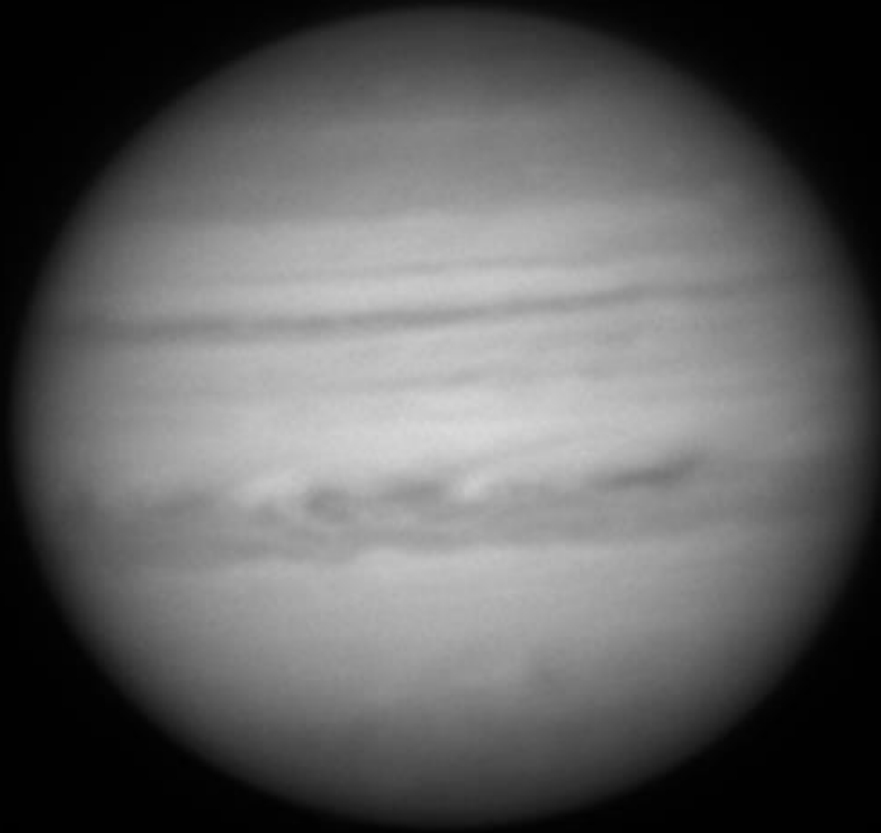




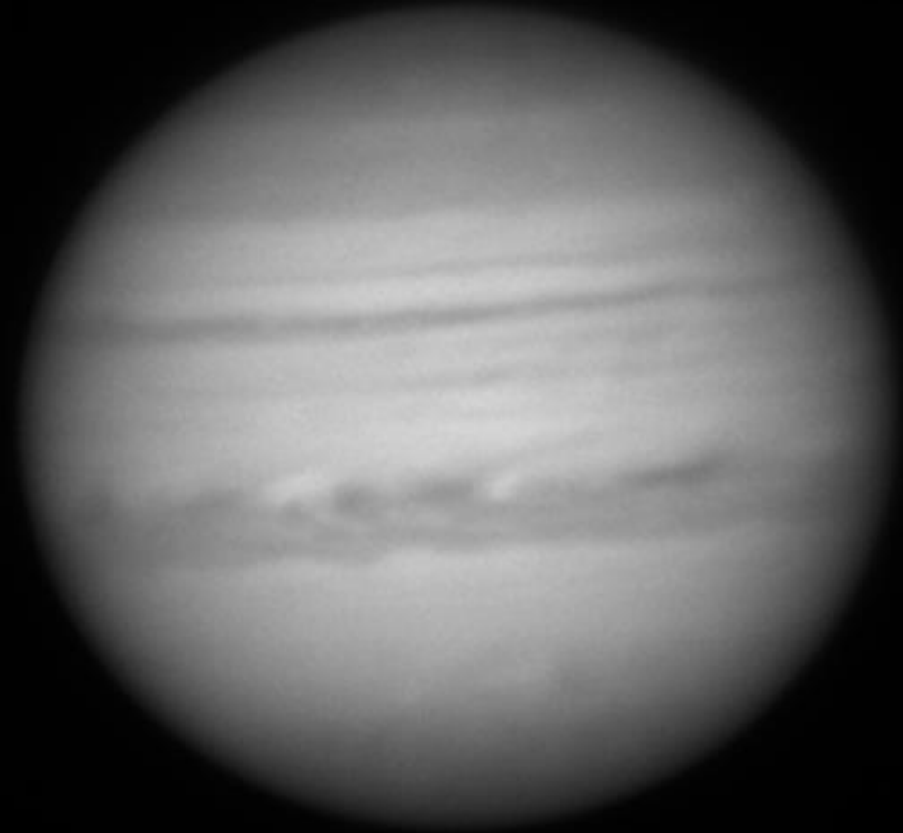
# Jupiter IR comparison

6/23/19 6:49 UTC

IR 807

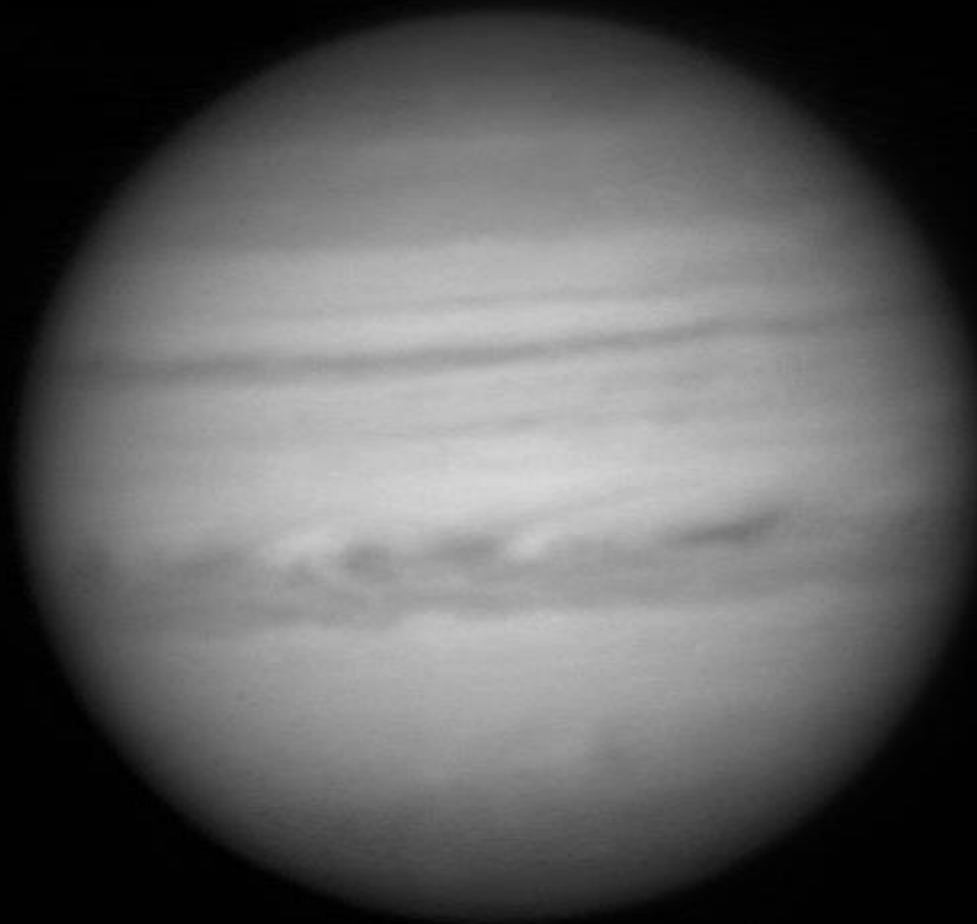


IR 685



# Jupiter

IR 807



685 nm

FPS=116

Shutter=4.931ms

Frames captured=10453

807 nm

FPS=34

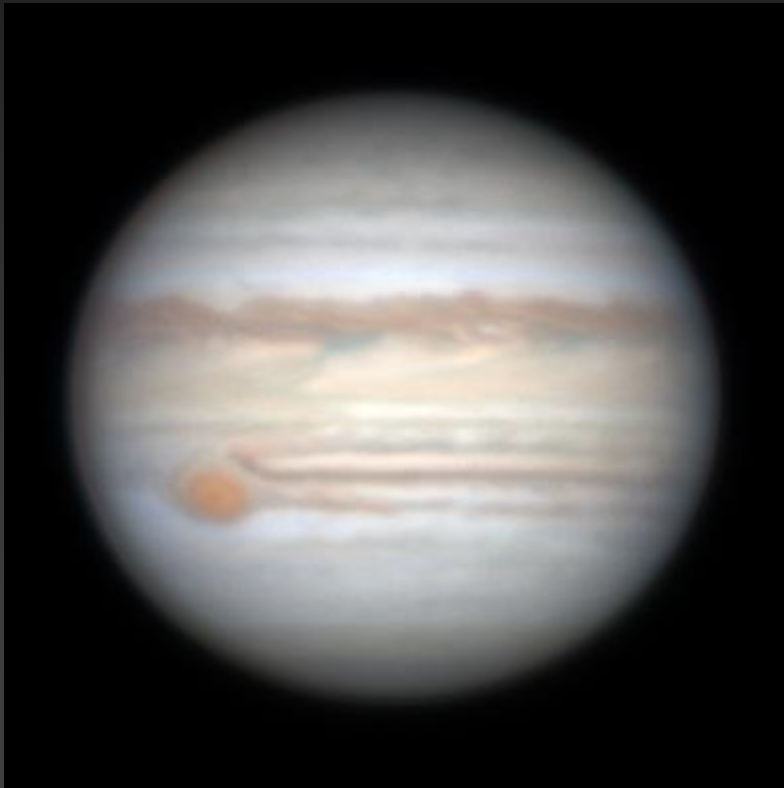
Shutter=23.89ms

Frames captured=3065

# Jupiter GRS Peel Off

6/9/19 8:52 UTC

RGB



IR-GB



# Jupiter GRS Peel Off

6/9/19 8:52 UTC

IR-GB



RGB/IR-GB



# Jupiter GRS Peel Off

Here's a time lapse of the great red spot taken by [BQ Octantis](#), a member of the cloudy nights forum, imaging from the Australian outback:

Great Red Spot Progression  
25 May - 28 June 2019



2019-05-25 12:18 UTC

# Jupiter GRS Peel Off

Great Red Spot Progression  
25 May - 28 June 2019



2019-05-25 12:18 UTC

Copyright 2019 BQ Octantis. All rights reserved.

