

High Resolution Planetary Imaging Workflow



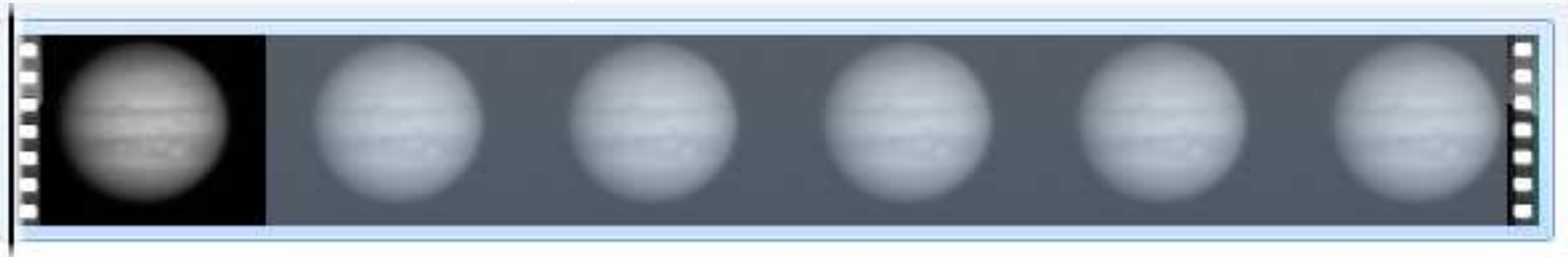
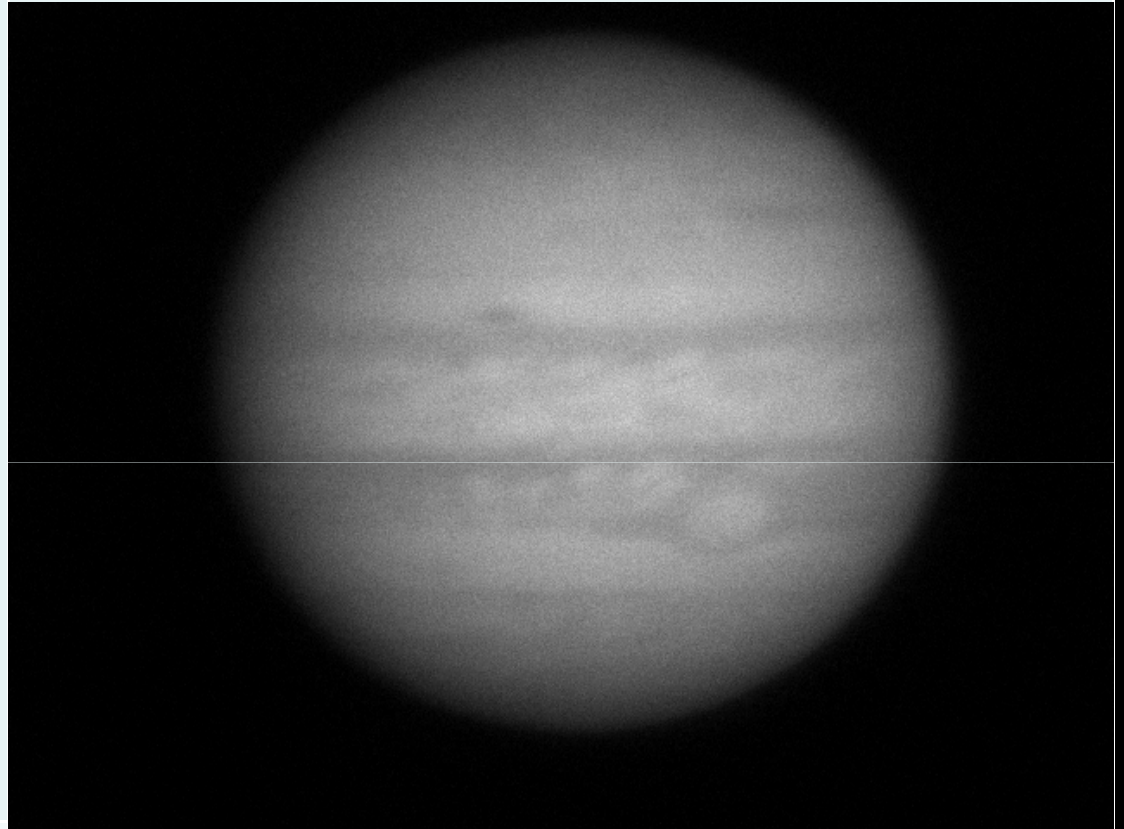
Fighting the Atmosphere

- Getting out of the Atmosphere
- Adaptive Optics
- Lucky Imaging



Feeling Lucky

Lucky Imaging is the process of capturing planets using a CCD video camera. A software to sort out the quality of the images. This takes advantage of the fleeting good seeing.

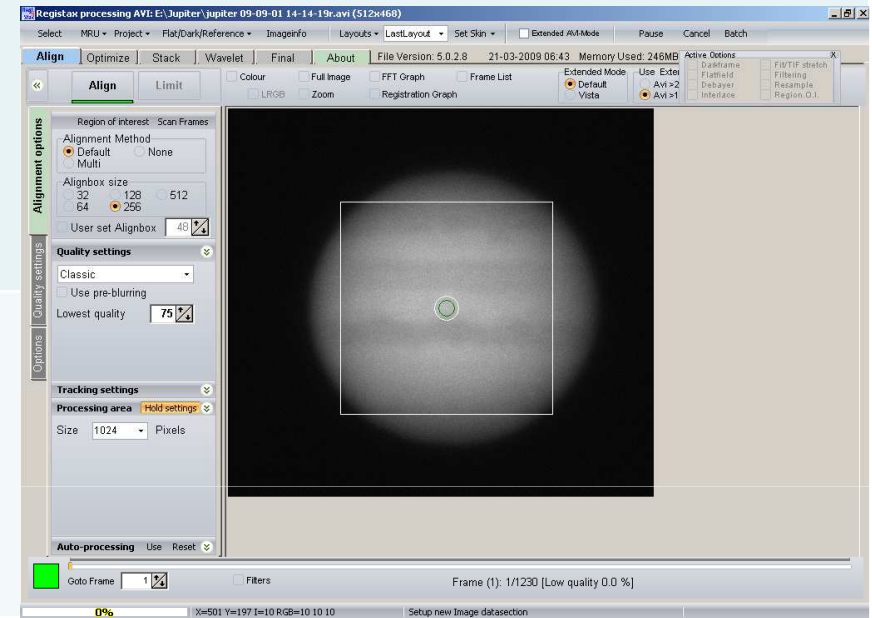


Amateurs doing Lucky Imaging

Development of inexpensive video capture devices.

The advances of computer hardware and interface.

The development of processing and control software. (ie Registax and Firecapture)



SUMMARY

Choosing the Right Equipment

Imaging Workflow

a. Preparation

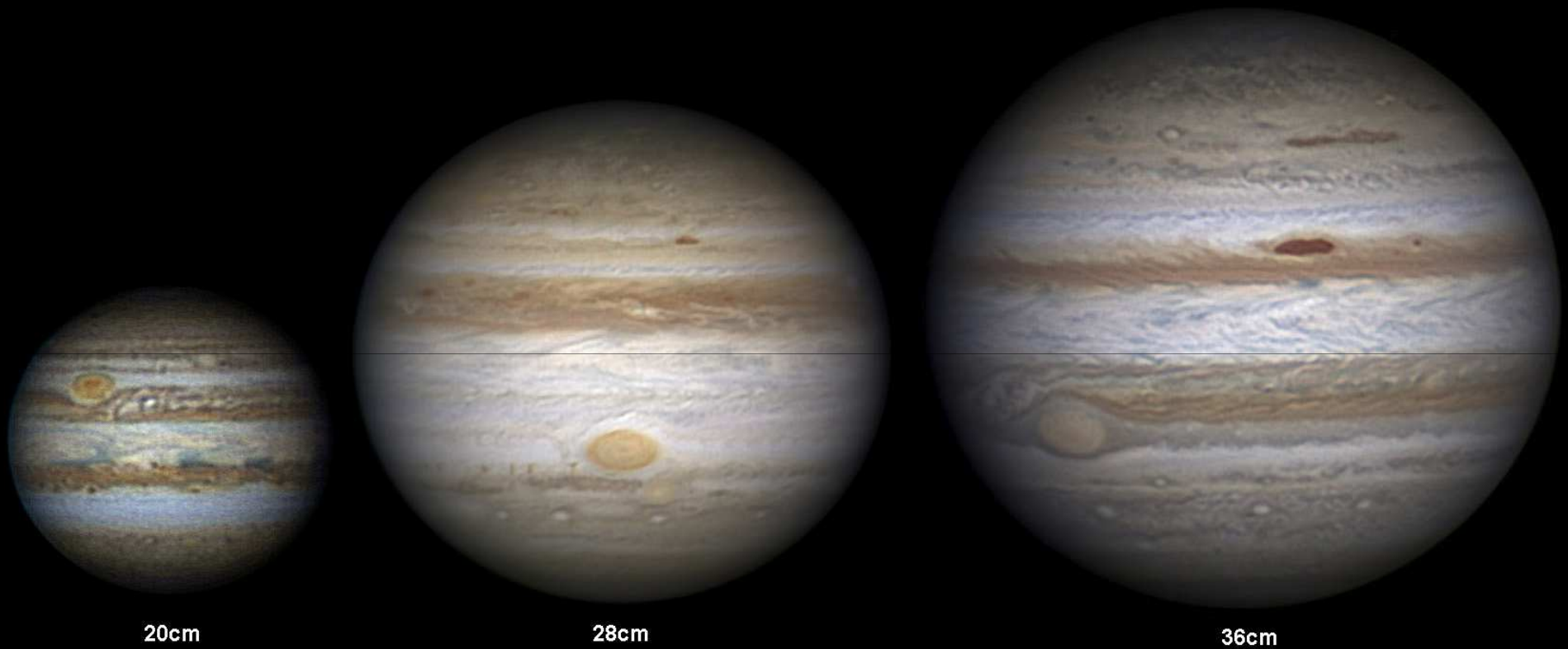
b. Image Capture

c. Image Processing

d. Post Processing

e. Archiving

The Telescope: Aperture Rules!



