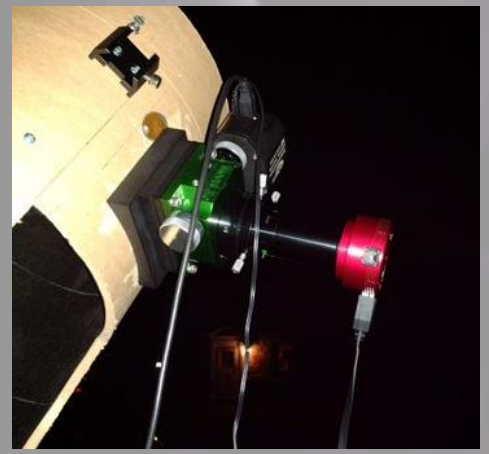
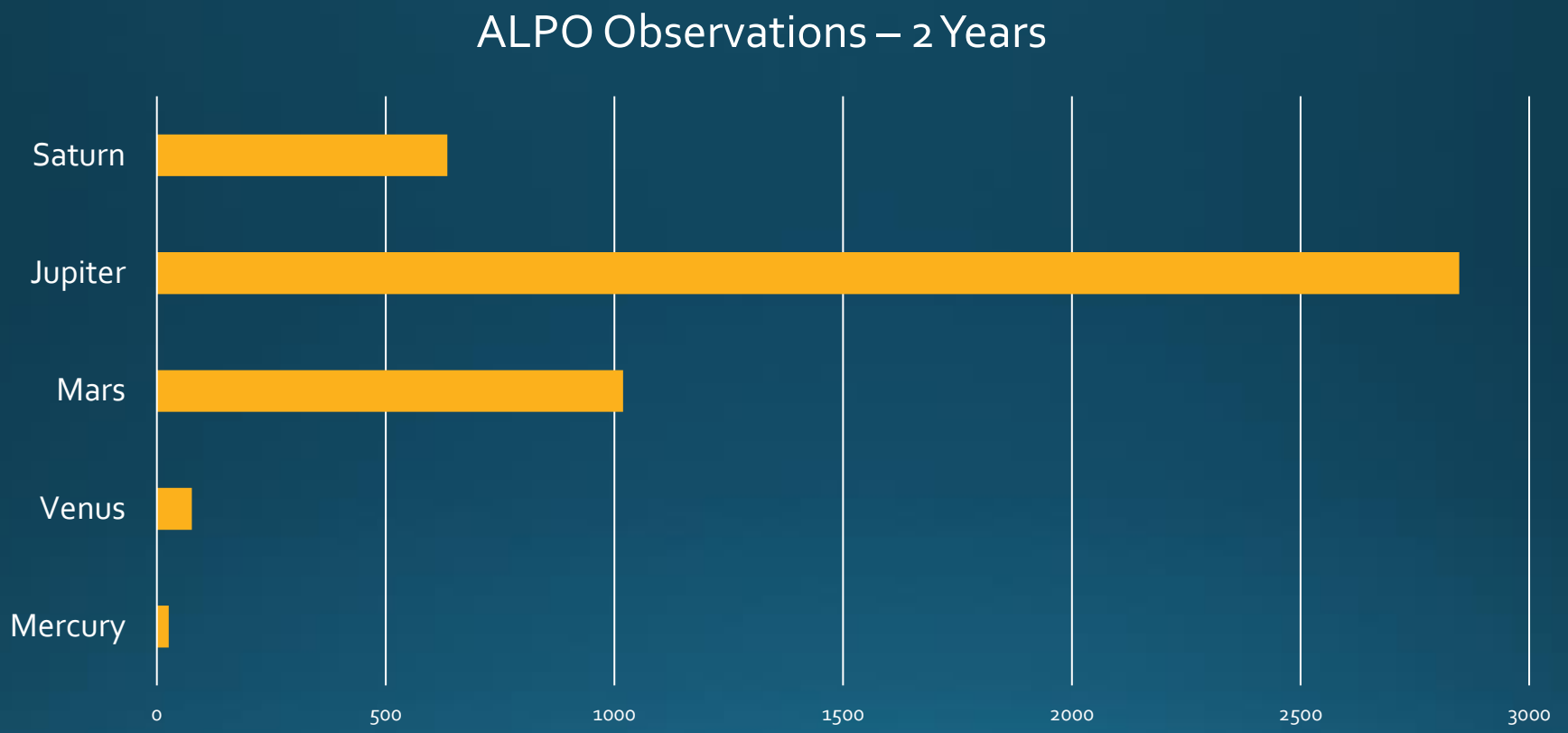
Jupiter

Big Fun for the Amateur Astronomer!



Jupiter is one of the most popular planets for amateur observers



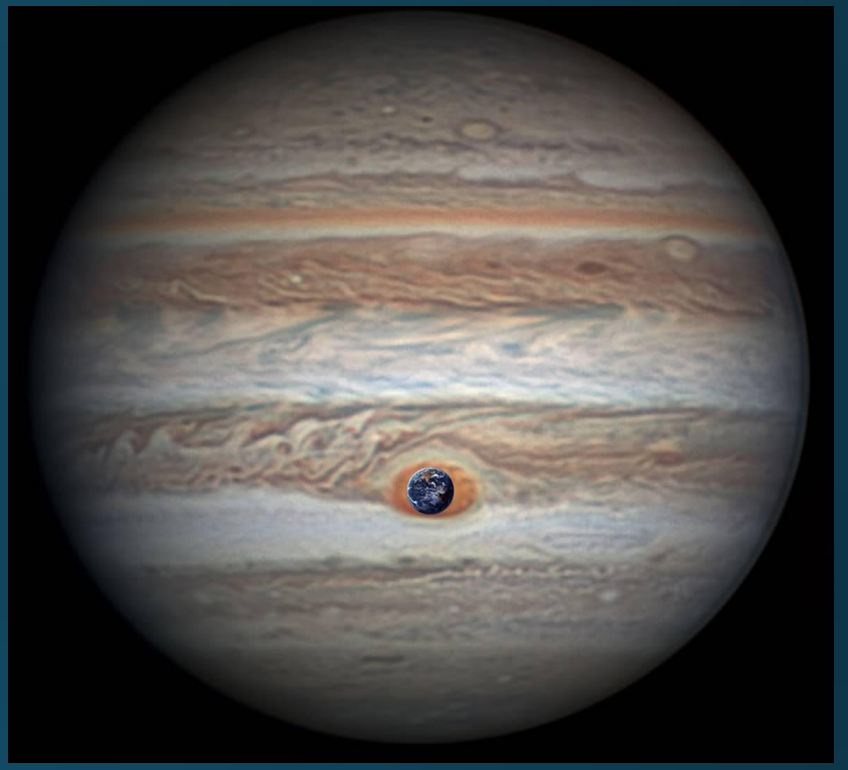
What's the attraction?

Size!

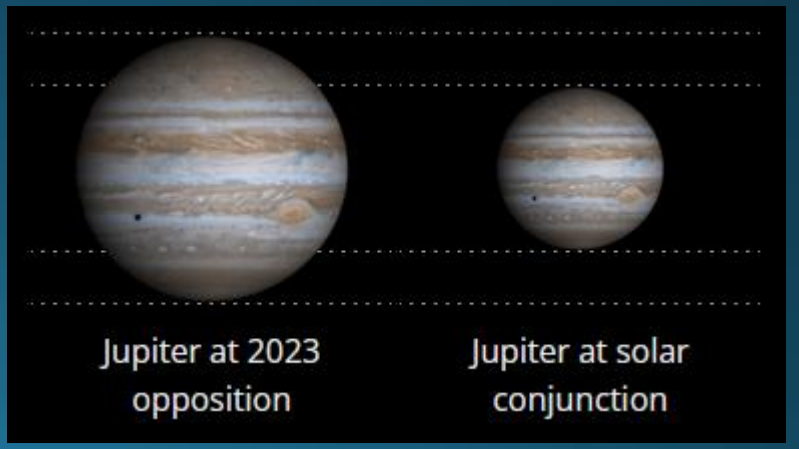
- Equatorial = 44,425 miles; Polar 41,540 miles
  - Can fit over 1,300 Earths inside Jupiter
  - In fact, even the Great Red Spot (GRS) is larger than our home planet!

Fun Fact!

- Telescopic size at opposition
  - Orbit Eccentricity 0.049 (Earth 0.017)
    - Aphelic opposition: 43 arc-seconds (507M)
    - Perihelic opposition: 50 arc-seconds (460M)
      - **November 1, 2023 (Aries)**
  - Smallest (Solar conjunction): 30 arc-seconds



Credit: NASA



Credit: In-the-Sky.org

Visibility!

- Reliably observable 8 months of a year
- 11.86 years to complete an orbit with synodic period of 399 days (1.09 years)
  - Given 12 signs of zodiac, it advances one sign each year, returning to opposition every 13 months
  - No opposition in 2025

Fun Fact!

August 20, 2021: Aquarius
September 26, 2022: Pisces
November 1, 2023: Aries
December 6, 2024: Taurus
January 9, 2026: Gemini
February 10, 2027: Leo
March 13, 2028: Virgo
April 13, 2029: Virgo
May 14, 2030: Libra
June 16, 2031: Ophiuchus
July 20, 2032: Sagittarius
August 25, 2033: Back in Aquarius

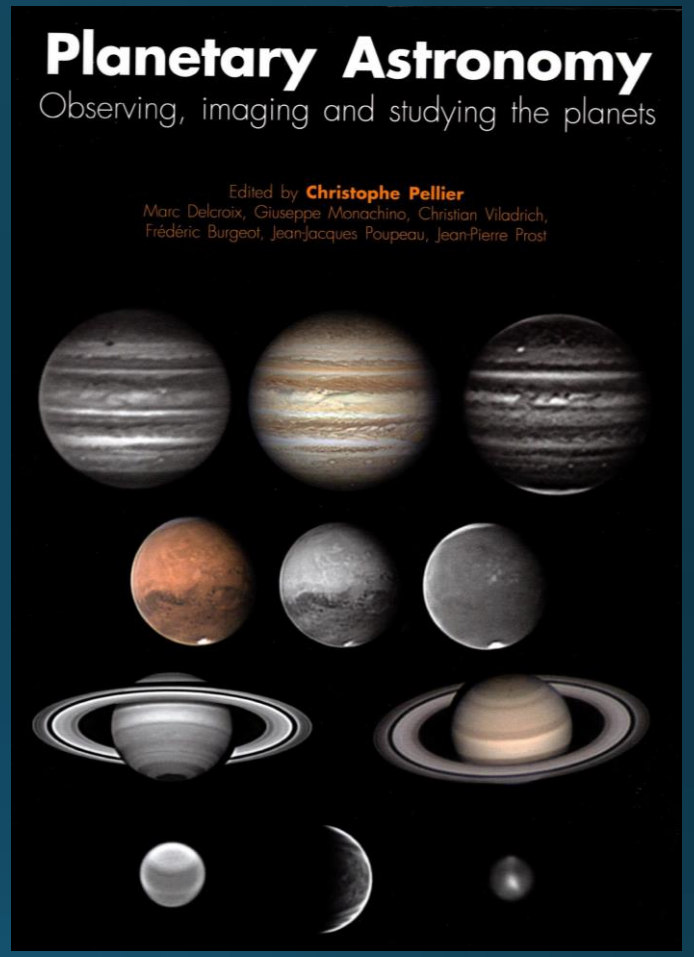
Sky & Telescope 08/20/2021

Bright!

- 4th brightest object (-2.9 at opposition)
- Makes for great conjunctions when pairing with the other bright objects
- Makes imaging easier (higher fps possible with lower gain)
- At the eyepiece when visually observing you want a filter to reduce that brightness

Cool Features!

- Galilean satellites are easily seen and perform transits, eclipses, and occultations with Jupiter
- Cloud bands change appearance from apparition to apparition
- Storms like Great Red Spot (GRS) persist for years and sometimes merge

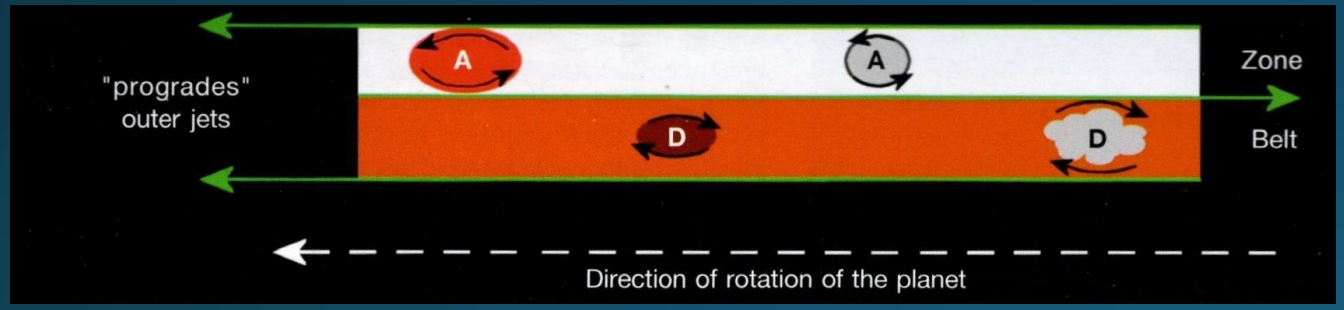


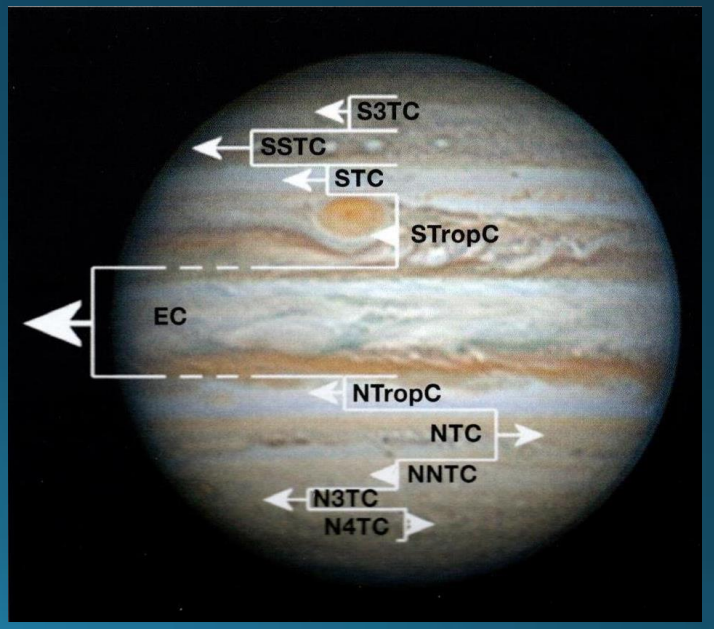
An orientation to Jupiter's features

Jovian Nomenclature

Belts & Zones

- Jupiter's fast rotation sets up very strong E-W jet streams in its atmosphere.
  - There are 16 Prograde jets rotate with the planet
  - There are 5 Retrograde jets rotate against the rotation
  - Their combination sets up a slow moving current – the pairing of a belt and zone into a domain that carries along features within it.