A section of the great red spot appears to peel off on June 1 and then progress to the right.

<https://www.skyandtelescope.com/astronomy-news/jupiters-great-red-spot-unfurls-see-it-in-your-scope/>

# Jupiter Methane

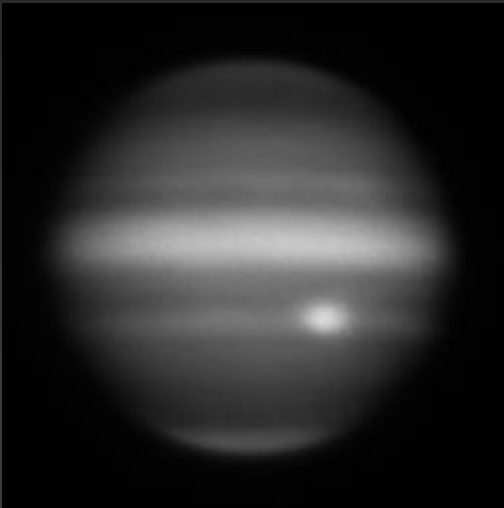
-GRS unfurling

# Jupiter Methane

- There is methane everywhere in Jupiter's atmosphere
- absorption less when there is a reflective element higher up in the atmosphere
- proxy for height of clouds.
- higher clouds, brighter signal (less absorption 2x distance)



# Jupiter Methane



- Brighter at GRS

  - high in the atmosphere, therefore little methane absorption

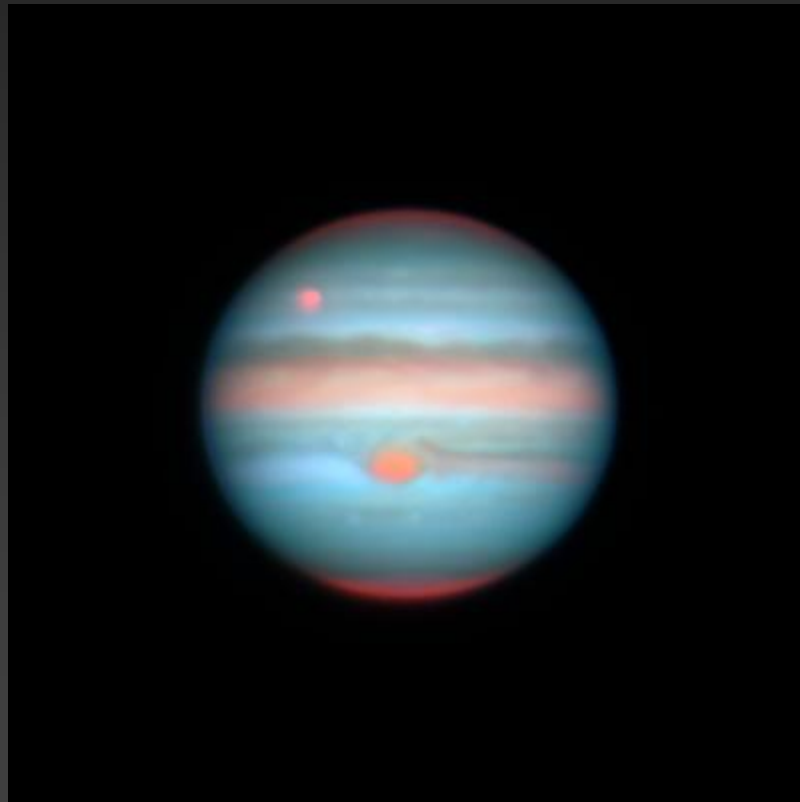
- equatorial “clearing”