The bigger the aperture, the higher the resolution.

The Camera

Webcam

Pro: Cheap and Simple to use.

Cons: Noisy Interface and Slow Frame Rate.



High Speed Industrial Camera

Pro: Can do high frame rate with no compression. Low noise circuit. Flexible imaging capabilities.

Cons: Expensive and requires a fast computer to run.



Monochrome or Color

Color CCD

Pro: Simple to Setup and Fast Processing.
Very inexpensive setup.

Cons: Less sensitive CCD due to Bayer Layers. Needs to compensate for Atmospheric Dispersion.



Monochrome CCD

Pro: Very Sensitive CCD, better image quality, no problem with Atmospheric Dispersion.

Cons: Expensive and Complicated Setup.



ATMOSPHERIC DISPERSION CORRECTOR

If you are using a color camera, an ADC is a necessary accessory.



Camera Interface:

USB 2.0	480Mbps. Does not require an external power source. Standard with all recent PCs.
Firewire A	400Mbps. Some PCs might require an adapter and a power source.
Firewire B	800Mbps. Most PCs might require an adapter and a power source.
USB 3.0	4Gbps. This is the fastest interface available. Not yet as common as most PCs but will be in a few years time.



Some Useful Accessories

Barlow	Increases the image scale of the object imaged
Motorized Filter Wheels	Allows vibration free changing of filters.
Filters:	
RGB Filters	To make colored image from monochrome camera.
UV, IR and Methane Band Filters	Special Filters to reveal atmospheric details on gas planets.
Flip Mirror	Time saver in centering an object to the CCD camera.
Motorized Focuser	Allows vibration free and fine focusing
Vibration Suppression Pads	Reduces high frequency vibration when imaging on hard surfaces



Preparations before Imaging



Location, Location, Location

- Best place to do planetary imaging is at the area close to the equator (where planets are higher), and close to the sea.
- Stay away from heat sources (ie., air conditioning system, chimneys, hot asphalt, etc.)
- The three most important thing in getting quality planetary image are: seeing, seeing and seeing!

COOL YOUR OTA

1. Keep your OTA indoors.
2. Use a cooling fan to reduce tube currents. The bigger the OTA the longer it requires to cool.



LOCK THE MIRROR

Lock the mirror after focusing to prevent focus shift!!



Fine Collimate the OTA

1. During a night of good seeing, rough collimate your OTA visually. Attach your imaging setup to the OTA.

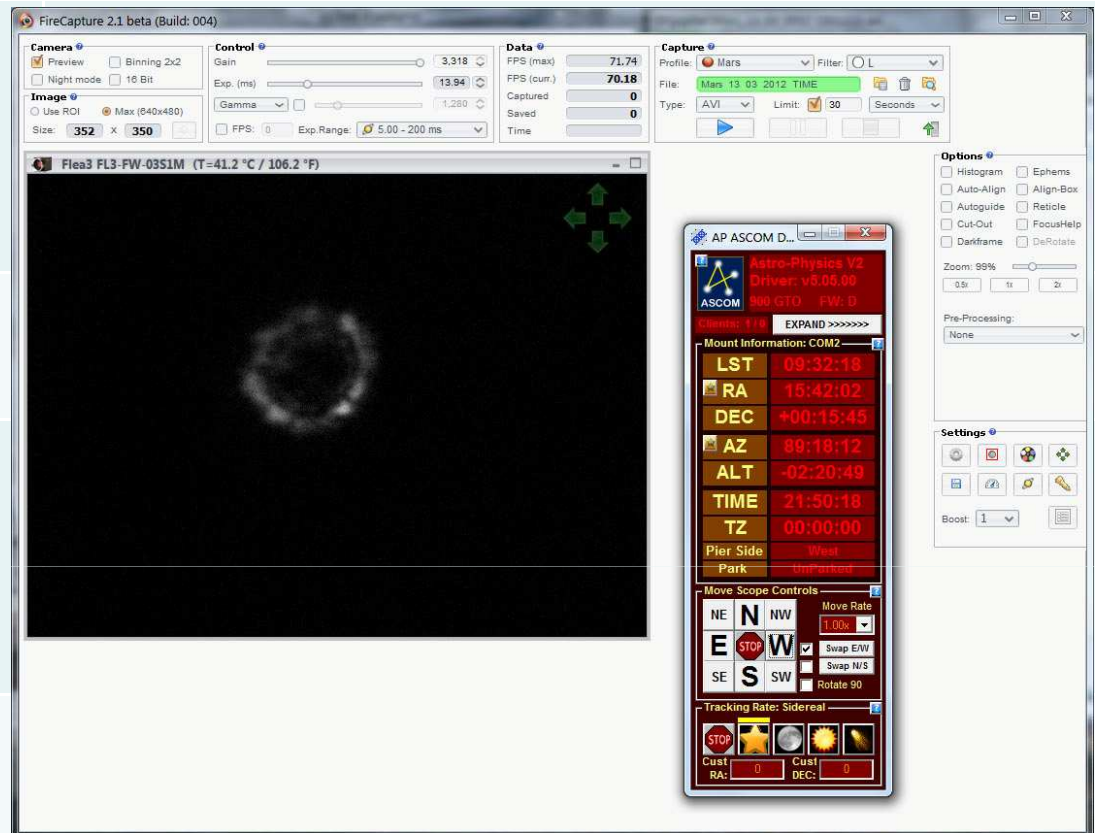
2. Pick a bright STAR that is at least 70deg above the horizon.

3. Center the star with your capture software. Choose the RED filter when using a monochrome camera.

4. Make the star out of focus by turning the focuser in.

5. Adjust the collimation screws to make sure that the rings are center.

6. Make sure that you have your screen in front facing you when you collimate. The star will get out of the FOV when you move the collimating screws.