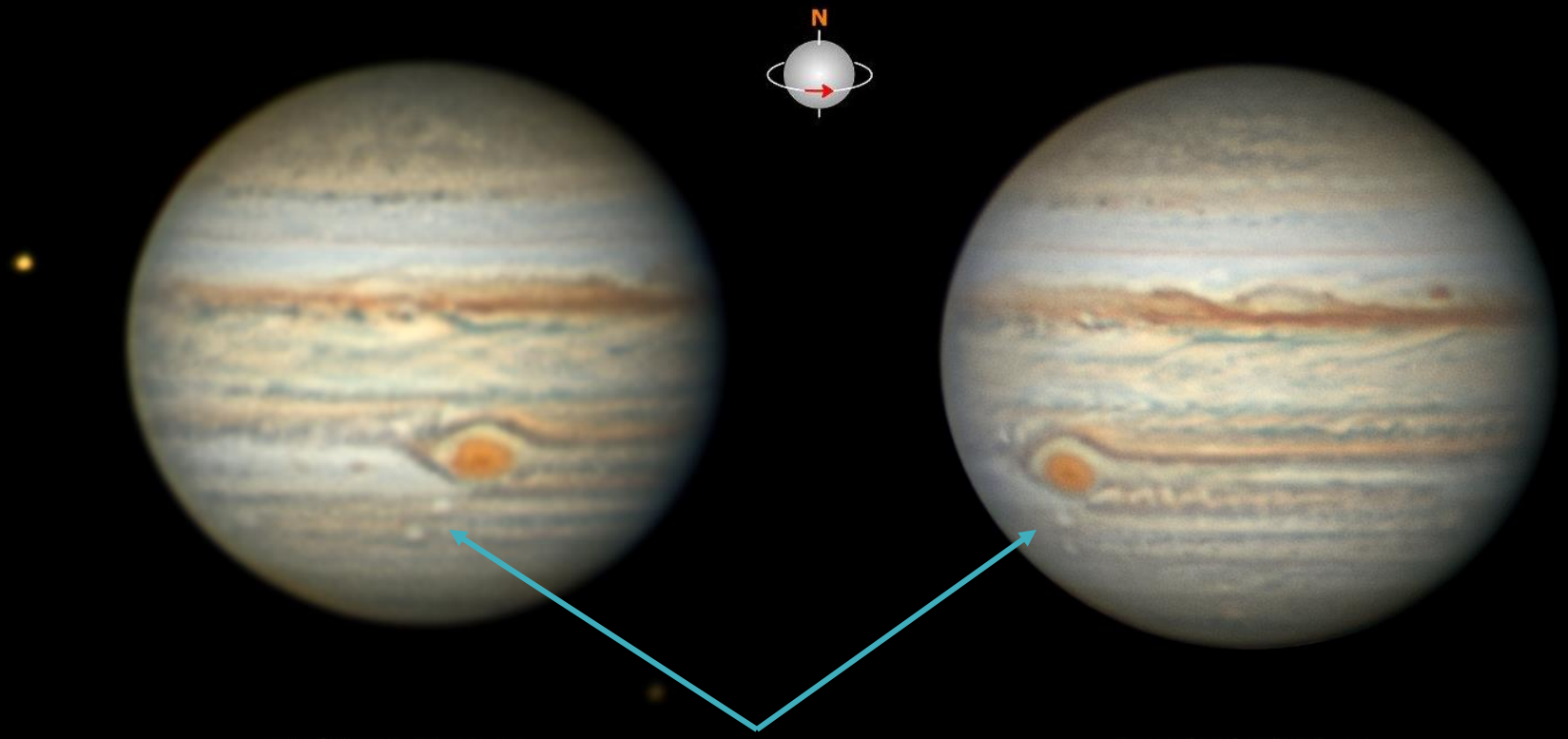




- These currents move at different speeds (faster towards equator) – so you can see features catch up to and move past features in adjacent currents

Jupiter with Io (left) and Callisto 3/8/2022

Jupiter in better 'seeing' 7/8/2022



derotated to 00:44 UT

derotated to 02:40 UT

Below the Great Red Spot the two white oval storms have changed position in four days of rotation. Both images taken with the same equipment.

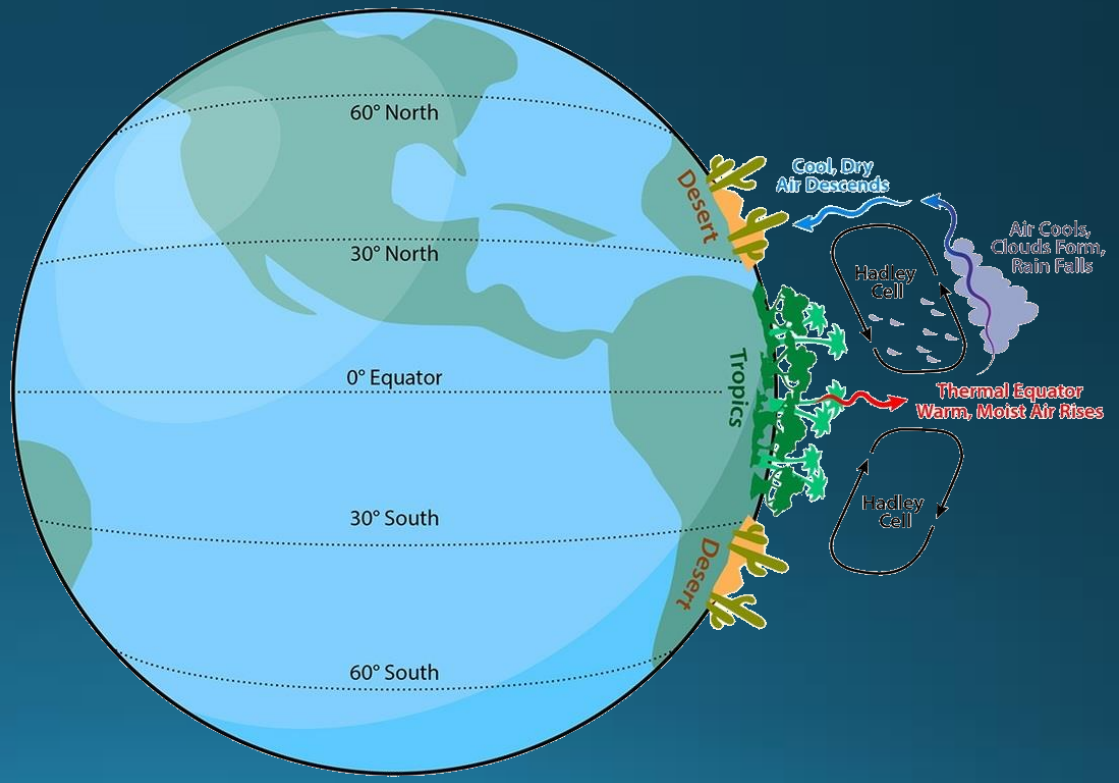
356 mm f/10 SCT + ZWO ASI482MC + ADC + 4x PowerMate

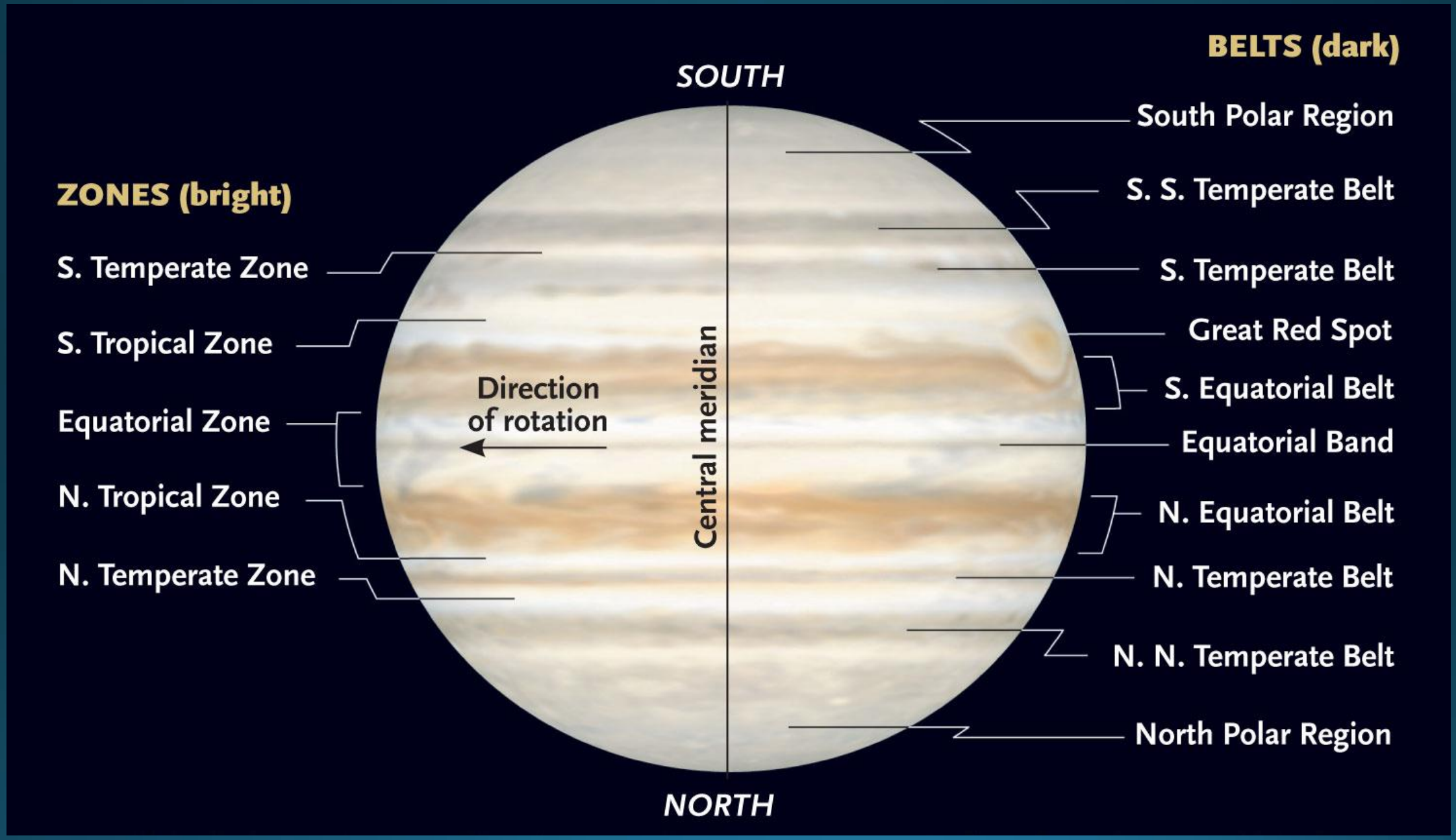
Peter Tickner

Berkshire

Belts & Zones

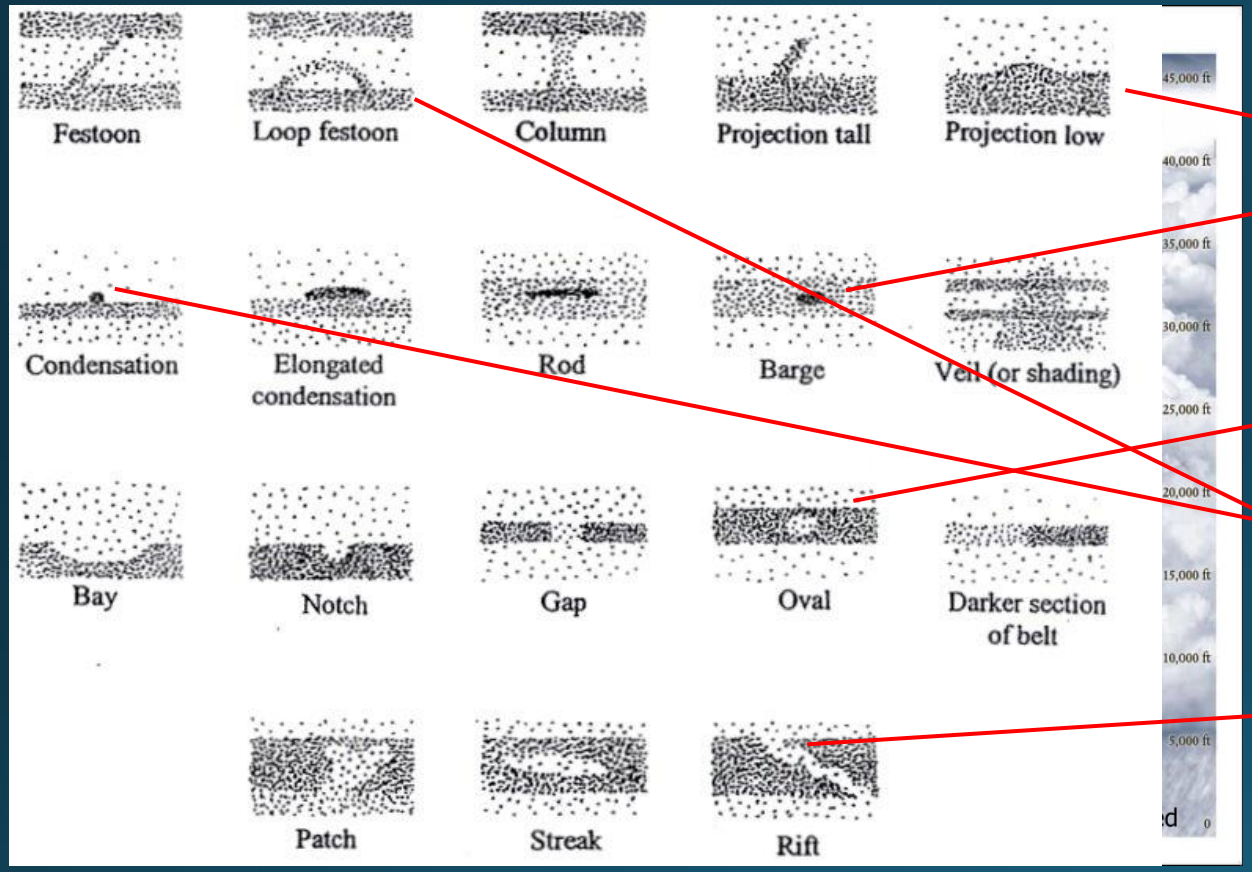
- A pairing of belt & zone forms a large unit of atmospheric convection, a "Hadley Cell"
  - Vertical circulation of the air due to temperature differences. Warm air rises, cools, and then sinks.
  - The white zone represents ascending air that forms ammonia ice clouds, while the belt is dryer, descending air where the white ammonia ice has dissipated to reveal a deeper layer of the atmosphere