- bright poles

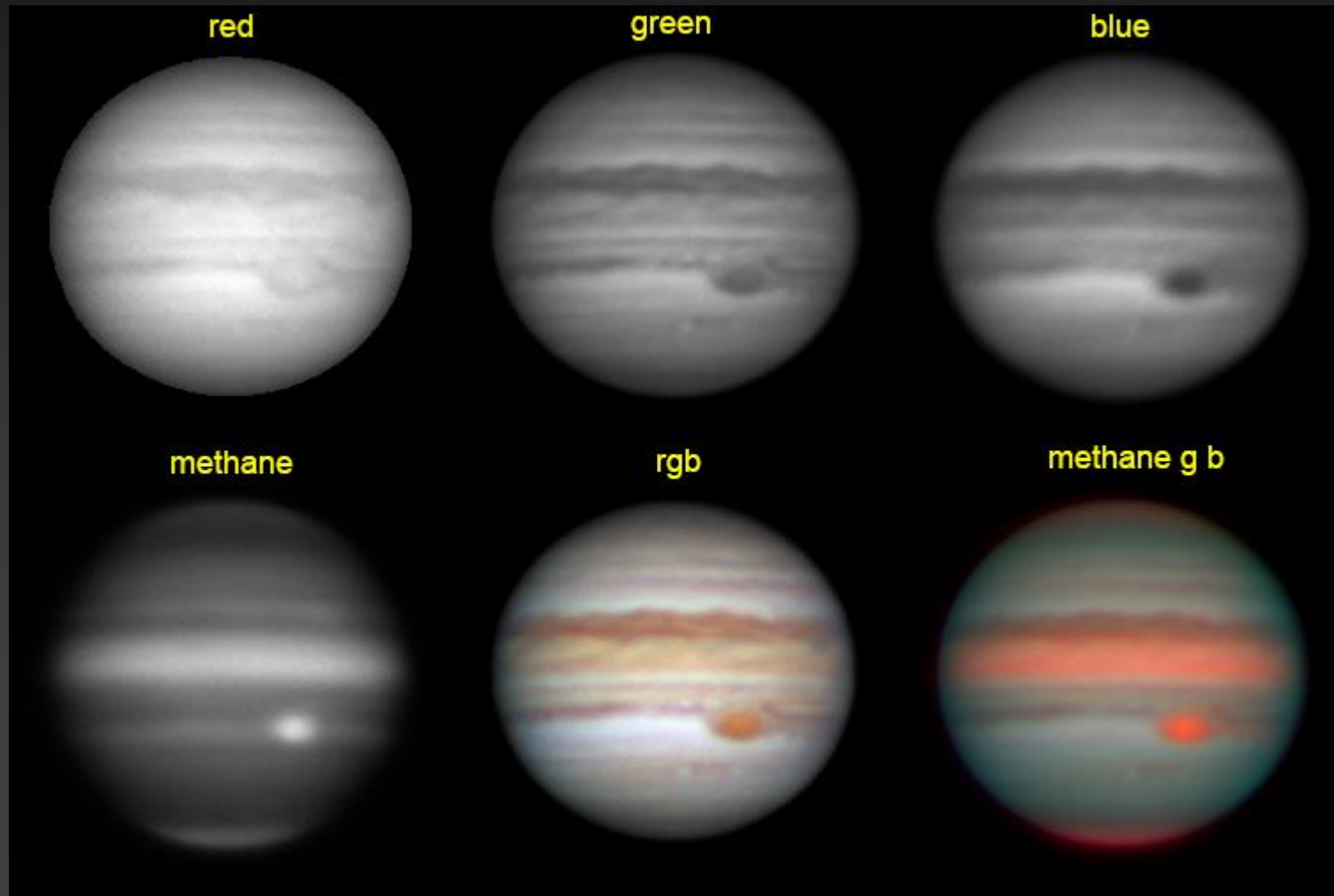
- very dark east and west sides

# Jupiter Methane

-Looks Cool



# Jupiter Methane



# Jupiter Methane

6/27/19 5:23 UTC  
C11 Edge ZWO ASI 290 MM  
Baader 889 nm x 8 nm

Methane

Frames captured=452

**Binning=2x2**

FPS (avg.)=4

Shutter=200.3ms

Gain=361 (60%)

Blue

Frames captured=25737

**Binning=no**

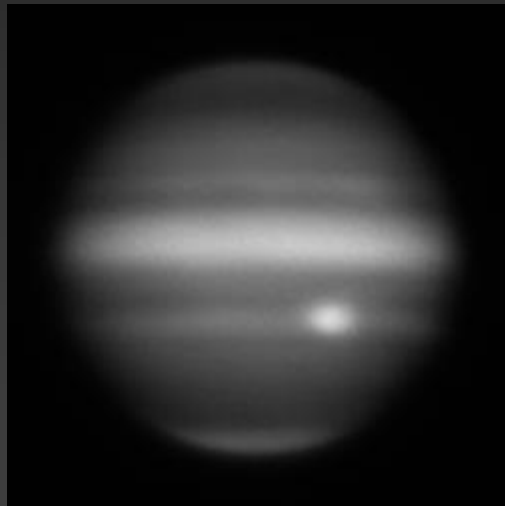
ROI=304x300

ROI(Offset)=0x0

FPS (avg.)=285

Shutter=1.829ms

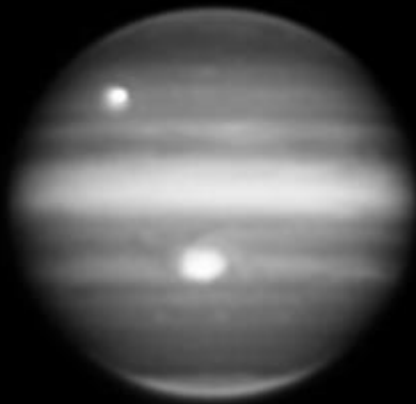
Gain=361 (60%)



# Jupiter Methane

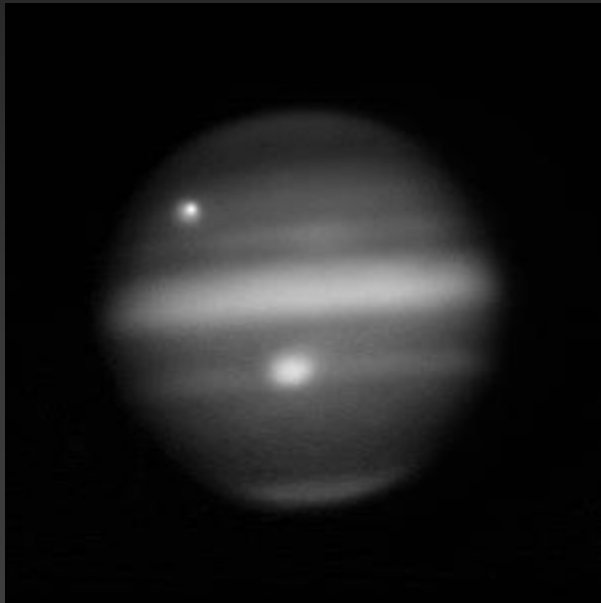
GRS unfurling?