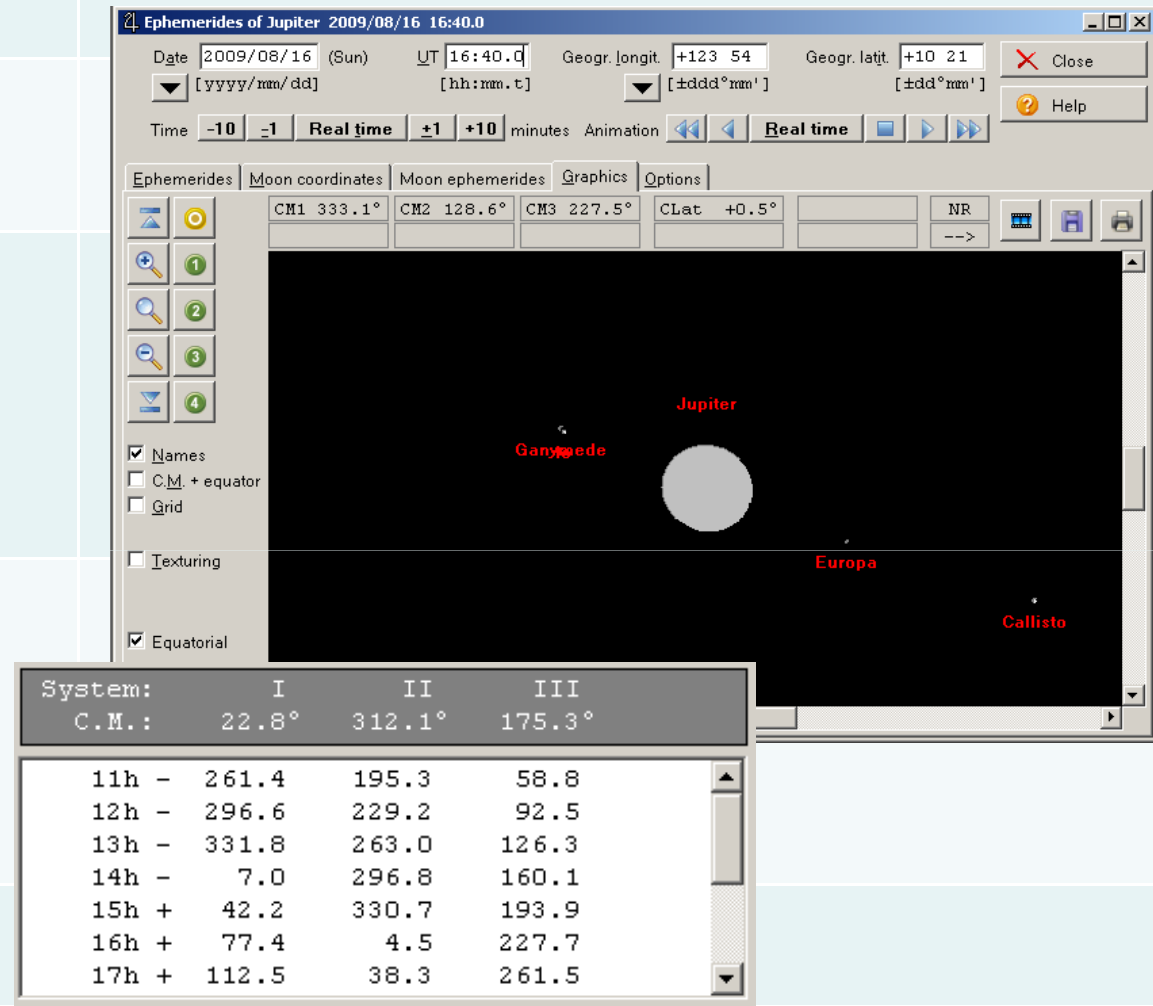


Plan your imaging with WinJupos

Use the Ephemerides function of WinJupos.

Check which side of the planet will be visible in your planned observing time.

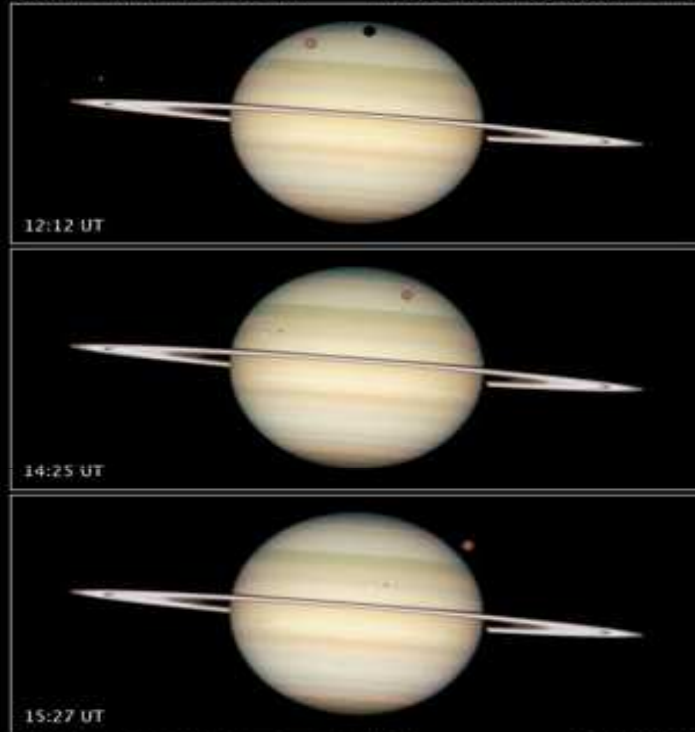
Check the position of the moons of the planets to check for transits or eclipses.



If you do not plan, you might miss exciting events!!

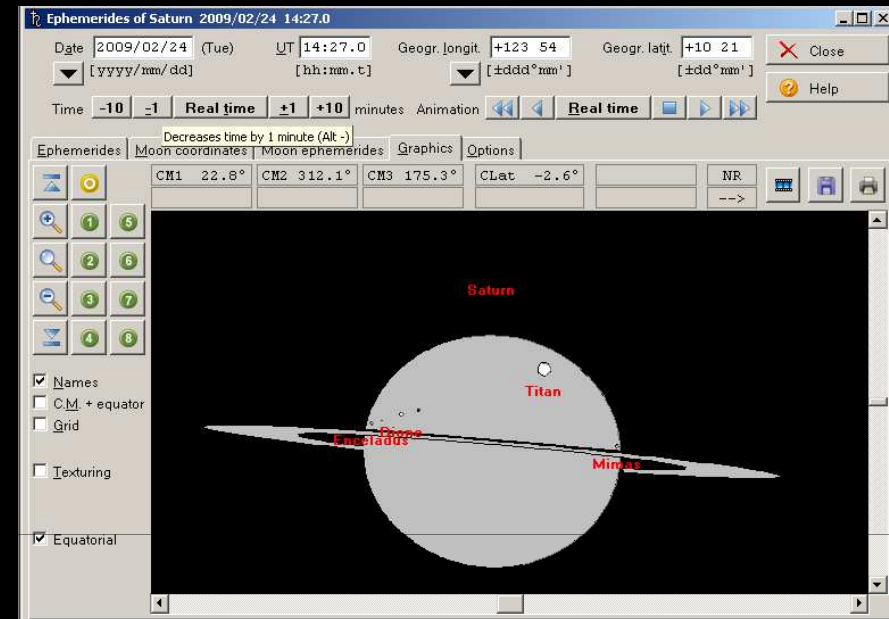
The 2009 Quad Transit at Saturn

Saturn • February 24, 2009 Hubble Space Telescope WFPC2



NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

STScI-PRC09-12b



HST Imaging with Mike Wong and the Hubble Heritage Team.