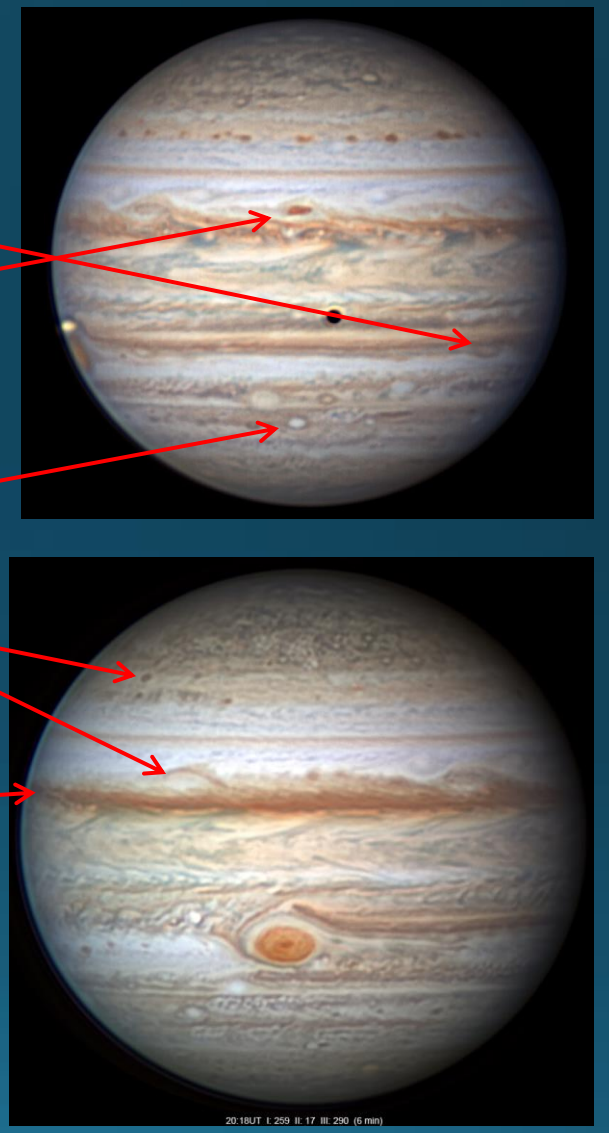


Credit: https://skyandtelescope.org/astronomy-news/observing-news/jupiter-at-opposition-3020420153/

Nomenclature



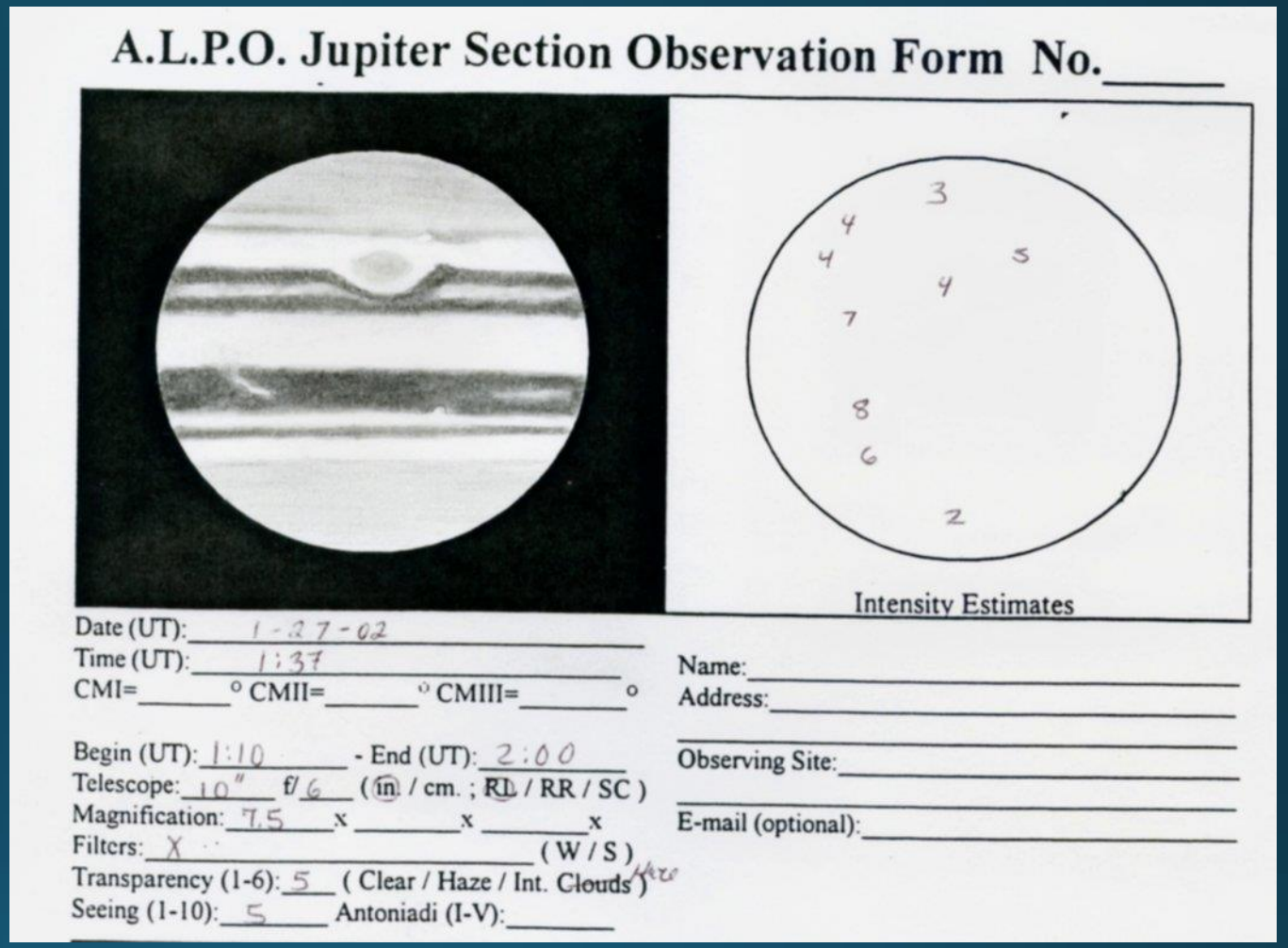
Credit: *Observing Jupiter in 21st Century*



Credit: Christopher Go

Jupiter at the eyepiece

Visual Observing



A.L.P.O. Jupiter Section Observation Form No._____

Intensity Estimates

Date (UT): 1-27-02
Time (UT): 1:37
CMI=_____° CMII=_____° CMIII=_____°

Begin (UT): 1:10 - End (UT): 2:00
Telescope: 10" f/6 (in. / cm. ; RL / RR / SC)
Magnification: 7.5 x _____ x _____ x
Filters: X (W / S)
Transparency (1-6): 5 (Clear / Haze / Int. Clouds)
Seeing (1-10): 5 Antoniadi (I-V):_____

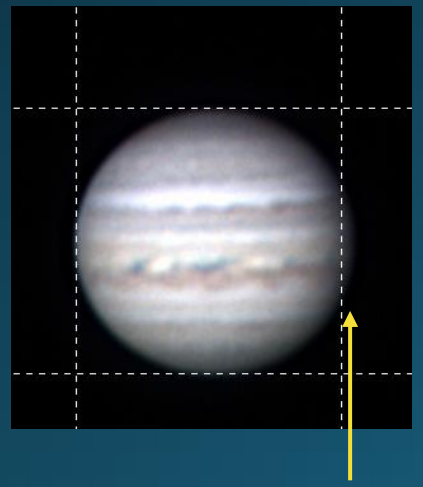
Name:_____
Address:_____
Observing Site:_____
E-mail (optional):_____

What's Needed?

- Telescope
  - While some factors such as central obstruction can make one telescope type superior to another at equivalent aperture, **size** is still the primary factor in what you can see
  - Collimation is important
- Quality Eyepiece (10-5mm)
- Stable mount
- Optional (but recommended)
  - Tracking so that you can observe the planet for a long period of time
  - Filters (Yellow helps overall; blue can help with GRS)
- Steady seeing!!
- Patience

The Easy Stuff

	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
Oval Appearance	✓	✓	✓	✓
Equatorial Belts				
Shadow Transit				
Eclipse				
Great Red Spot				



- Jupiter has the fastest rotation rate of any planet – just under 10 hours
  - Equatorial region (System I) 9h 50m
  - Elsewhere (System II) 9h 55m
- This centrifugal force causes a bulging at the equator

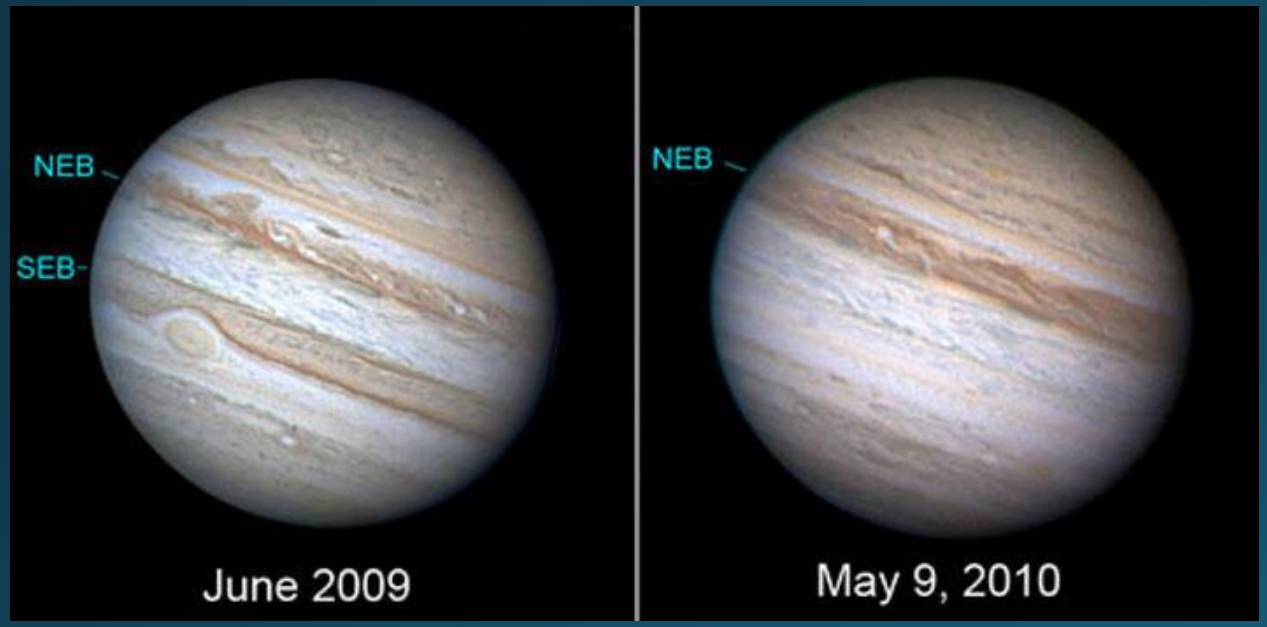
The Easy Stuff

	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
Oval Appearance	✓	✓	✓	✓
Equatorial Belts	✓	✓	✓	✓
Shadow Transit				
Eclipse				
Great Red Spot				

- The North Equatorial Belt (NEB) is usually the thinner of the two, but more intense in its color
  - It is currently very thin – we are monitoring for a "revival that may come this year or next
- The South Equatorial Belt is usually wider and not as prominent…. but not always!

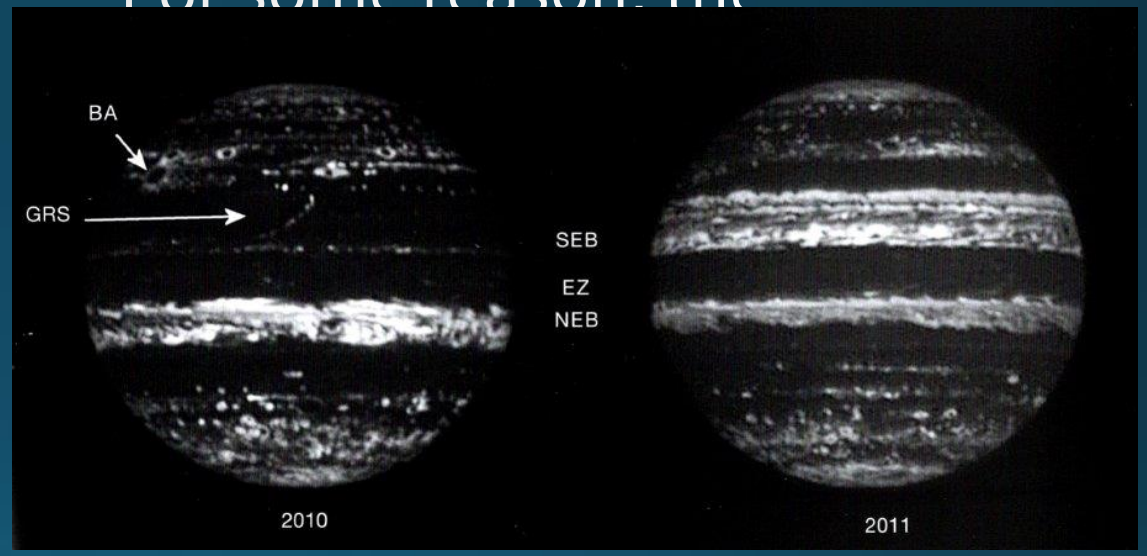
The Great SEB Disappearing Act

- Every ~15 years the SEB undergoes a set of two fadings over ~4 years



Credit: Anthony Wesley

- For some reason, the



https://news.softpedia.com/news/Jupiter-Loses-Its-Southern-Equatorial-Belt-141942.shtml