6/29/19 6:17 UTC



# Jupiter Methane

Moons extremely bright



# Jupiter Methane

-equatorial clearing?

<https://www.skyandtelescope.com/astronomy-news/astronomers-identify-weather-cycle-jupiter/>

# Saturn

- north polar hexagon blue
  - excellent target for IR
- detail in ring structure



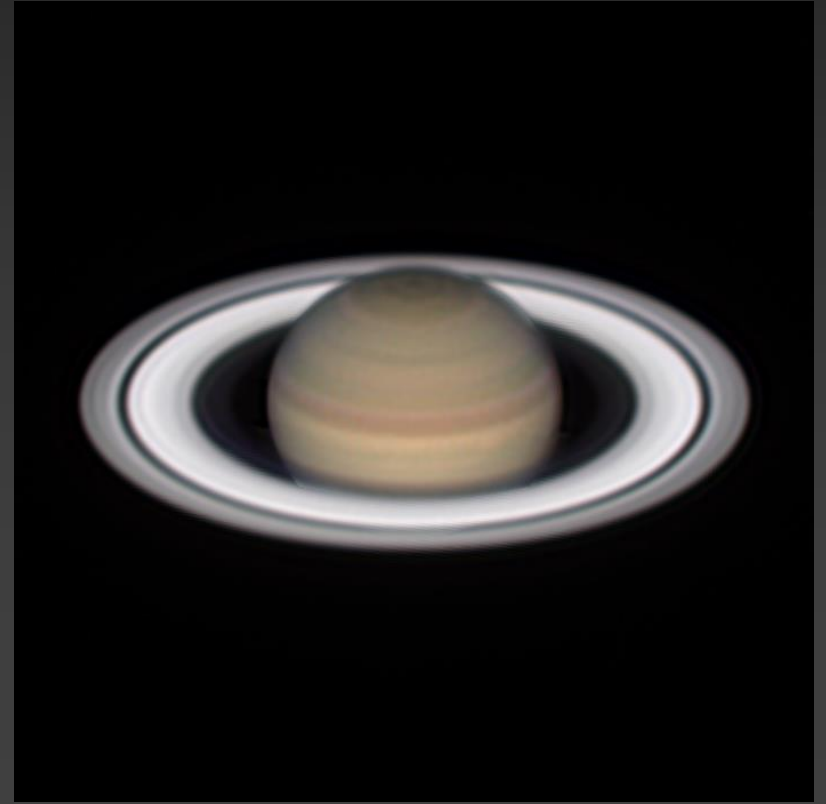
# Saturn IR

6/26/18 7:45 UTC

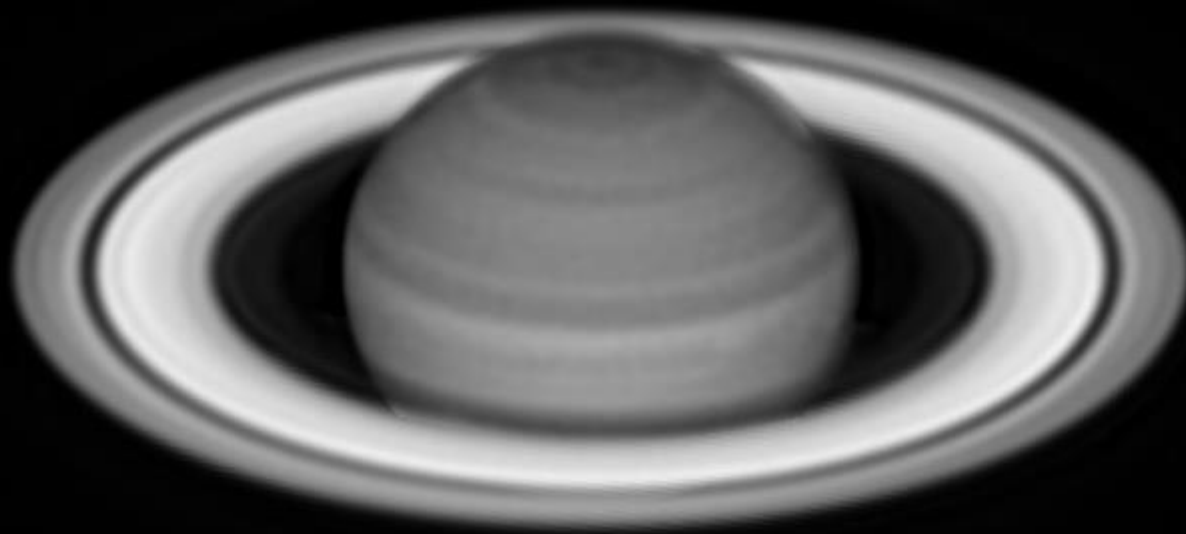
RGB



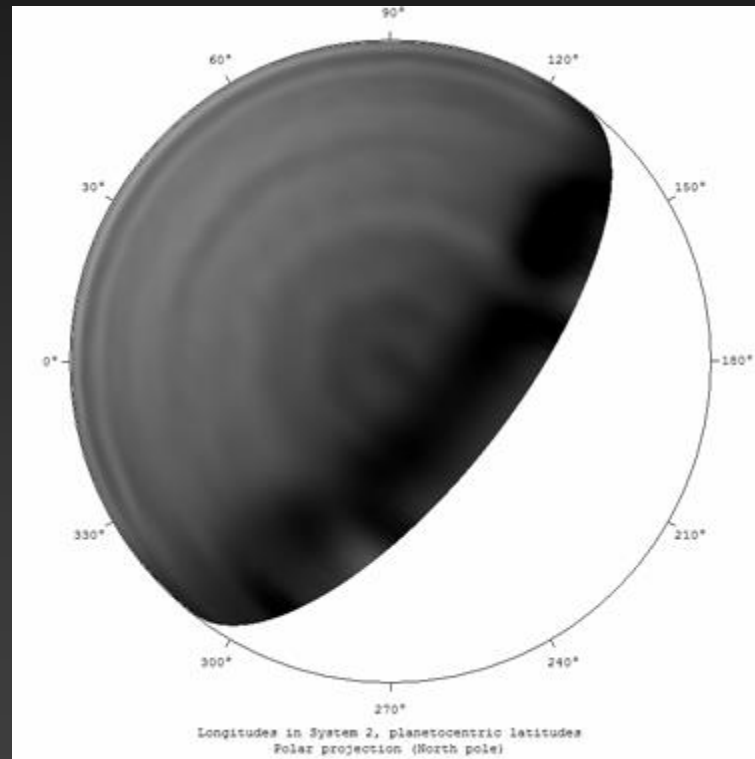
IR-RGB