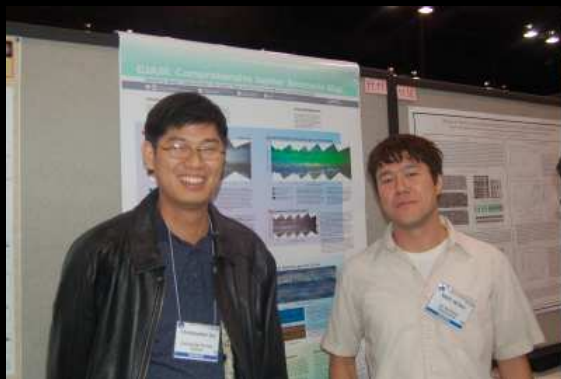


IMAGE CAPTURE



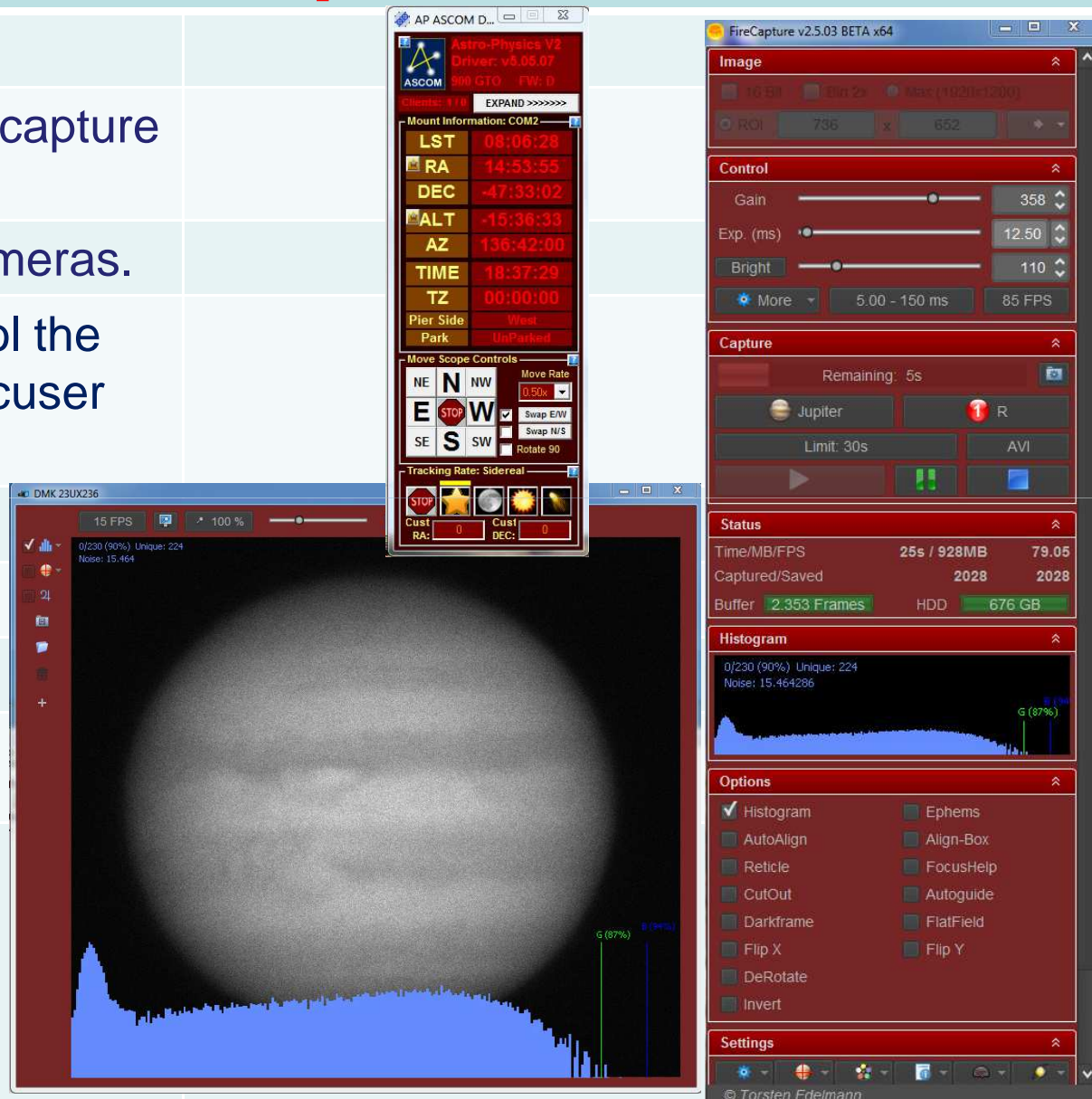
FireCapture

Currently, one of the best capture software.

It supports a variety of cameras.

Feature rich. It can control the mount, filter wheel and focuser using ASCOM.

It's Free!!

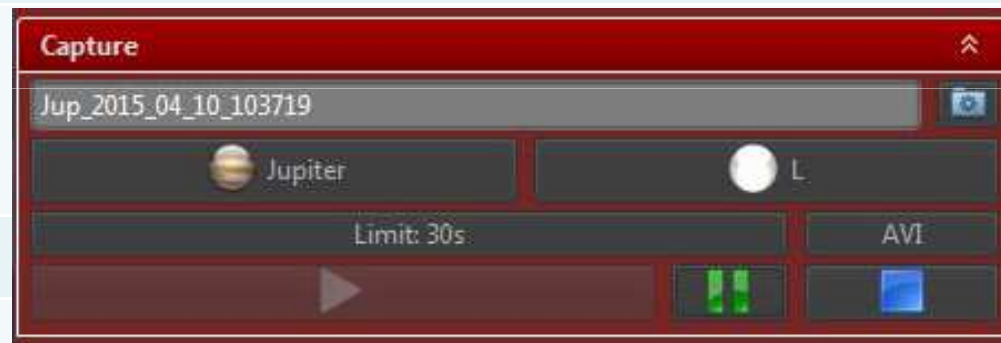


FireCapture Controls

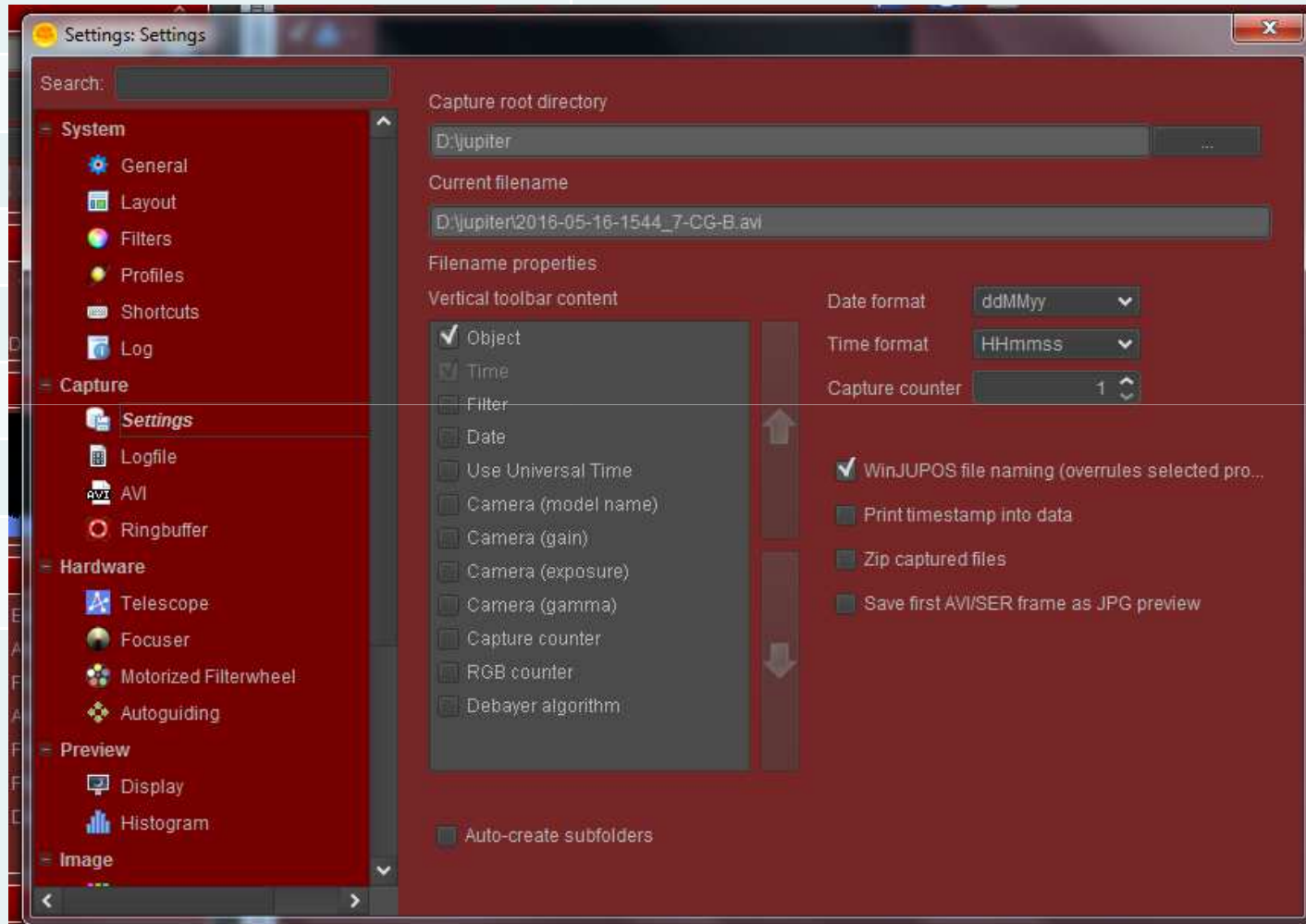
Use Gain and Exposure time to increase brightness.

Set Exposure time limit with the limit function.

Set ROI to reduce file size, increase frame rate and for faster processing.