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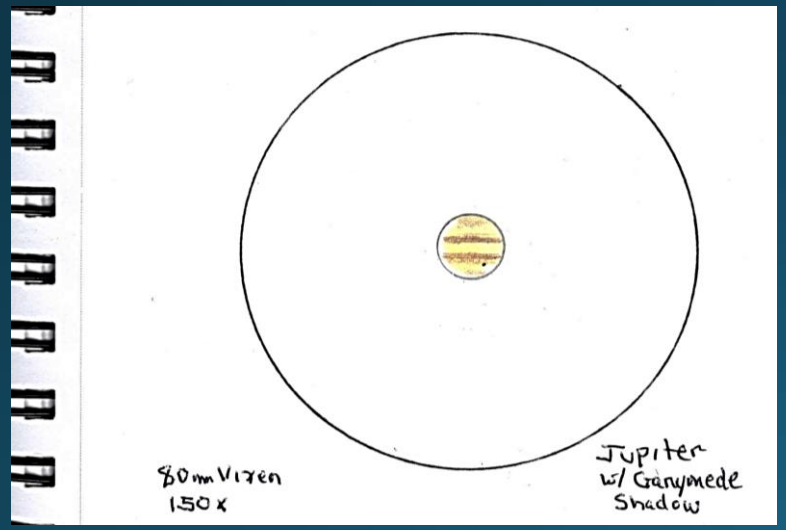
Shadow Transit	✓	✓	✓	✓
Eclipse	✓	✓	✓	✓
Great Red Spot				



Credit: Clyde Foster

- Ganymede provides the most prominent shadow due to its size
- Io is the most frequent transitor
- Best time for eclipse is at quadrature (3 months before or after opposition)
- "Mutual Events" every few years at Jovian equinox (2026)

https://skyandtelescope.org/wp-content/plugins/observing-tools/jupiter_moons/jupiter.html

The Easy Stuff

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Equatorial Belts	✓	✓	✓	✓
Shadow Transit	✓	✓	✓	✓
Eclipse	✓	✓	✓	✓
Great Red Spot	✓	✓	✓	✓

Credit: Tomney - Jupiter 80mm Vixen 150x

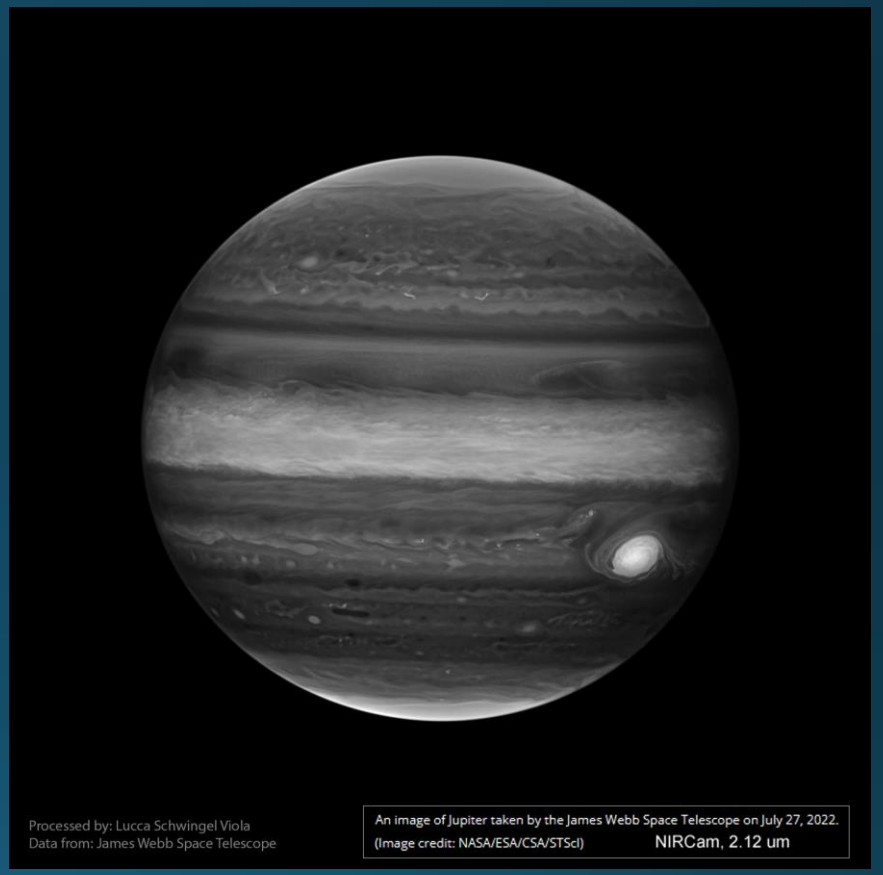
Credit: Don Parker

Credit: Jim Tomney – July 2022

https://skyandtelescope.org/observing/interactive-sky-watching-tools/transit-times-of-jupiters-great-red-spot/

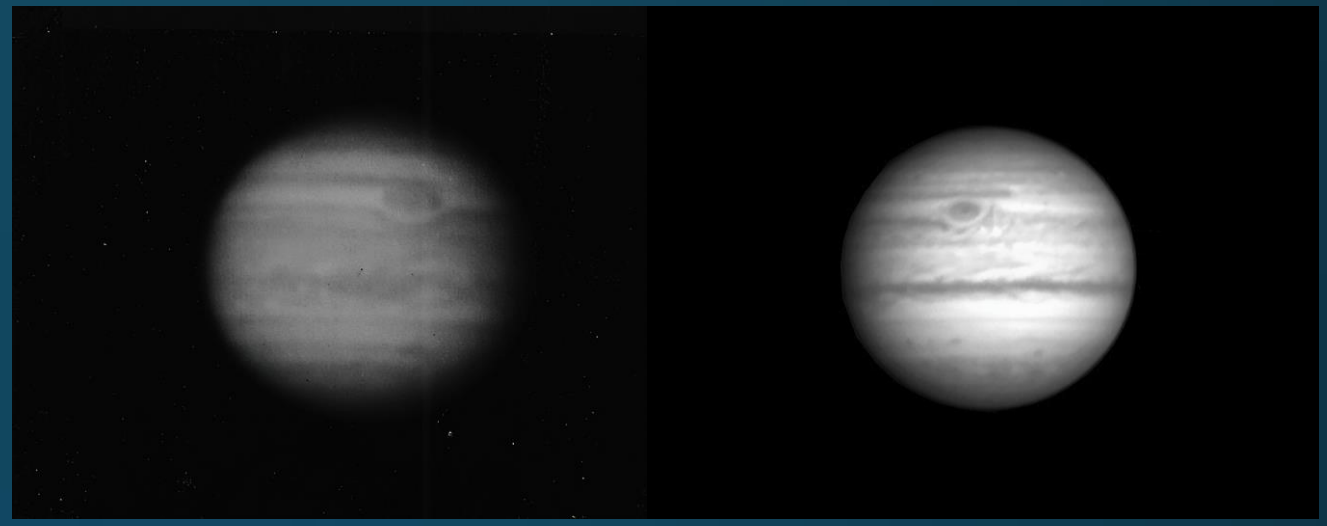
Great Red Spot

- The GRS is an anti-cyclonic storm some 1.3 times larger than the Earth that has been around for centuries.
- It towers above & below the cloud tops



Great Red Spot

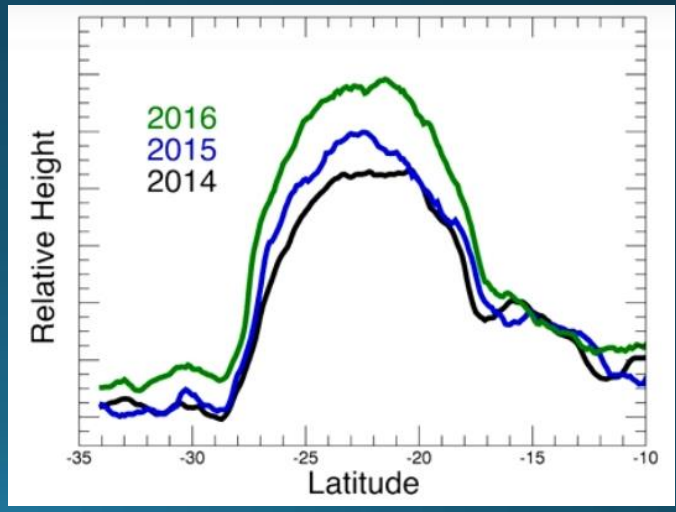
- Shrinking in Size
  - In 1878: 25.5K miles (estimate)
  - Voyager 1979: 14.5K miles
  - Hubble 2009: 11.1K miles
- Flaking
- Taller, not faster



Credit: 1964 ALPO archives
R. Schorn using 82" McDonald

Credit: James Willinghan
2022-07-01 using 12" SCT

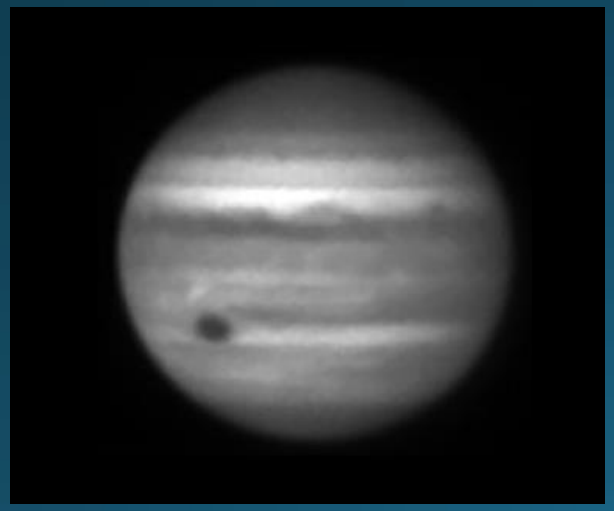
Credit: Juno Feb 12, 2019



Great Red Spot

- Why's the GRS red?
  - In short – we're not certain
  - Perhaps UV generating complex organic compounds?

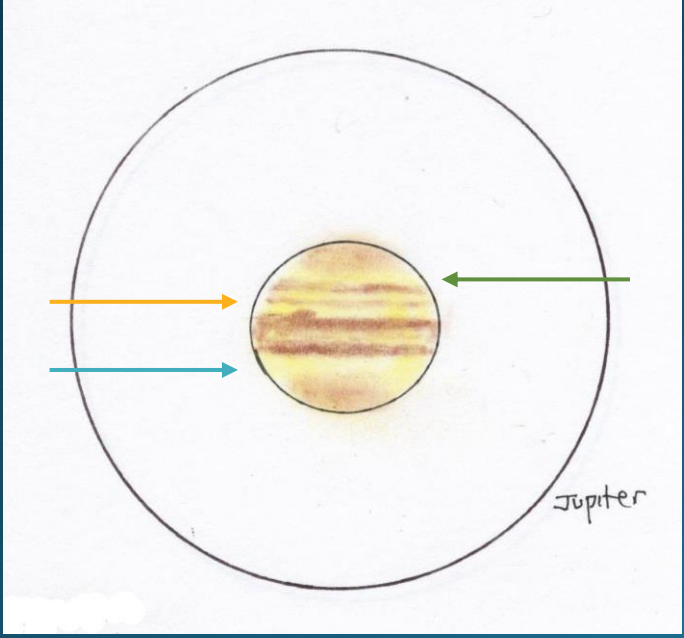
Credit: Jim Johnson

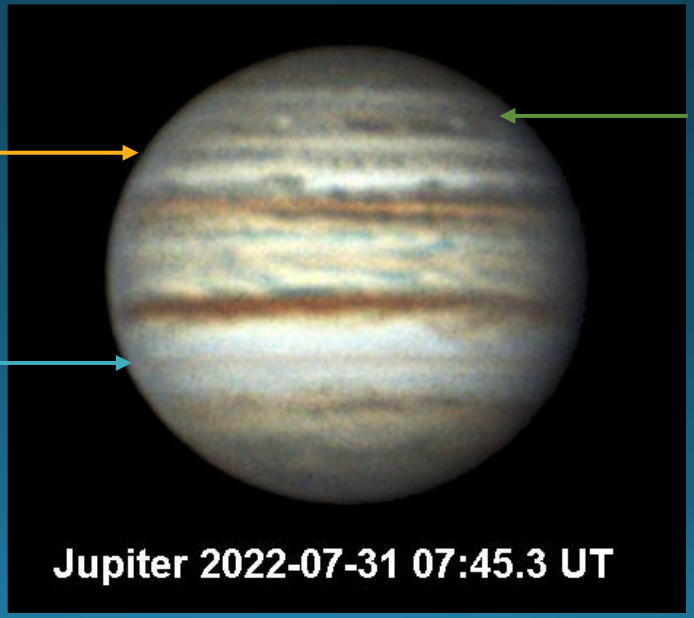


Credit: Greg Shanos – UV Image

The Subtler Stuff

	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
North Temperate Belt	✓	✓	✓	✓
South Temperate Belt	✓	✓	✓	✓
South-South Temperate Belt	✗	✓	✓	✓
Galilean Moon Disks				
Oval BA				
Barge, Projection, Notch				





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Galilean Moon Disks	✗	✓	✓	✓
Oval BA				
Barge, Projection, Notch				

Ephemerides | Image caption | Moon coordinates | Moon ephemerides | Graphics | Options

		CM	Diameter	Visual magnitude
Moon	Io	168°	1.118"	5.4 mag
	Europa	298°	0.967"	5.5 mag
	Ganymede	93°	1.621"	4.9 mag
	Callisto	328°	1.478"	6.2 mag

- Can you visually identify Ganymede (largest and brightest)?
- Can you pick out Calisto (dimmest)?
- Large aperture – any shadings on Ganymede?
- Moons are excellent target for checking your focus

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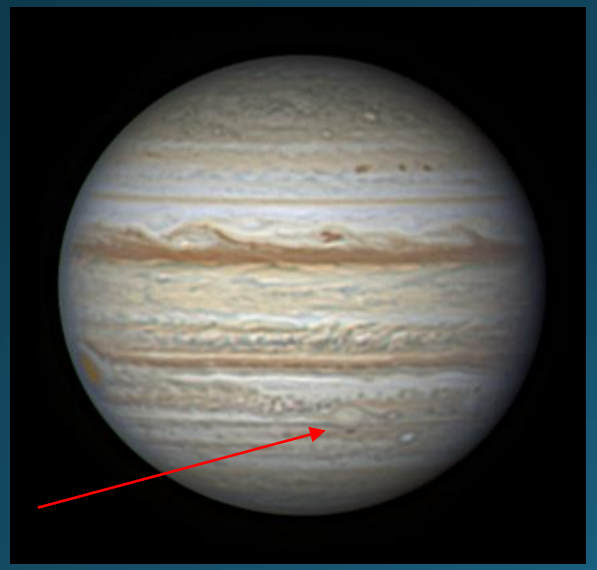
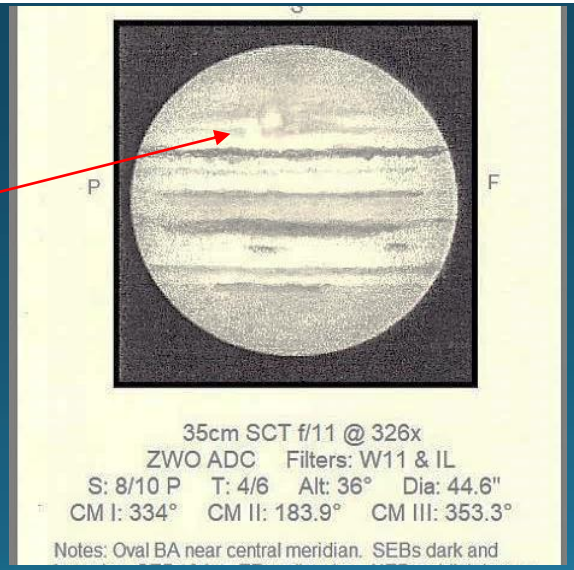
Barge, Projection, Notch				