# Saturn IR



# Saturn IR

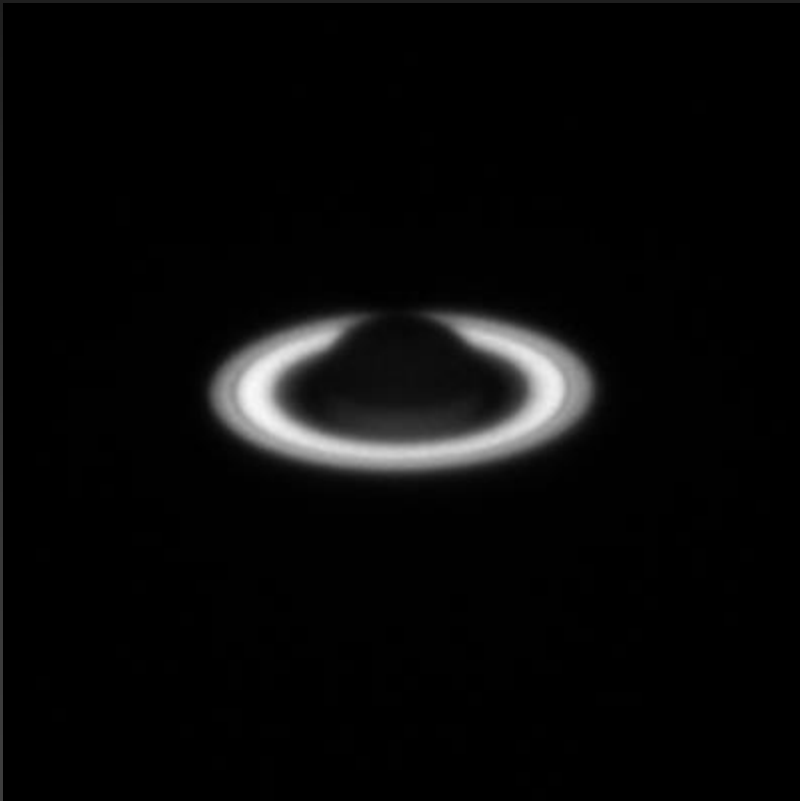


# Saturn

## -Methane

- Rings (water ice) glow dramatically in contrast to dark disk which absorbs methane band
- Not much detail on disk
- detect faint moons lost in the glare of the disk

# Saturn Methane



Frames captured=207

Binning=2x2

Shutter=283.0ms

Gain=351 (58%)

# Ice Giants

- Bluish due to methane absorbing red light
- very faint so most advocate IR as a proxy for methane (need enough signal to track disk for stacking)