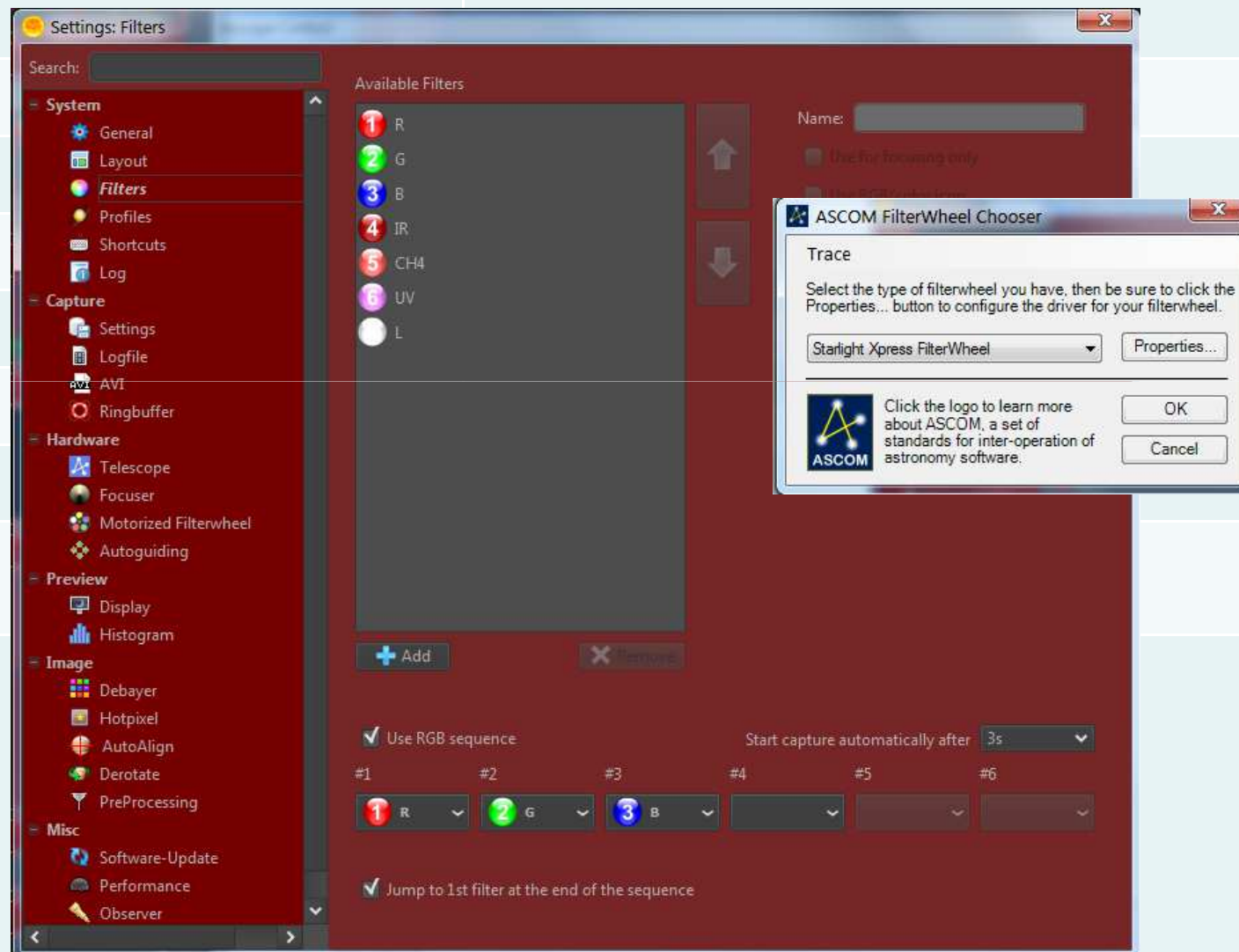


Important Setup



Use Winjupos Filename override!

Filter Wheel Automation



Firecapture Autoguide

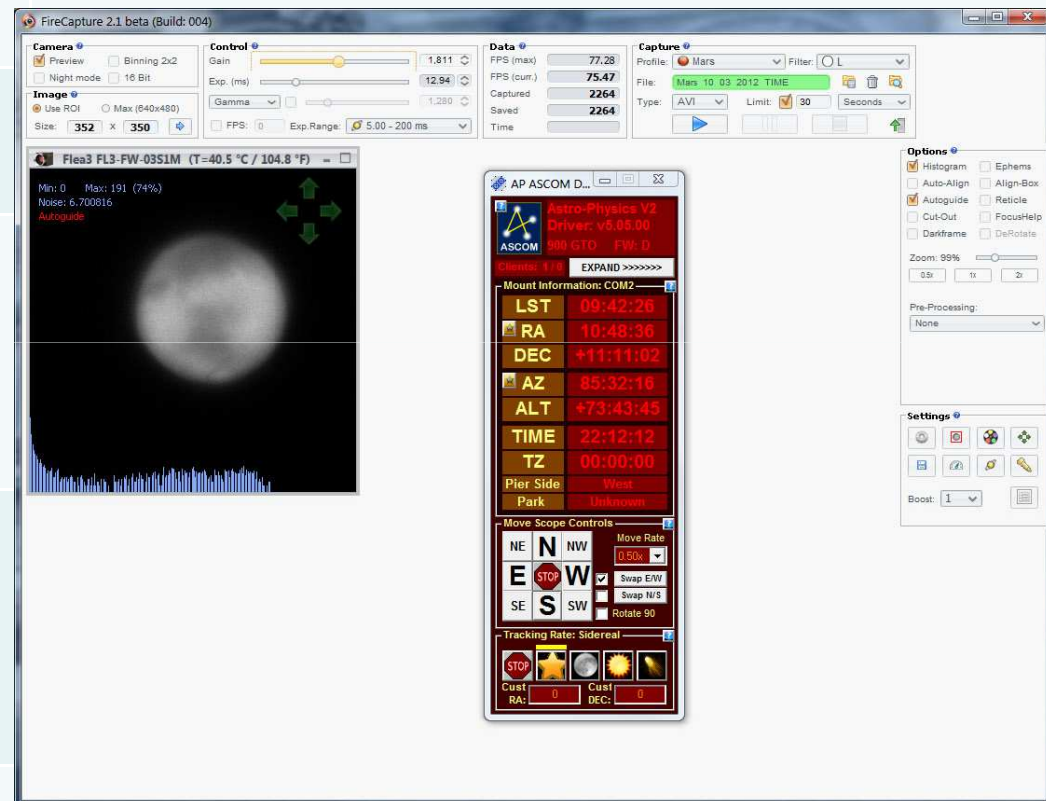


Autoguide feature is used to keep the planet centered on the FOV.

It is compatible to all ASCOM compatible mounts.

When using autoguide make sure the planet's orientation is parallel to the motion of the mount.

Make sure that orientation of the green control arrows match the motion of the mount. Flip E-W or N-S to achieve this.



Capture Secrets

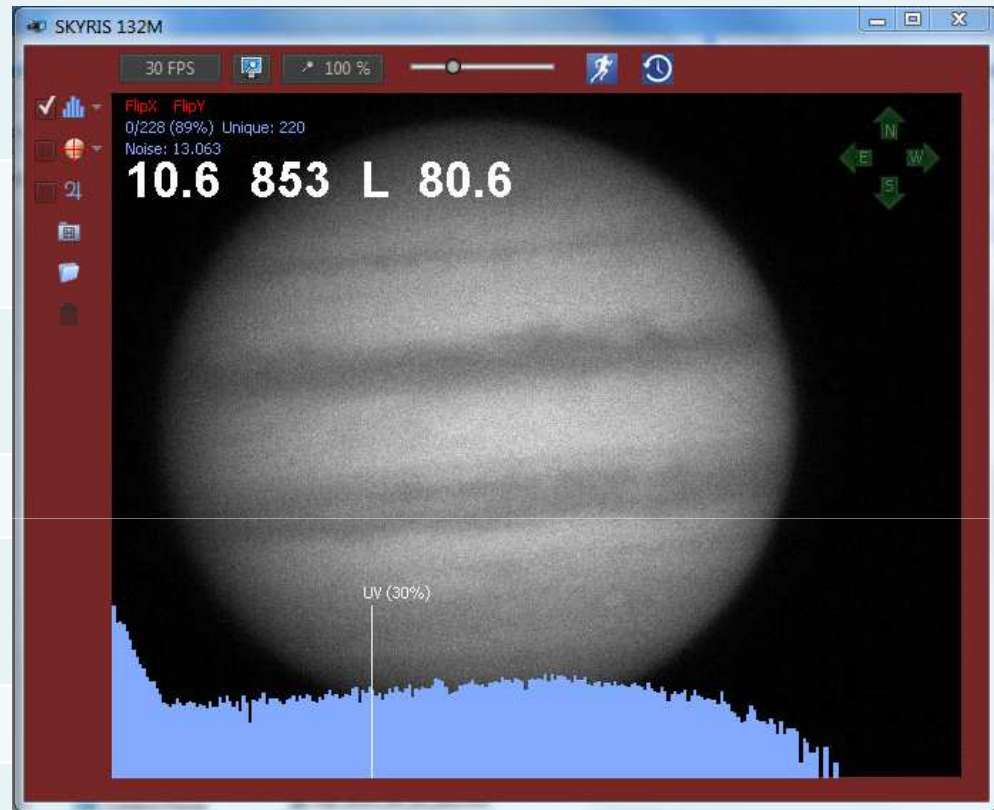
Find the sweet spot of your imaging system. Have a capture routine for each target object.

Use the fastest frame rate possible.

Understand the gain limits of your camera.

Turn off Gamma!!

Spend time to focus the telescope.



Final Image Quality Depends on your capture quality. So be patient!

Jupiter

Keep histogram level around 80-90% on all channels.

Keep total integration time below 2 minutes.

Use focal length of around 30X of your aperture 5 micron pixel cameras and 20X the aperture for 3.75 micron cameras.