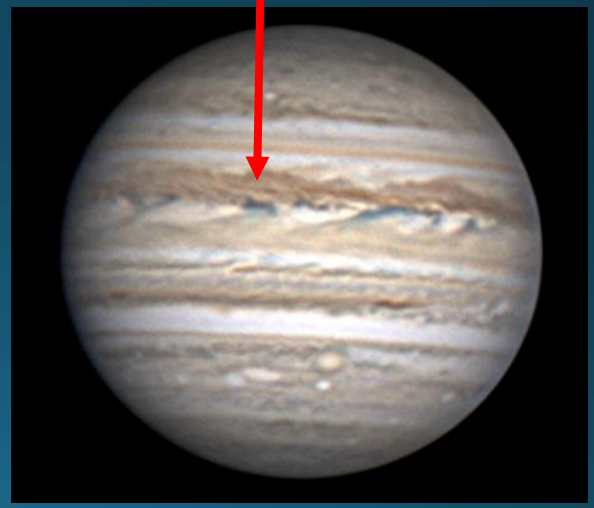


Credit: Gary Walker
7/29/22 10" Cass-Mkstv



Credit: Michael Rosolina
14" SCT

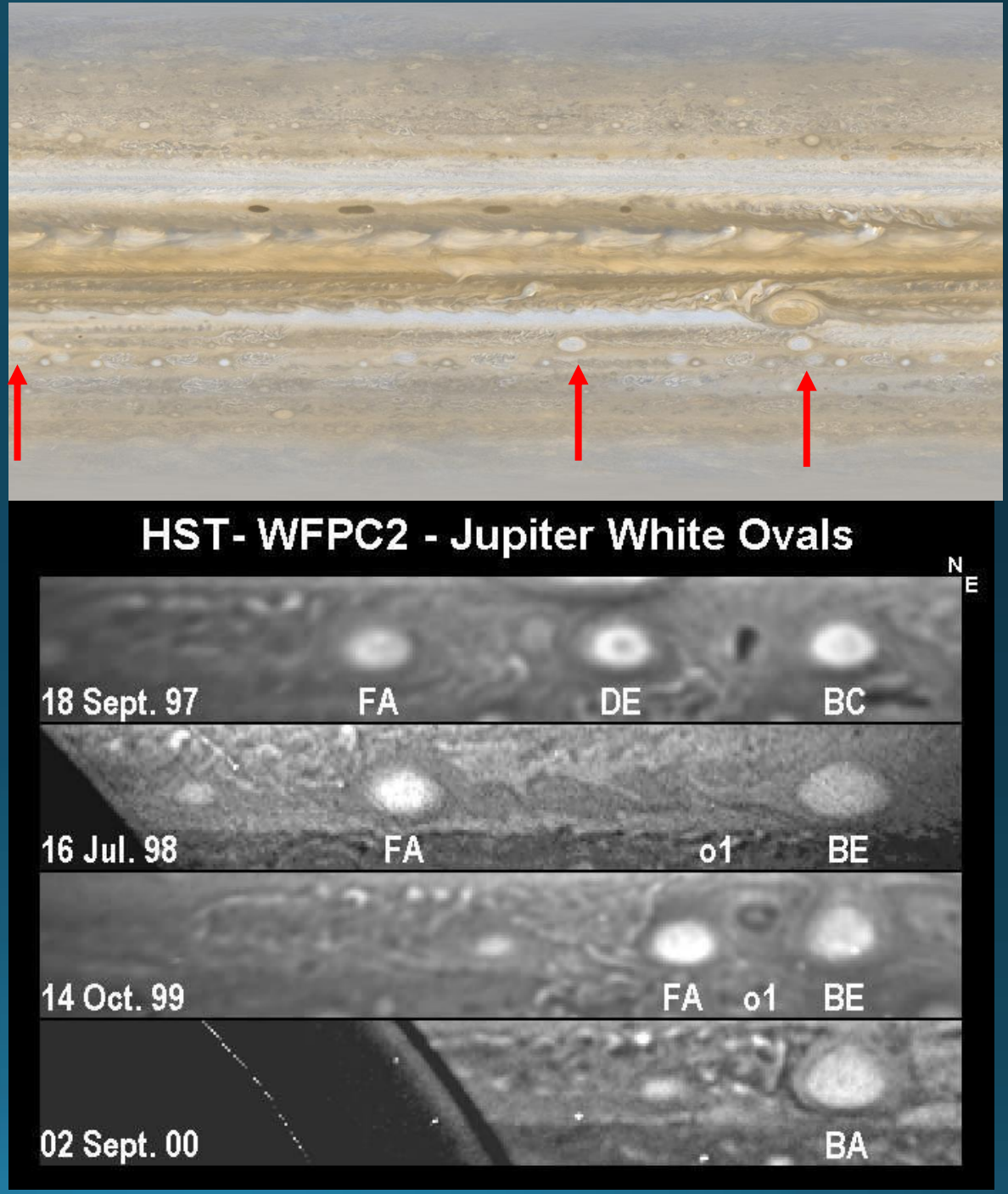
Hot Spot!



Credit: Christophe Pellier
6/12/18 12" Newt

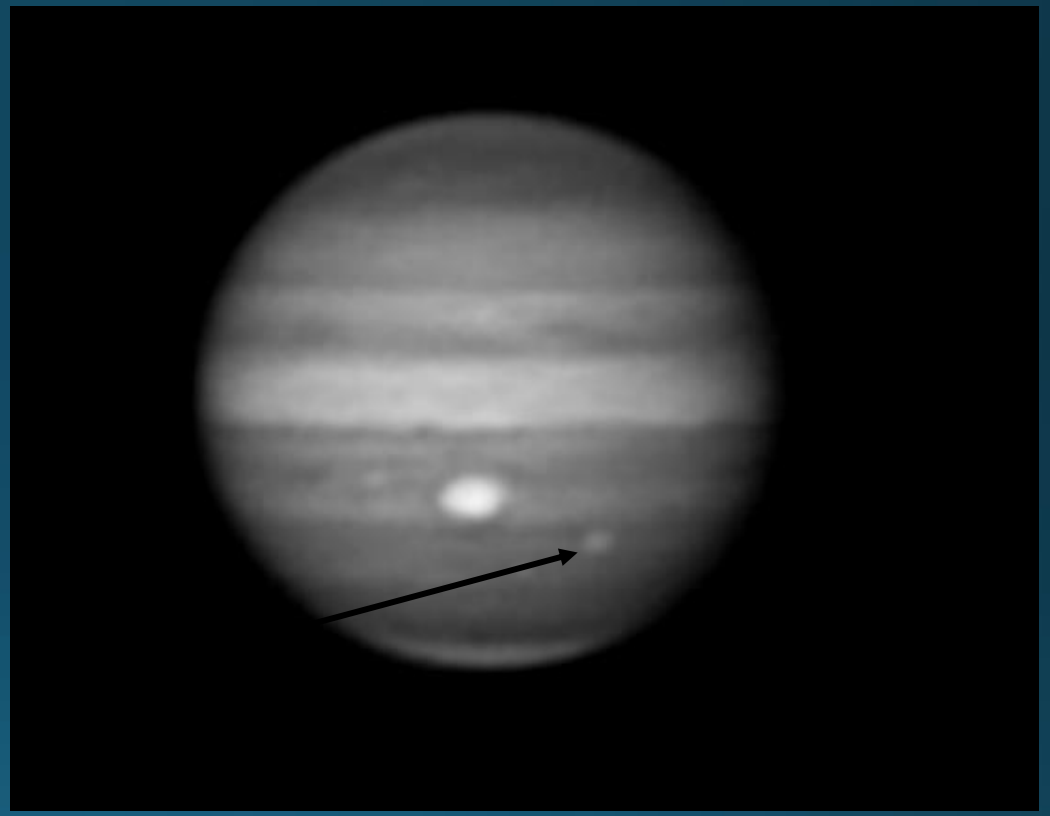
The History of BA

- Oval BA is actually the product of 3 large ovals in the STB that emerged in the late 1930s.
  - For 60 years they drifted about the belt. When approaching one another they would somehow slow down or even reverse course.
- Late 1997/early 1998 while near Solar conjunction, DE and BC did collide and merge (2nd panel)
- Finally FA also approached BE and became what we now know as Oval BA



Oval BA – a.k.a. Red Spot Jr.

Credit: HST



Credit: Clyde Foster

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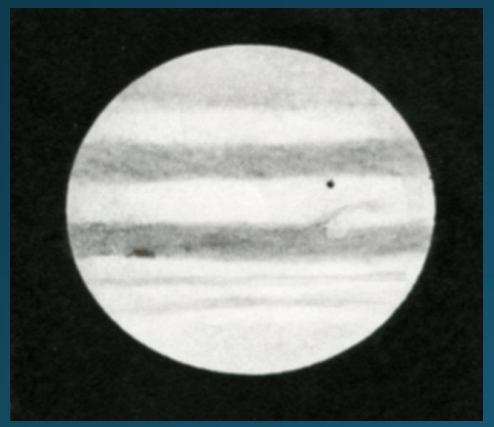
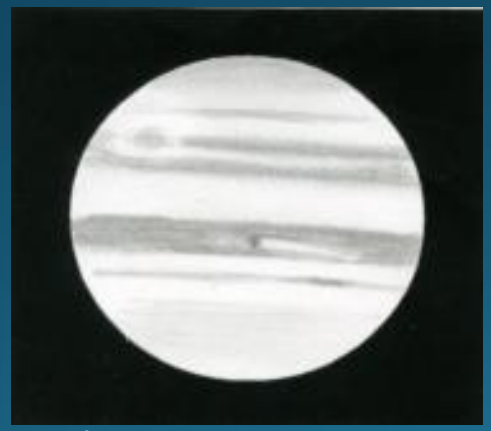
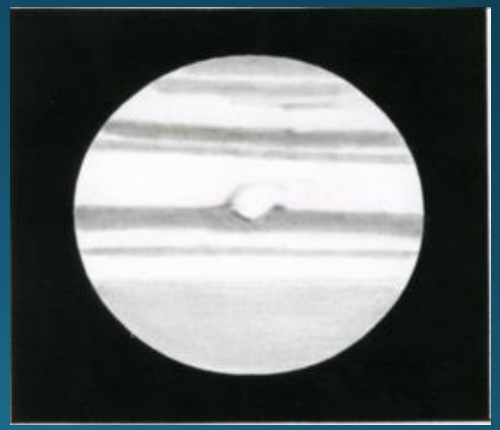
Galilean Moon Disks	✗	✓	✓	✓
Oval BA	✗	✓	✓	✓
Barge, Projection, Notch	✓	✓	✓	✓



Credit: Jim Tomney
10/5/1997 6" Newt
Barge, Festoon



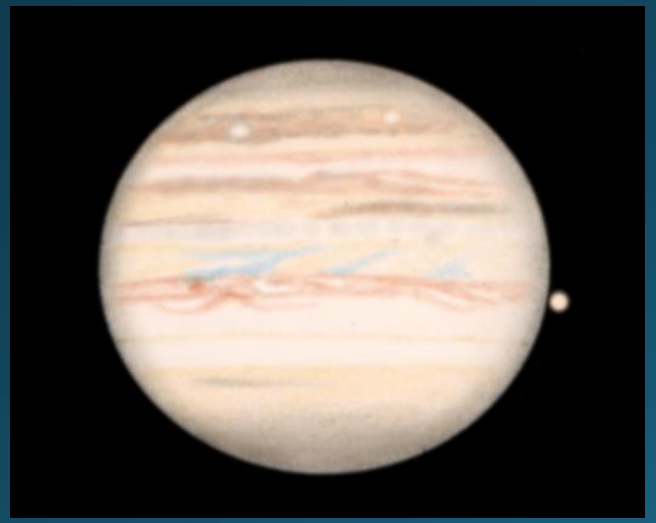
Credit: Jim Tomney
8/4/2000 10" Newt
Rift, Thickening in NTB, Condensation



Credit: Jim Tomney
9/14/2000 10" Newt
Festoon, Bay, Projection

The Tough Stuff

	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
SSTB Anti-cyclones	✗	✗	✓	✓
NN Ovals				
Transiting Moon				

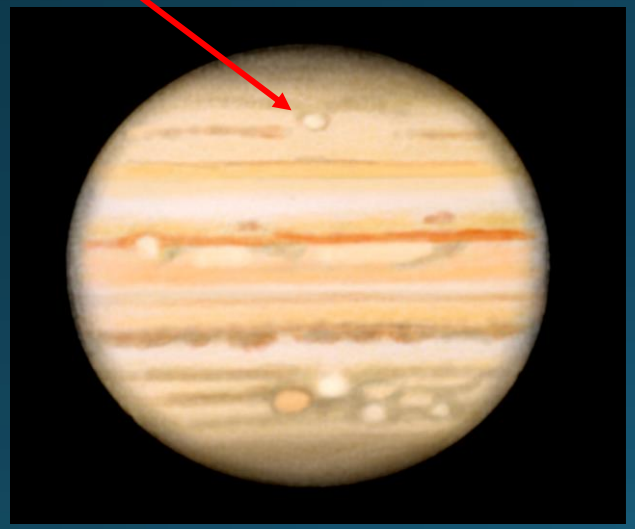


Credit: Paul Abel
7/18/2022 20" Dall-Kirkham
A5, A7

Credit: Tom Williamson
7/16/2022 12.5" Newtonian
A5, A7

The Tough Stuff

	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
SSTB Anti-cyclones	✗	✗	✓	✓
NN Ovals	✗	✗	✓	✓
Transiting Moon				