# Uranus

- well suited for northern hemisphere observers

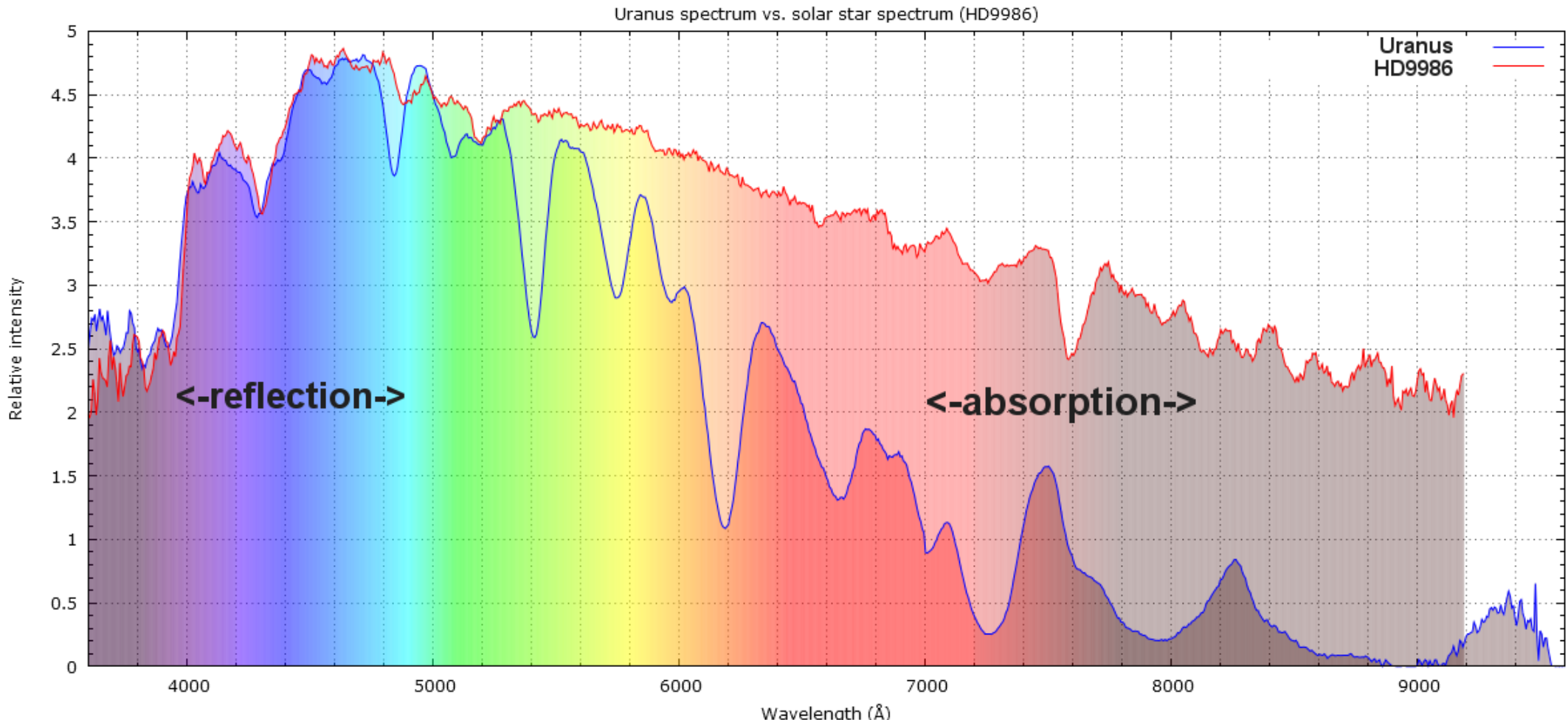
  - transit elevation 67 degrees

  - vs 34 for jupiter

# Uranus Spectrum

-Christophe Pellier (with permission)

<https://www.planetary-astronomy-and-imaging.com/en/uranus-spectrum-commented>





# Uranus IR Filter review

-Christophe Pellier

Baader 610 nm brightest

Astronomik BP642 OK

Baader 685 nm sacrifices brightness, but improves contrast

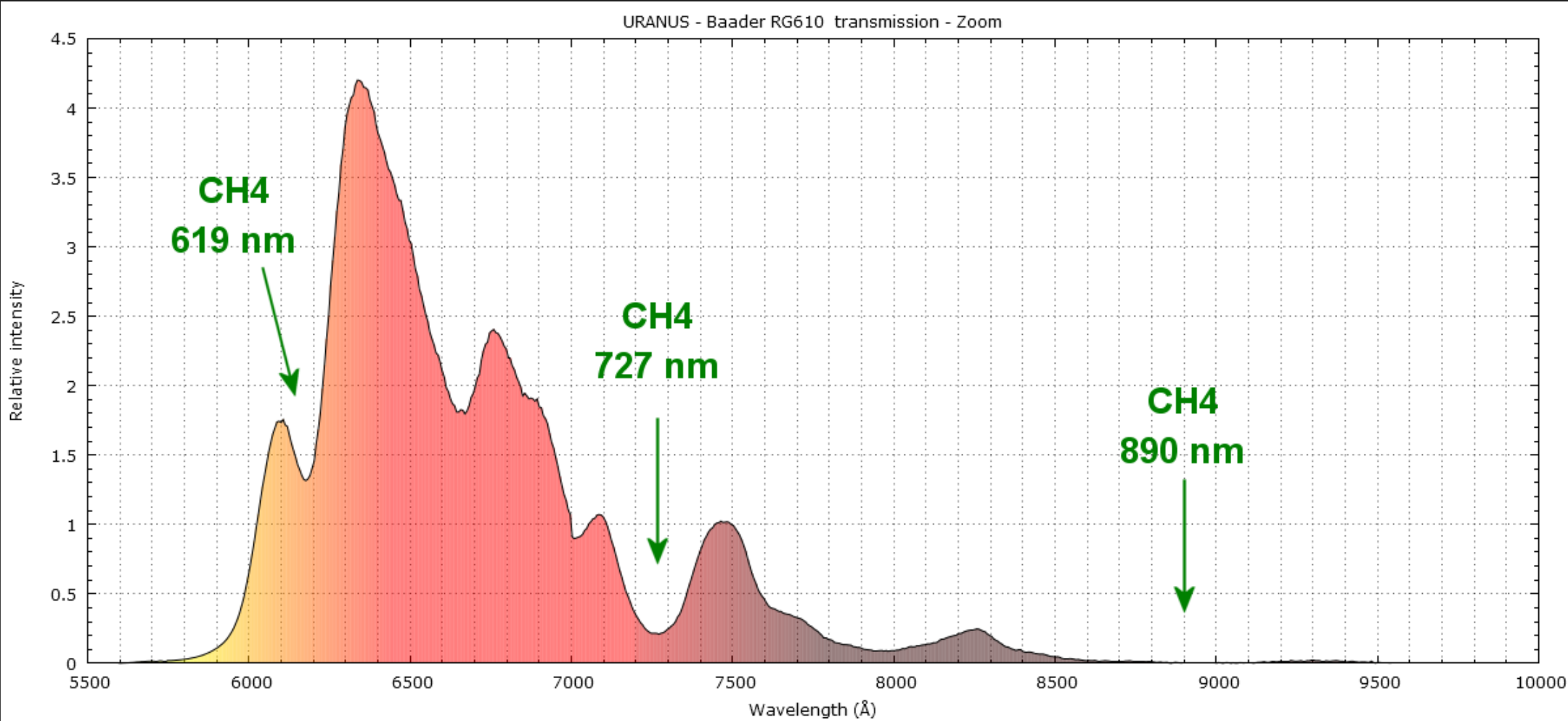
Astronomik IR742 does not pass enough light