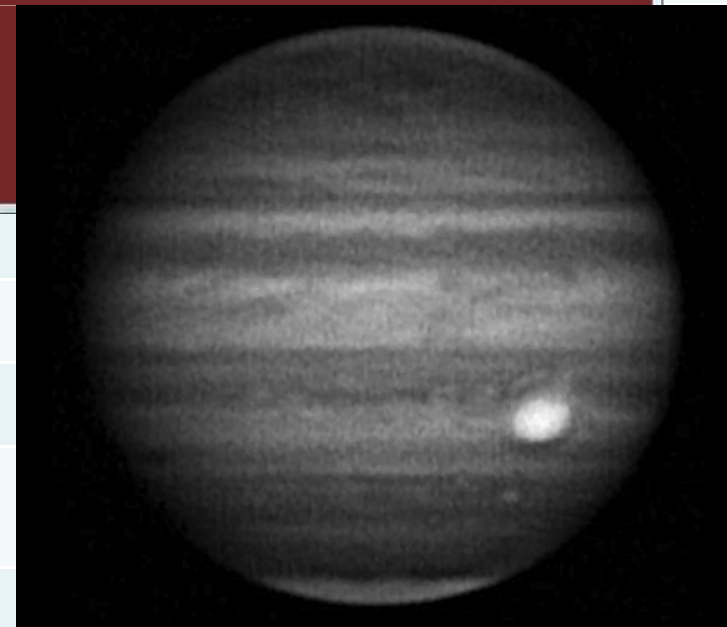
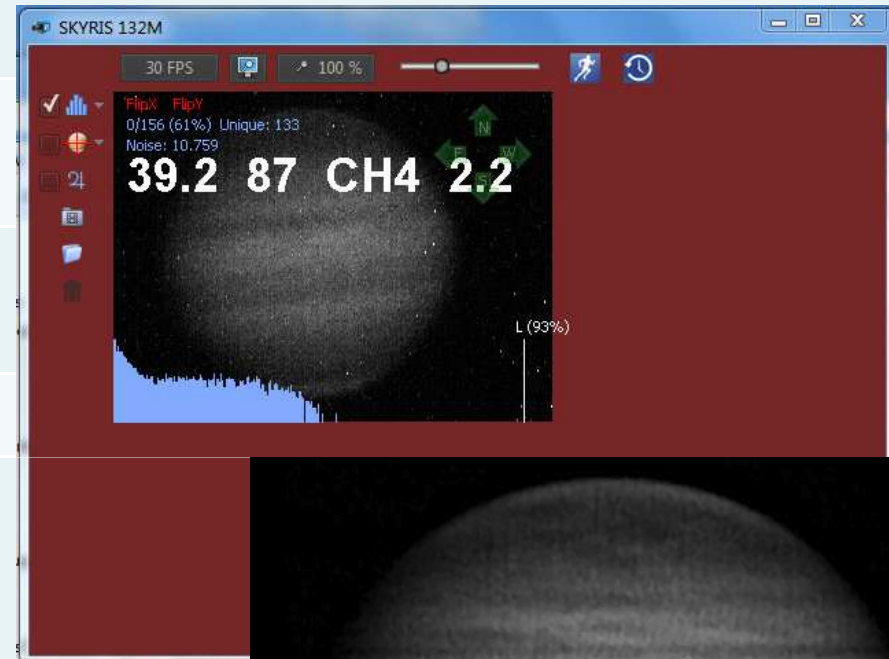
Jupiter Methane Band

Methane Band shows high altitude clouds of Jupiter.

Because Image is very faint, use 2X2 binning.

Capture time of up to 2 minutes.

Take DARK FRAMES! Dark frames must be done by capture 5 frames and stacking this in Registax.



Saturn



Saturn has very low surface brightness.

Use 50% histogram level for red and green and 30% for blue.

Keep total integration time to around 3 minutes.

Use 100% gain and variable frame rate.

Use Winjupos Derotation so that the final image will be smooth.

Mars

Use focal length around 50X the aperture for 5 micron pixel cameras and 30X the aperture for 3.75 micron cameras.

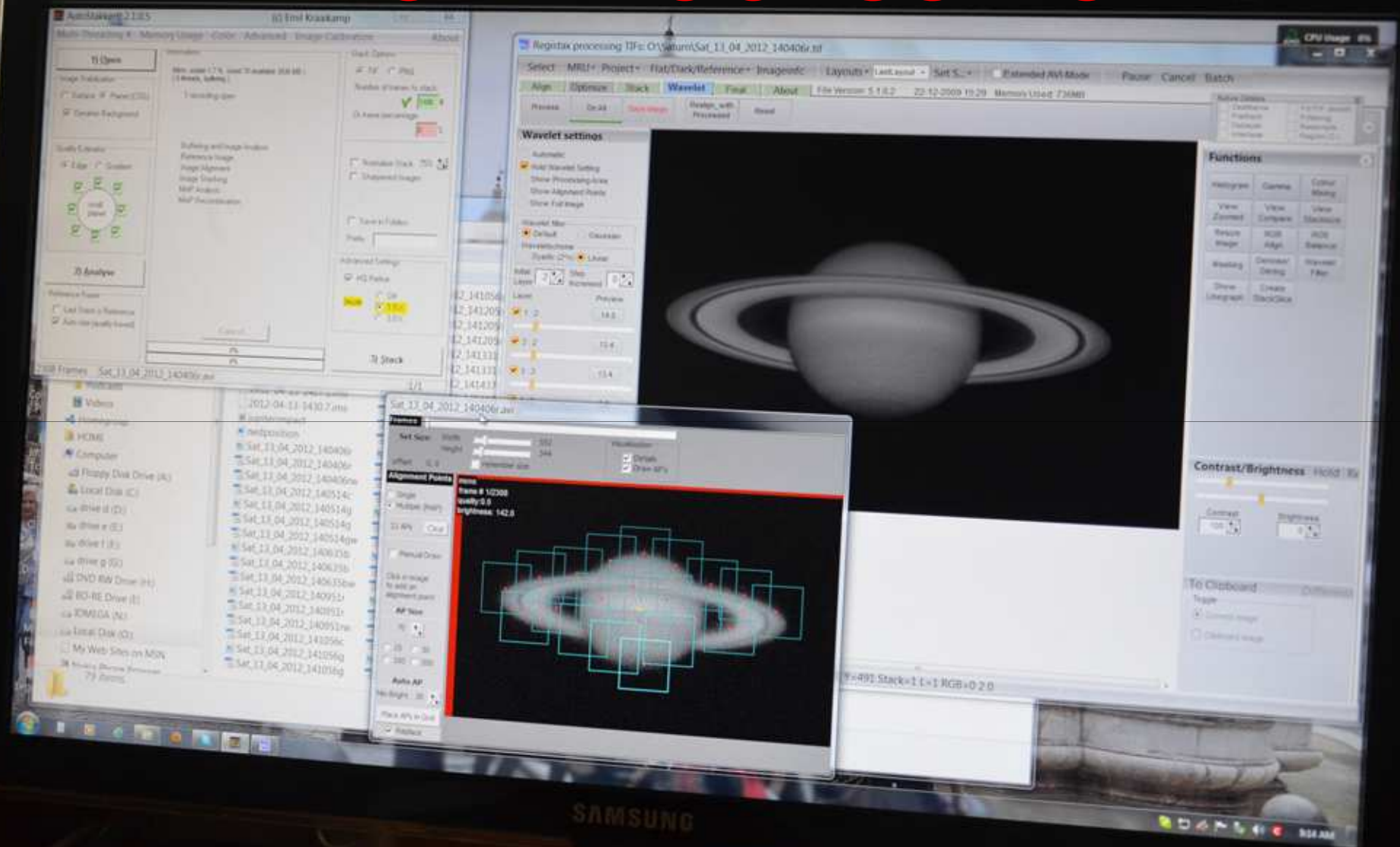
Keep histogram level of the Red Channel at around 80-90%. Keep Green at around 60-70% and Blue around 30-40%.

Total integration time can be as long as 4 minutes.

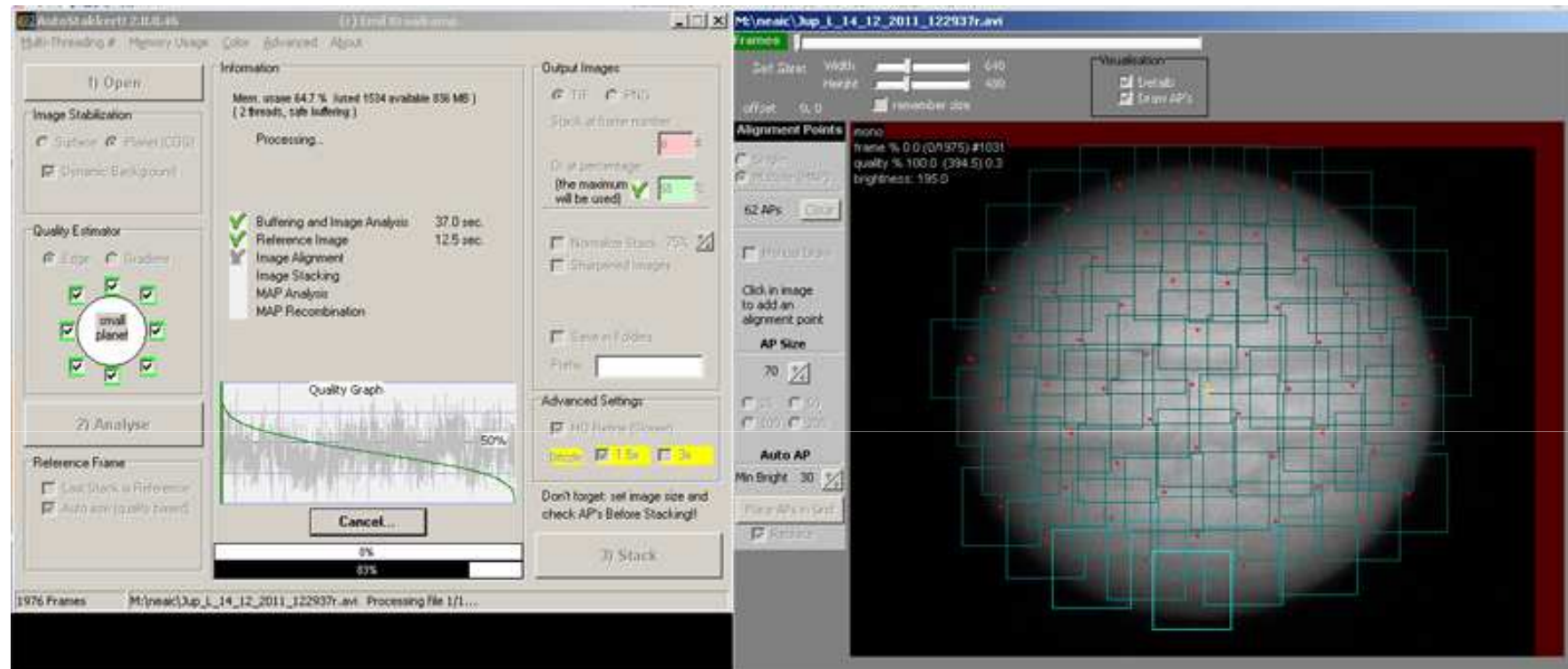
UV-IR should be blocked to get true colors. Make sure your blue channel has no IR leakage.