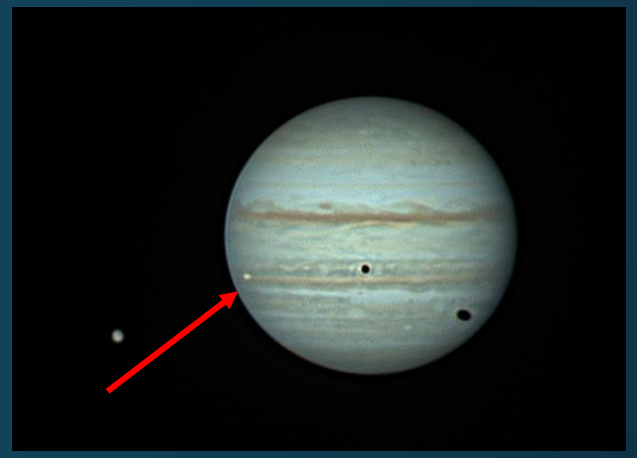


Credit: Paul Abel
8/23/2021 12" Newtonian
NN-WS-6, WS6,BA, SSTB
Anti-cyclones

Credit: Gary Walker
9/28/2021 10" Cass-Mkstv
NN-WS-6, WS6,BA, SSTB
Anti-cyclones

The Tough Stuff

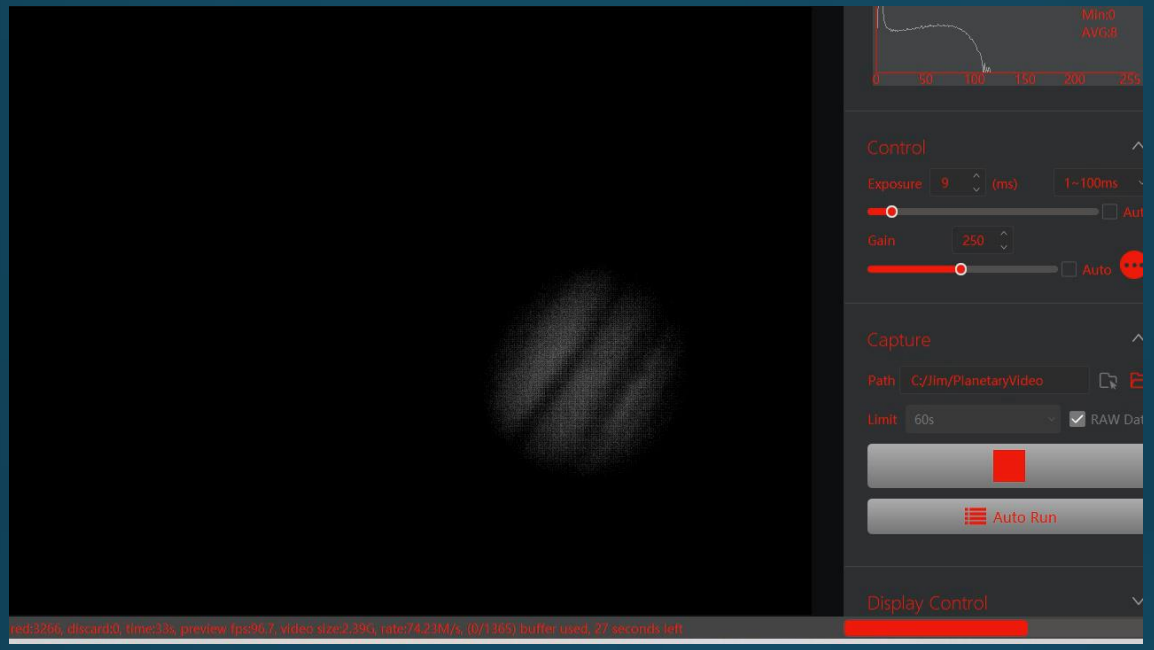
	Small 80-120	Medium 125-200	Large 225-275	X-Large 300 & above
SSTB Anti-cyclones	✗	✗	✓	✓
NN Ovals	✗	✗	✓	✓
Transiting Moon	✗	✗	✗	✓



Credit: Chris Hooker, BAA

"Observing and imaging the Galilean moons, as they transit the planet's disc, can be a challenging feat. Apart from when a Moon is passing over the darker limb regions, most of them will have a similar albedo to Jupiter's bright zones and, unless seeing is perfect, the Moon will become lost in the Jovian background. The one exception to this is Calisto, which is by far the darkest Moon with an albedo of 20%. (Io, Europa and Ganymede have albedos of 61, 64, and 42% compared to Jupiter's average albedo of 43%.)"

https://www.astronomyclub.xyz/planetary-imaging/the-galilean-moons.html#:~:text=The%20one%20exception%20to%20this%20is%20Callisto%2C%20which,is%20a%20shadow%20of%20one%20of%20the%20moons%21



Getting Started with Computer Assisted Planetary Imaging

Imaging Primer

What's Needed to Start?

- Telescope
  - 100 mm or greater in aperture
  - f/ratio > 6
- Tracking
- Color video camera
- Laptop for capture & processing
- Software (open source)
- Optional (but recommended)
  - UV/IR cut filter
  - Barlow
- Steady seeing!!

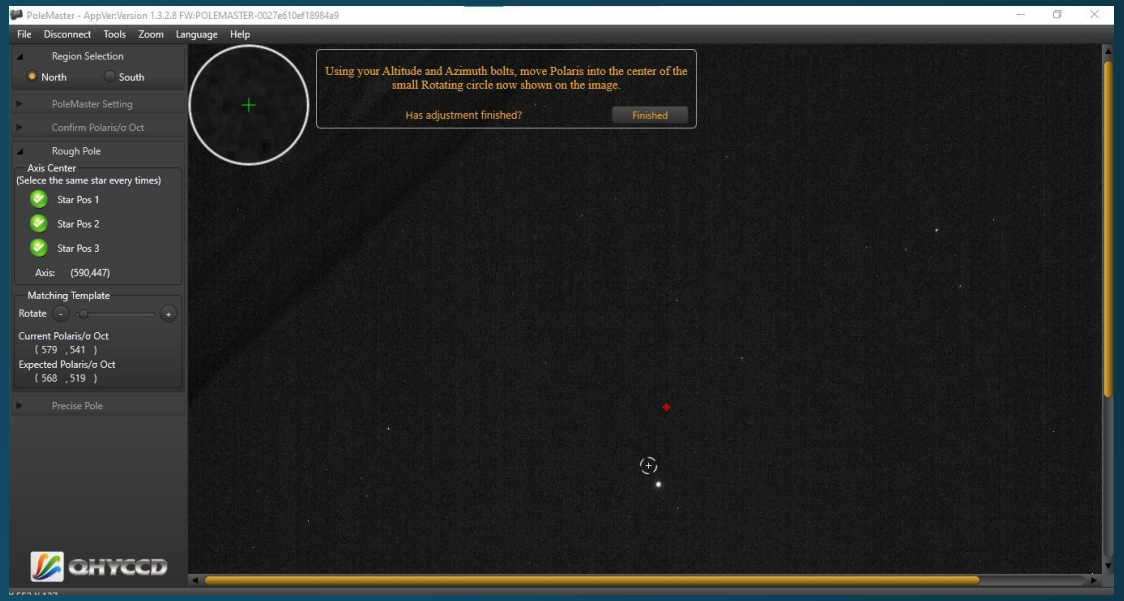
Video Camera

- Wide range of providers
  - ZWO
  - Celestron
  - Imaging Source
  - QHY
  - Orion
- Using your DSLR
  - Heavy and requires T-Ring adapter
  - Only in debayer mode

https://www.highpointscientific.com/astronomy-hub/post/astro-photography-guides/choosing-the-best-planetary-camera

Sample Video Capture Process

- Polar align telescope



Sample Video Capture Process

- Polar align telescope
- Check collimation

Sample Video Capture Process

- Polar align telescope
- Check collimation
- Align finder scope

Sample Video Capture Process

- Polar align telescope
- Check collimation
- Align finder scope
- Insert Barlow and camera, check balance

Sample Video Capture Process

- Polar align telescope
- Check collimation
- Align finder scope
- Insert Barlow and camera, check balance
- Connect to laptop & launch capture program

Sample Video Capture Process

- Polar align telescope
- Check collimation
- Align finder scope
- Insert Barlow and camera, check balance
- Connect to laptop & launch capture program
- Center planet, focus

https://www.youtube.com/watch?v=RDuDjIvtXWI

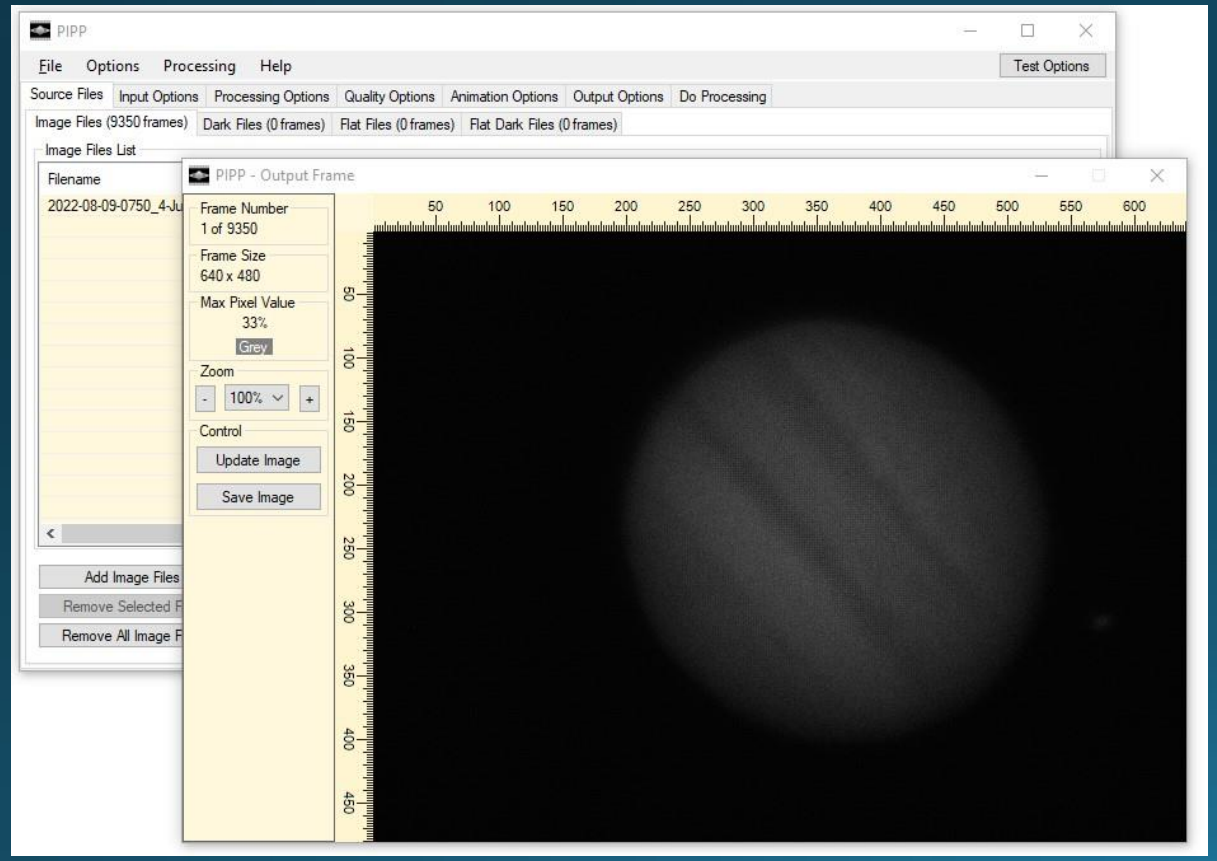
Sample Video Capture Process

https://www.youtube.com/watch?v=XfRybLlt3v4

- Polar align telescope
- Check collimation
- Align finder scope
- Insert Barlow and camera, check balance
- Connect to laptop & launch capture program
- Center planet, focus
- Set ROI as small as possible
- Adjust shutter and gain to get best possible fps rate without grainy frames
- Take series of 1-2 minute videos with debayer turned off

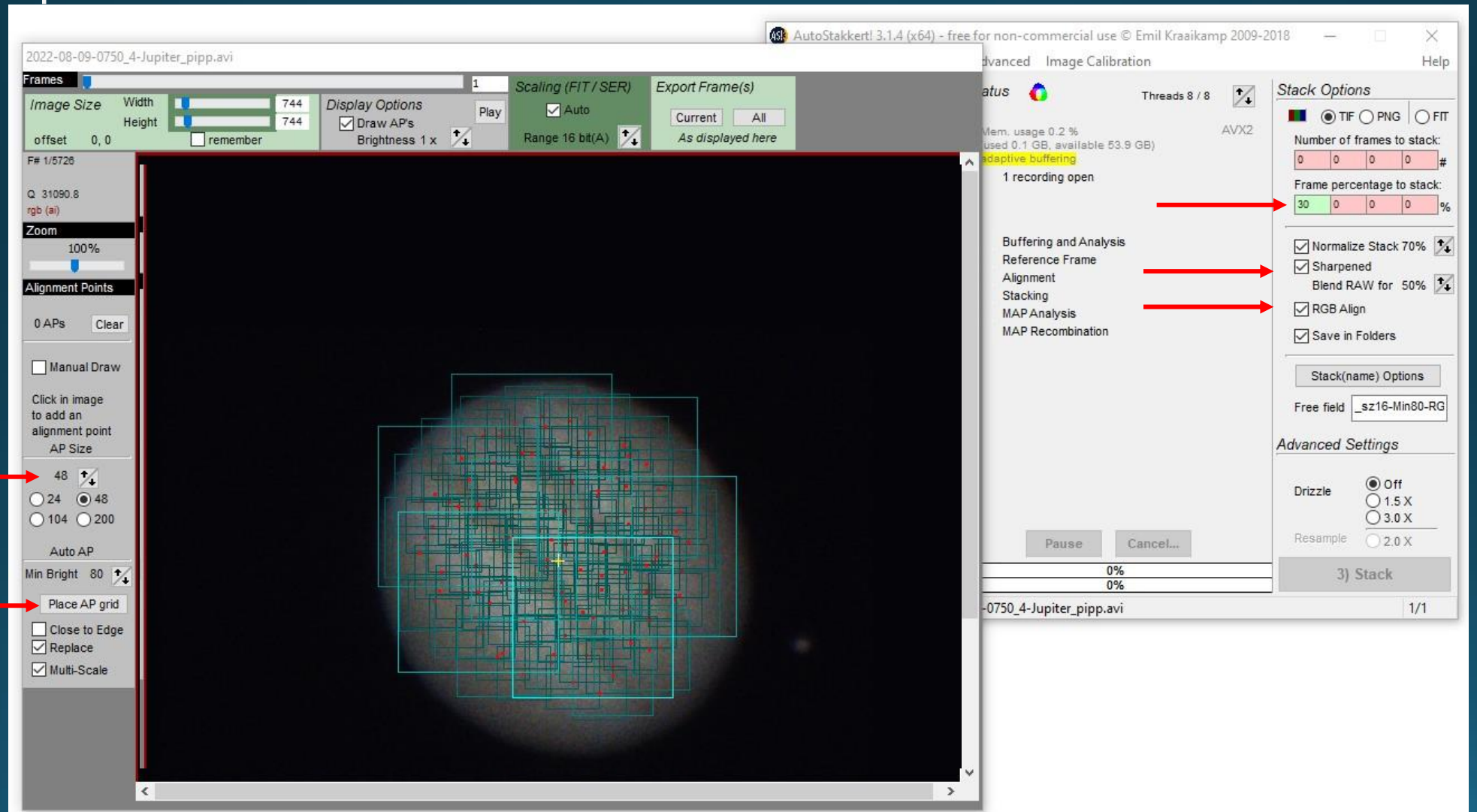
Sample Video Processing Flow

- Planetary Imaging PreProcessor (PIPP) to debayer, center, crop, and extract best frames into a video