<https://www.planetary-astronomy-and-imaging.com/en/filters-uranus-spectroscopy>

# Uranus IR Filter review

-Christophe Pellier (with permission)

<https://www.planetary-astronomy-and-imaging.com/en/filters-uranus-spectroscopy>



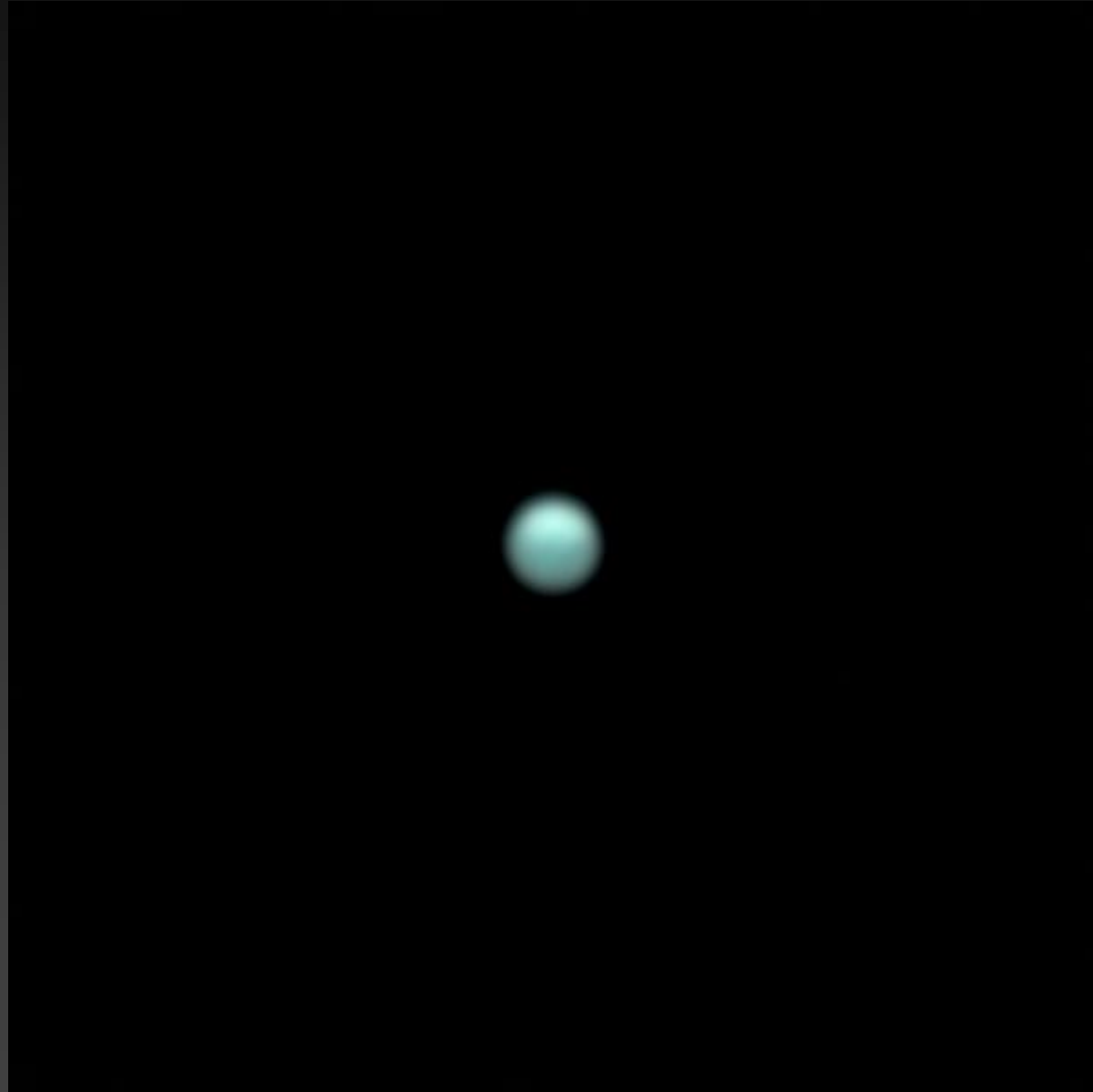
# Uranus

- No white point
- add long exposure wide field captures for color balance on moons and orientation for winjupos

# Uranus

-IR will show cloud detail on summer side

# Uranus IR-IRRGB



# Neptune

-IR may show small clouds, great dark spot

# Neptune

- No white point
- add long exposure wide field captures for color balance on Triton and orientation for winjupos
- Triton is relatively bright
  - often visible in standard captures

# Neptune





# Neptune



# The End