IMAGE PROCESSING



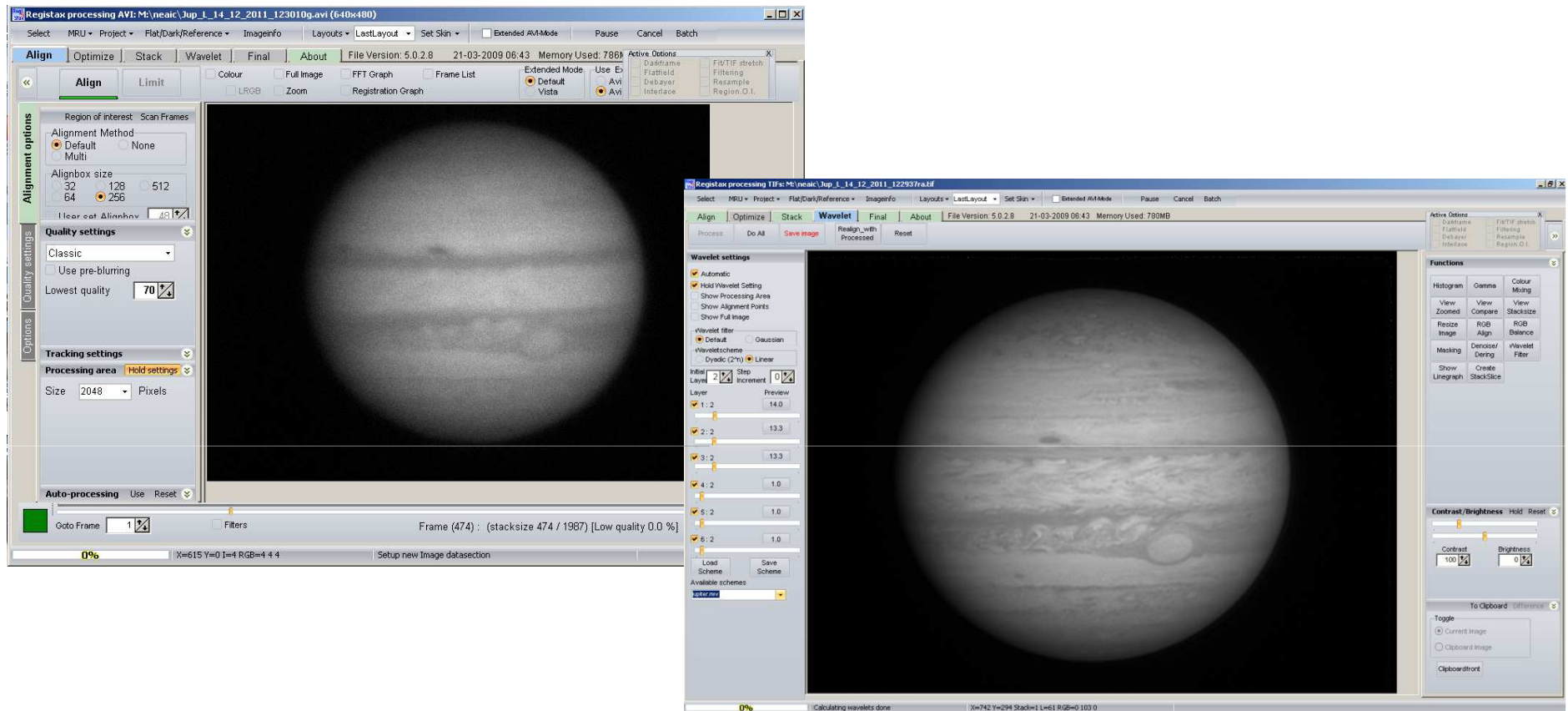
AutoStakkert!!



Pro: AutoStakkert is easier to use and better results vs Registax. Process the image faster and automatically aligns the image.

Con: Few controls. Not very intuitive to use.

Registax



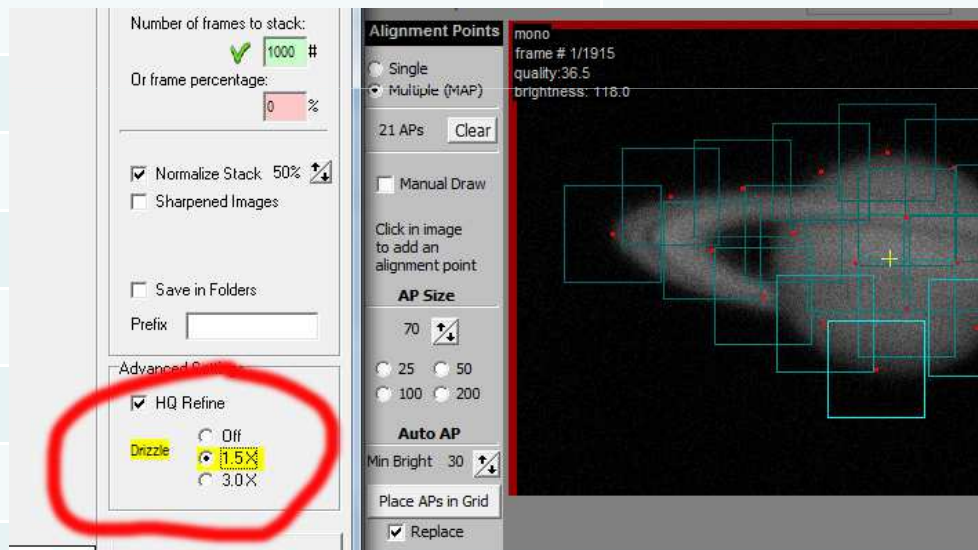
This is the software that revolutionized Planetary Imaging. It has an excellent sharpening wavelet tool.

Making Things Bigger

Resampling can be use to increase image size.