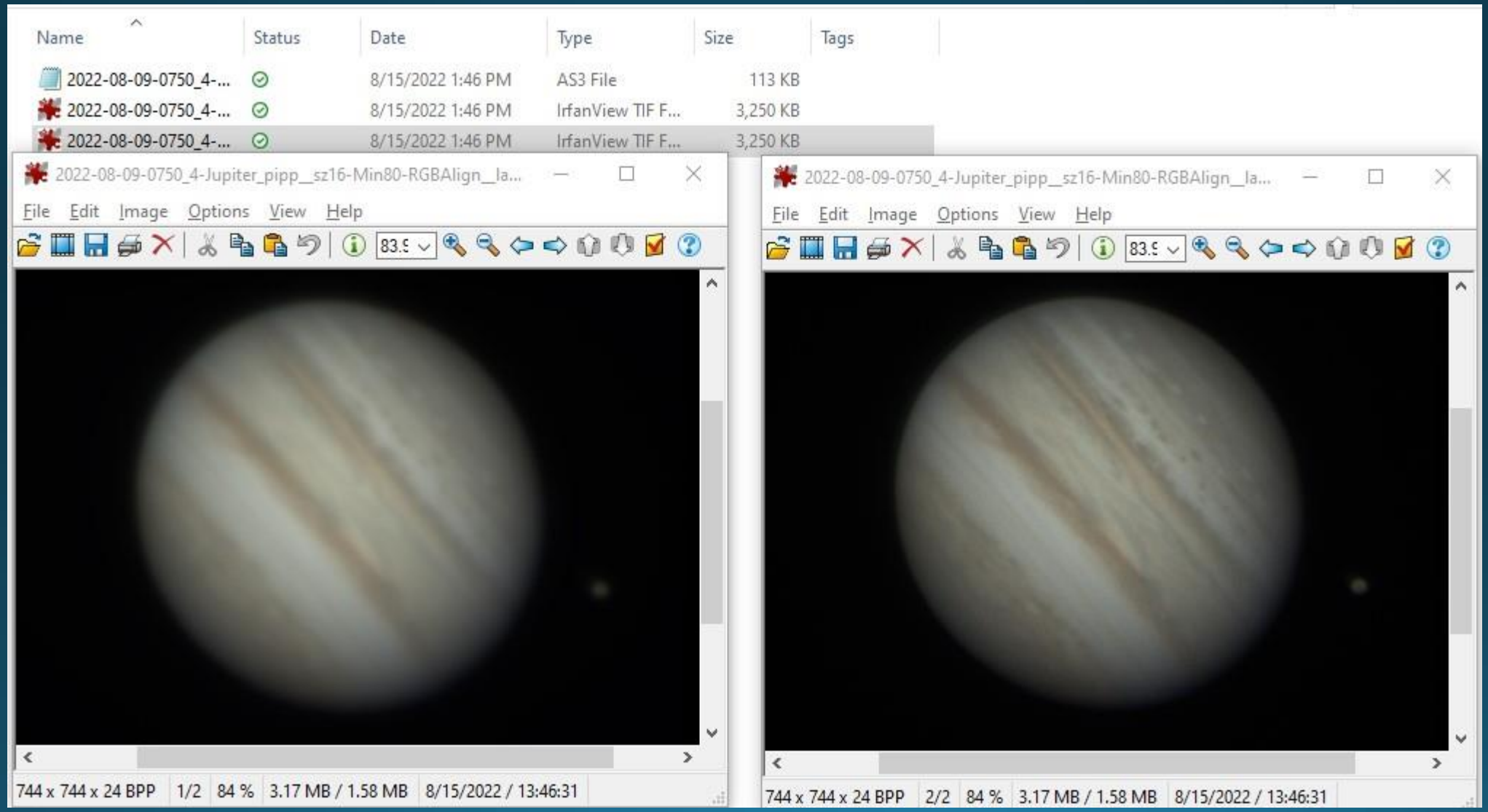


Sample Video Processing Flow

- Autostakkert3! to align and stack the best frames from your PIPP output into a TIFF

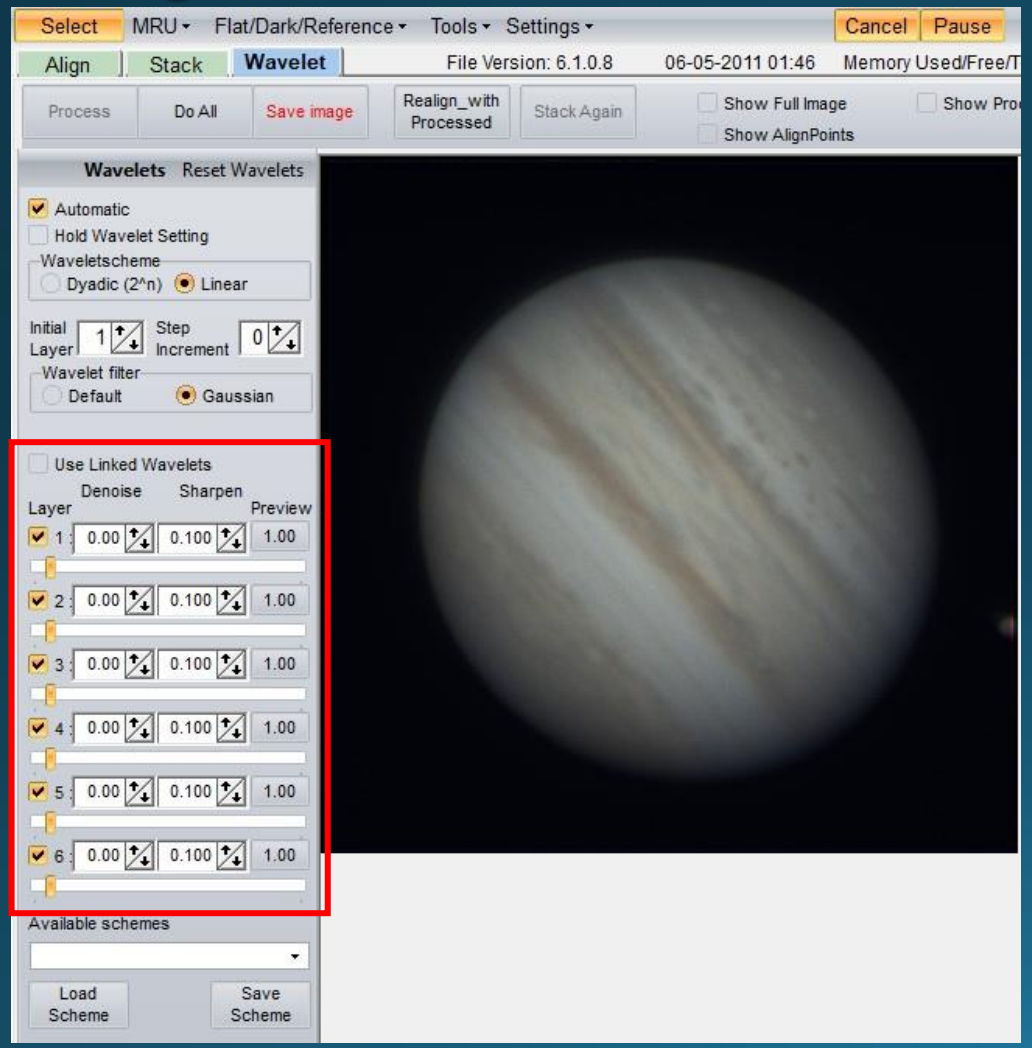


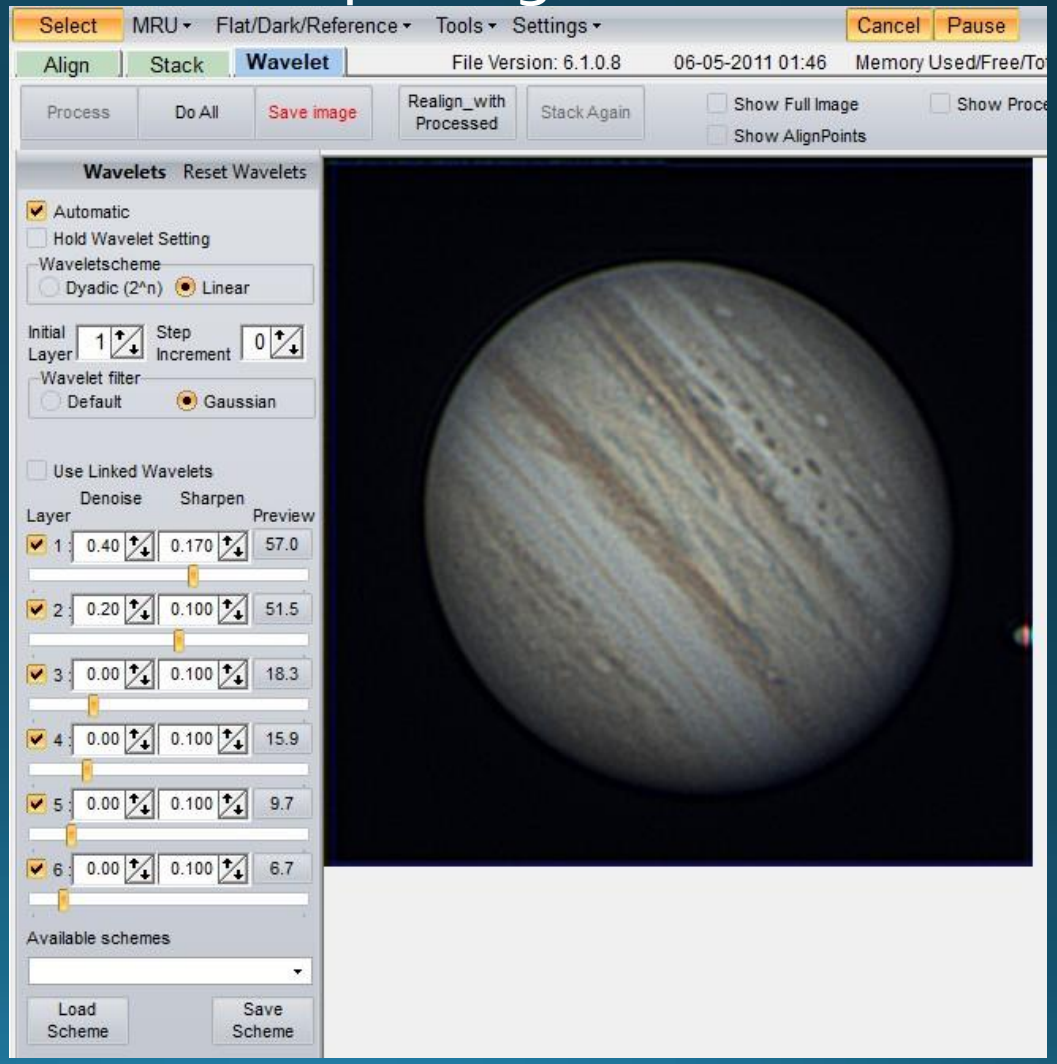
Sample Video Processing Flow



Sample Video Processing Flow

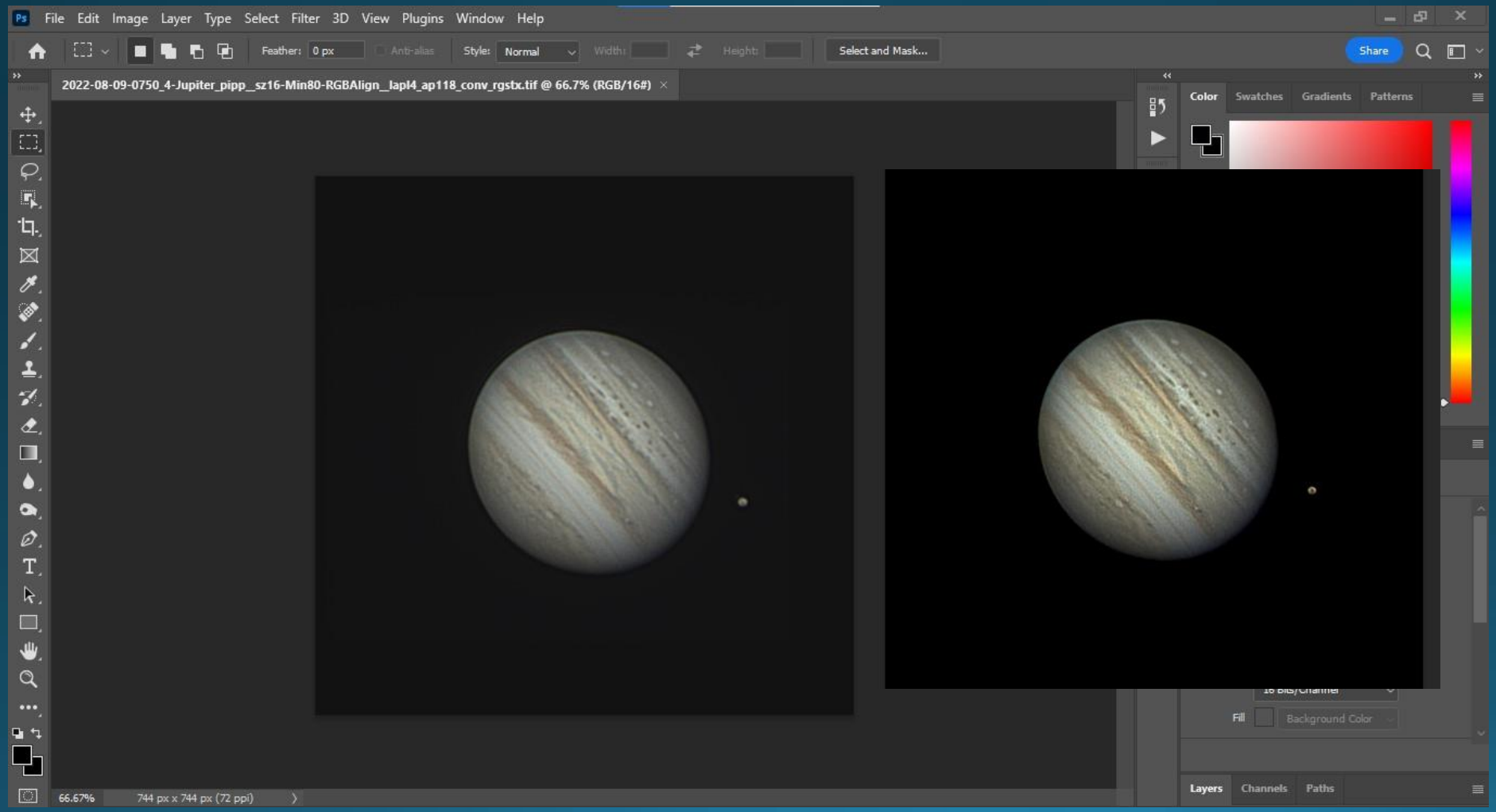
- Registax6 for wavelet transformation (sharpening)





Sample Video Processing Flow

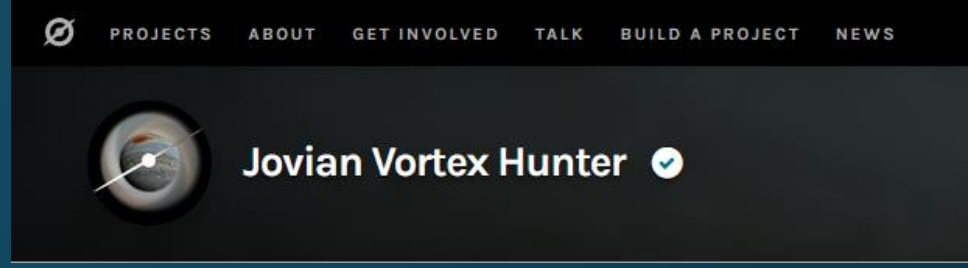
- Finally, a photo editing application of your choice to enhance the Registax sharpened image



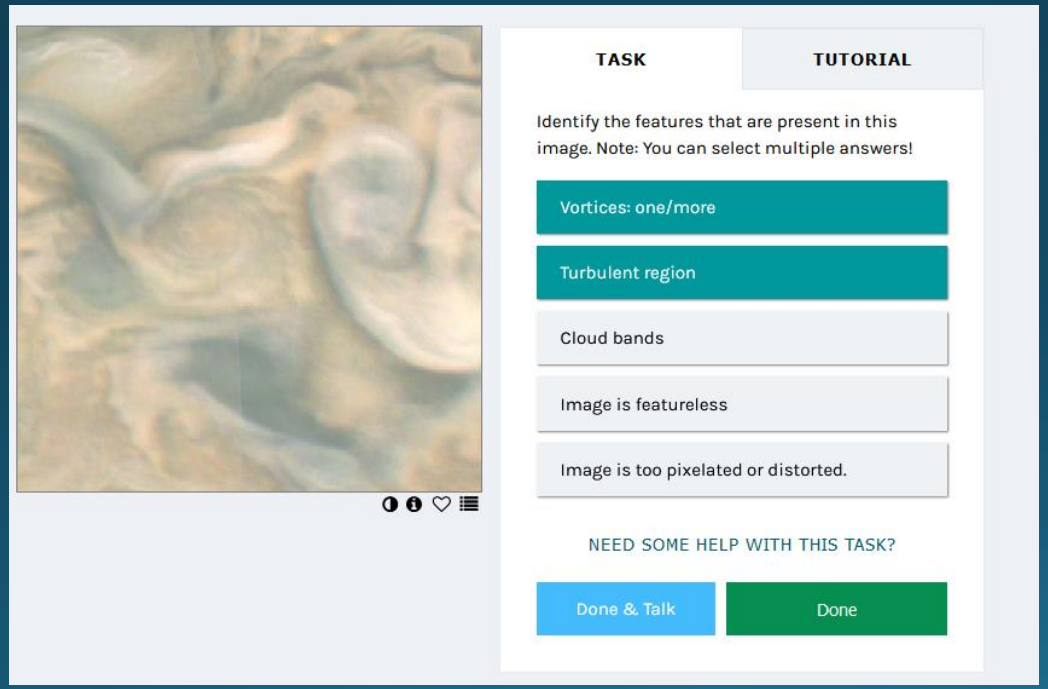
Enjoying Jupiter without a telescope

Armchair Activities

Participate in Jovian Vortex Hunter



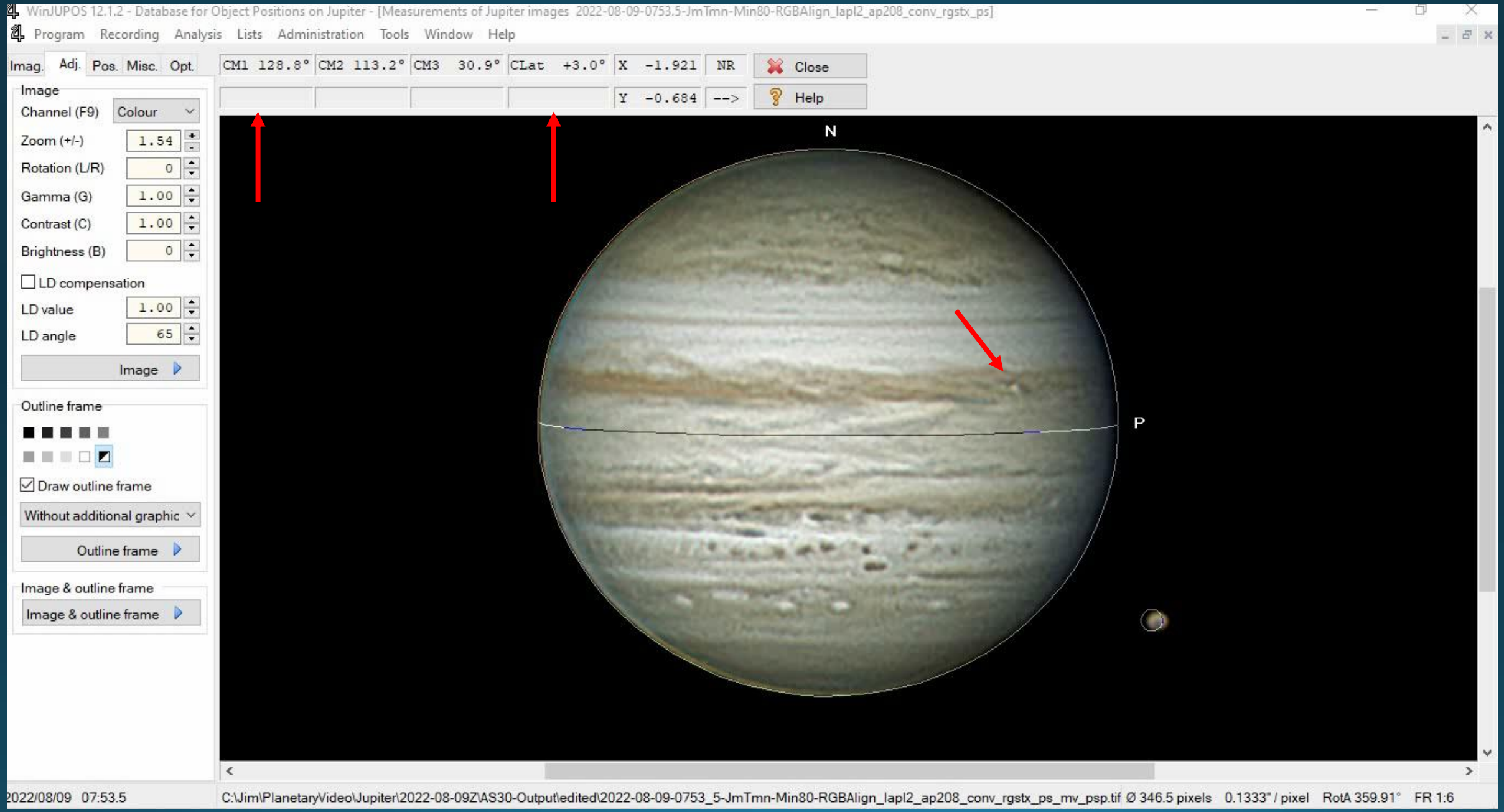
- This online site seeks input from citizen scientists to identify and catalog vortices seen in Juno images in an effort to better understand Jupiter's atmosphere.



https://www.zooniverse.org/projects/ramanakumars/jovian-vortex-hunter

Drift Analysis with WinJUPOS

- WinJUPOS is a free software app that seeks “to collect precise positions of Jovian cloud features, to analyze them in drift charts, and to examine if and how their movements change in time”
- Using online images you can identify the Jovian longitude and latitude of a feature and then track its drift. You can also post them online (or sign up to be a measurer and submit data to WinJUPOS)
- WinJUPOS is an amazing program with lots of functionality, would merit its own talk ☺


WinJUPOS 12.1.2 - Database for Object Positions on Jupiter - [Measurements of Jupiter images 2022-08-09-0753.5-JmTmn-Min80-RGBAlign_lapl2_ap208_conv_rgstx_ps]
Program Recording Analysis Lists Administration Tools Window Help
Imag. Adj. Pos. Misc. Opt.
CM1 128.8° CM2 113.2° CM3 30.9° CLat +3.0° X -1.921 NR
Y -0.684 -->
Close
Help
Image
Channel (F9) Colour
Zoom (+/-) 1.54
Rotation (L/R) 0
Gamma (G) 1.00
Contrast (C) 1.00
Brightness (B) 0
LD compensation
LD value 1.00
LD angle 65
Image
Outline frame
Draw outline frame
Without additional graphic
Outline frame
Image & outline frame
Image & outline frame
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2022/08/09 07:53.5
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Monitor the ALPO Jupiter Groups.IO

https://groups.io/g/ALPO-JUPITER

DDG Bing Dictionary Parler Fox RS WSJ FB OneDrive LR Astronomy ALPO Office IT Bill Mngmnt Personal From Microsoft Edge Other Bookmarks

Groups.io Your Groups Find or Create a Group Help Jim Tomney

- Home
- Subscription
- Messages
- Hashtags
- New Topic

ALPO-JUPITER@groups.io

Email network for the Jupiter Section of the Association of Lunar and Planetary Observers. Posted are messages, observations, and alerts about the planet Jupiter.

Group Information

66 Members
122 Topics, Last Post: Aug 11
Started on 12/11/20

Group Settings

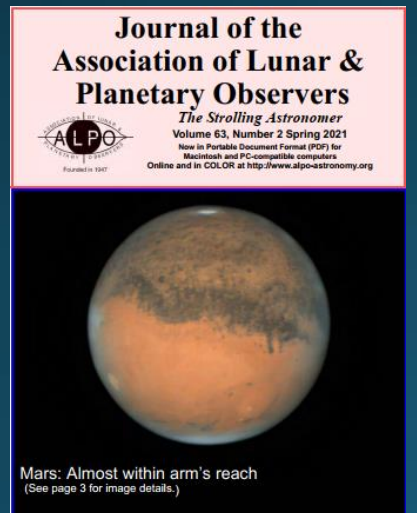
All members can post to the group.
✔ Posts to this group do not require approval from the moderators.
✔ Posts from new users require approval from the moderators.

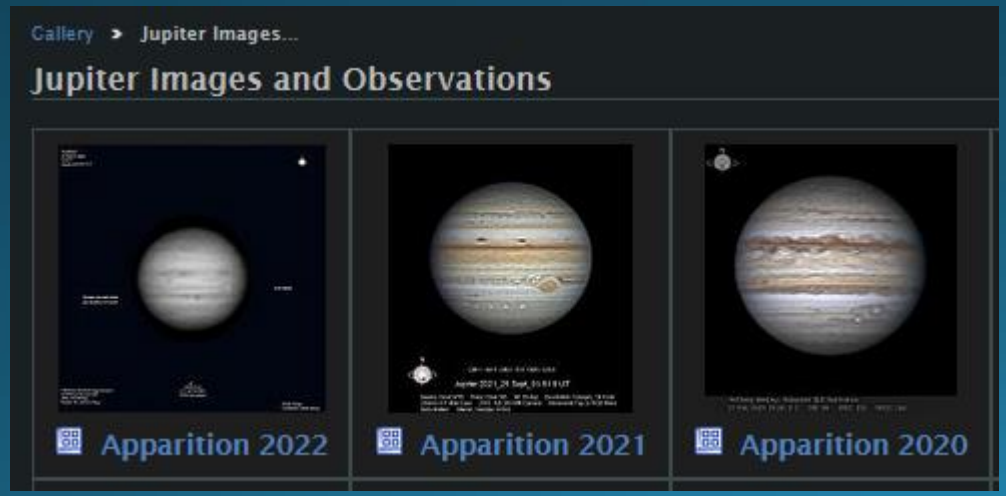
Resources

- Association of Lunar & Planetary Observers
  - $18/year includes the quarterly journal

    https://store.astroleague.org/index.php?main_page=product_info&cPath=10&products_id=39
  - ALPO Gallery

    http://www.alpo-astronomy.org/gallery3/index.php/Jupiter-Images-and-Observations
  - Annual Conference (has been virtual since COVID)





Resources

- BAA

  https://britastro.org/sections/jupiter

- Japan-ALPO

  https://alpo-j.sakura.ne.jp/indexE.htm

- Jupiter Impact Detection Software

  (Examines your video for any impact flashes)

  http://www.astrosurf.com/planetessaf/doc/project_detect.php

Resources

- GRS Transit Times

  https://skyandtelescope.org/observing/interactive-sky-watching-tools/transit-times-of-jupiters-great-red-spot/

- Galilean Moon Events

  https://skyandtelescope.org/wp-content/plugins/observing-tools/jupiter_moons/jupiter.html

- CM Calculator

  http://astroclub.tau.ac.il/ephem/JovMap/

Resources - Software

Image Capture Software

- Firecapture
- SharpCap
- ASIStudio (ZWO Cameras)

Image Processing Software

- Planetary Image Pre-Processor (PIPP)
- Autostakkert3!
- Registax6
- WinJUPOS

Resources

- AL Jupiter Observing Program

  https://www.astroleague.org/content/jupiter-observing-program

- JUNO Observation Upload

  https://www.missionjuno.swri.edu/junocam/planning/

- Jovian Vortex Hunter

  https://www.zooniverse.org/projects/ramanakumars/jovian-vortex-hunter

- ALPO Groups.IO (Email network for ALPO's Jupiter Section

  https://groups.io/g/ALPO-JUPITER

ALPO Imaging Training Program – Beta Testing

- For years ALPO has provided training for members to sharpen their observing skills. We want to explore starting an imaging training program for our members
- We need to evaluate what resources are helpful to new imagers as well as gauge how much time & effort the mentor should anticipate providing
- I do have an old camera that you can borrow for this initiative
- If you are a member of HAL and want to explore starting to image Jupiter, please head over to this online form and let me know of your interest.

https://forms.gle/4mCwyzLAVM9WSTKF6