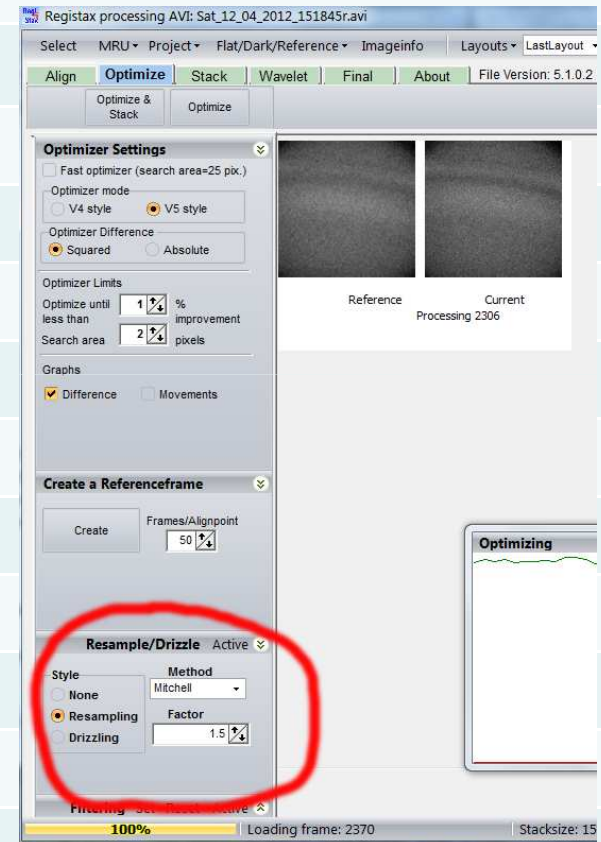
AutoStakkert

1.5X Drizzle



Registax

1.5X Mitchell



Sharpening vs Noise Reduction

Sharpening Tools

Registax Wavelets

Unsharp Masking

Google Nix

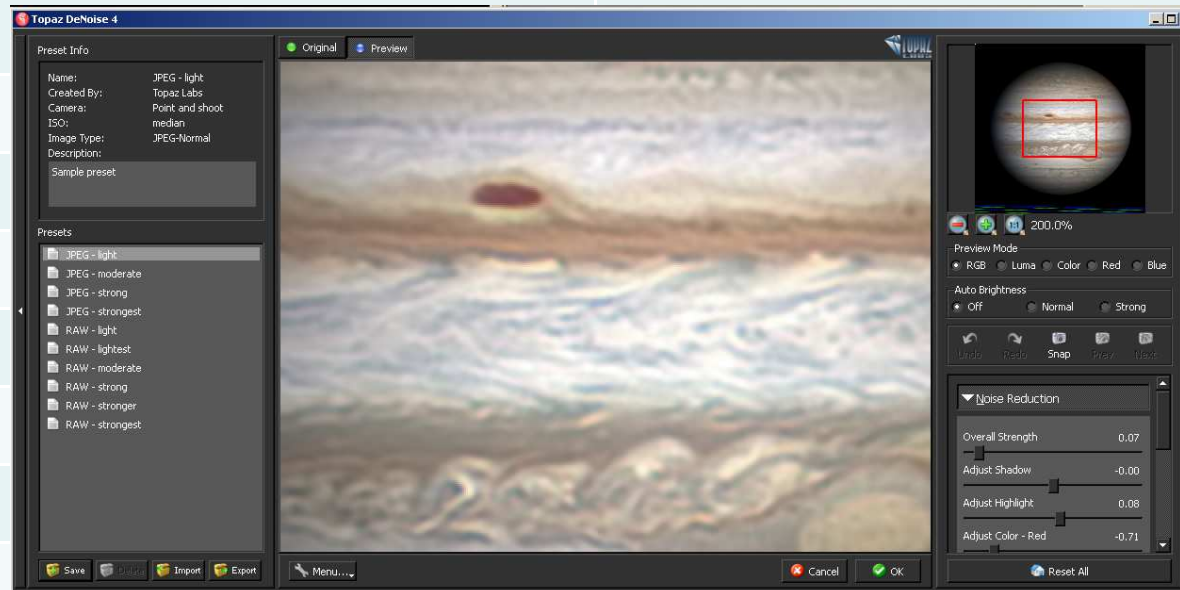
Noise Reduction Tools

Despeckle Tool

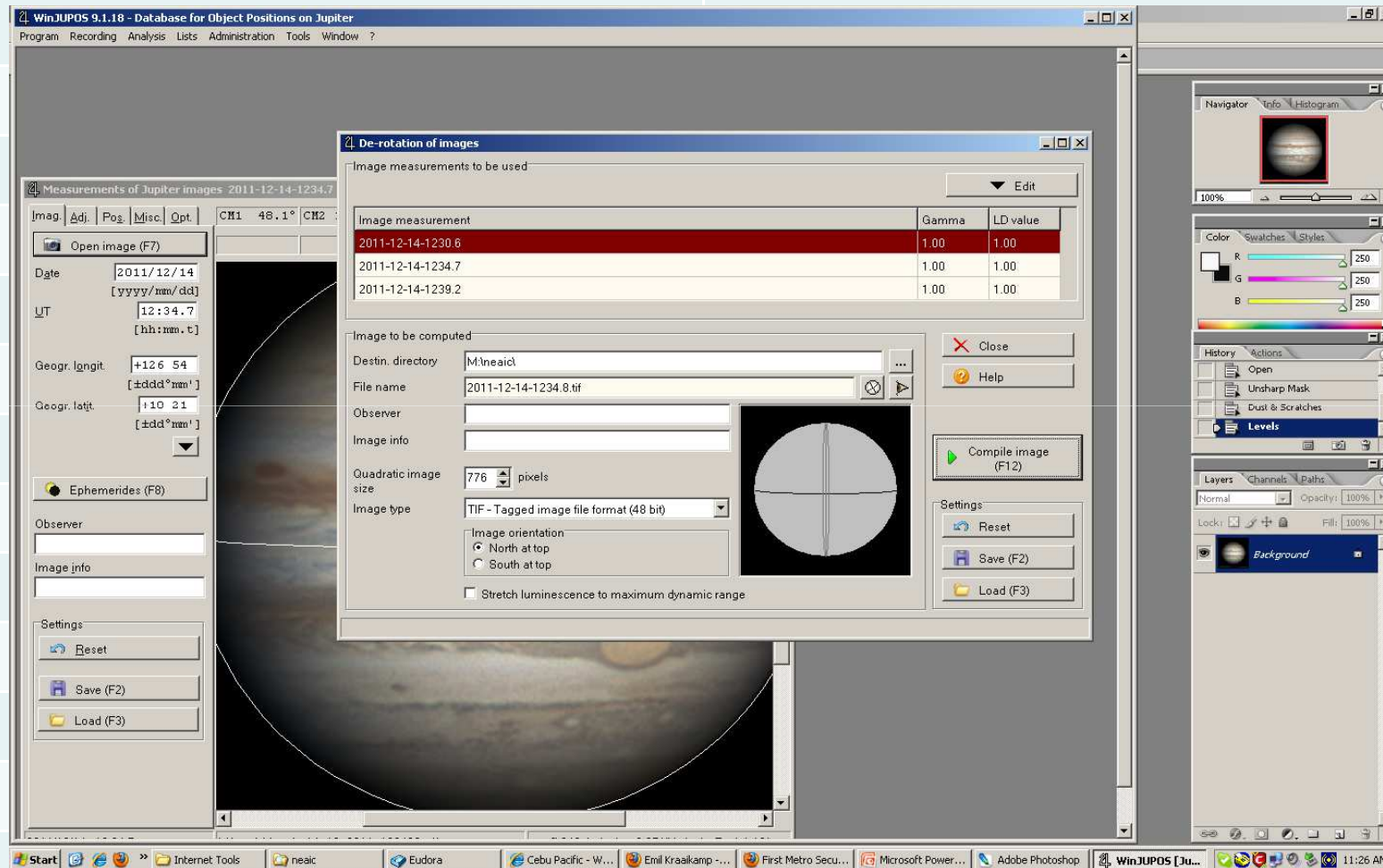
Dust and Scratches Tool

Topaz Labs DeNoise Tool

Image Processing is an art form. Each person will have their own look.



WinJupos DeRotation: The Next Revolution in Planetary Imaging



WinJupos DeRotation module allows imagers to go past the time limits set by the rotation of the planets.

1. Image Measurement

a. Capture multiple image sequence for a span of 15-20 min.

-Use Page Up and Down to increase or decrease the size of the outline.

b. Open Image in Image measurement window. Input the date and time the image was taken.

c. Press F11 to automatically adjust the outline.

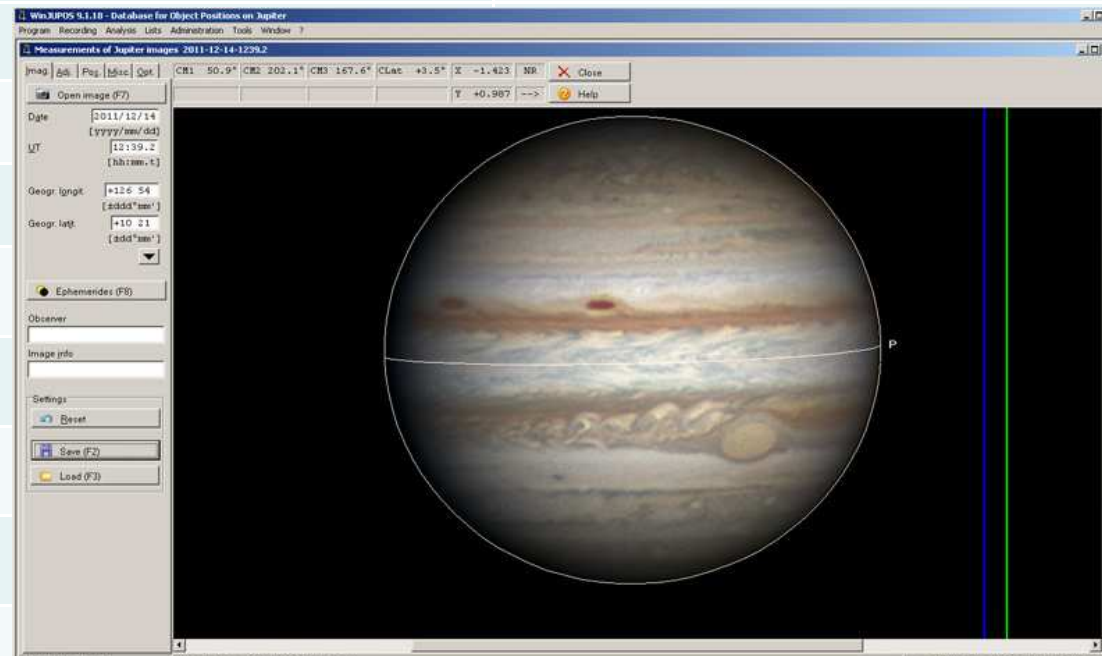
d. The outline has to be adjusted by:

-Use the Arrow Keys to go move the outline.

-N to rotate the outline clockwise and P to rate it counterclockwise.

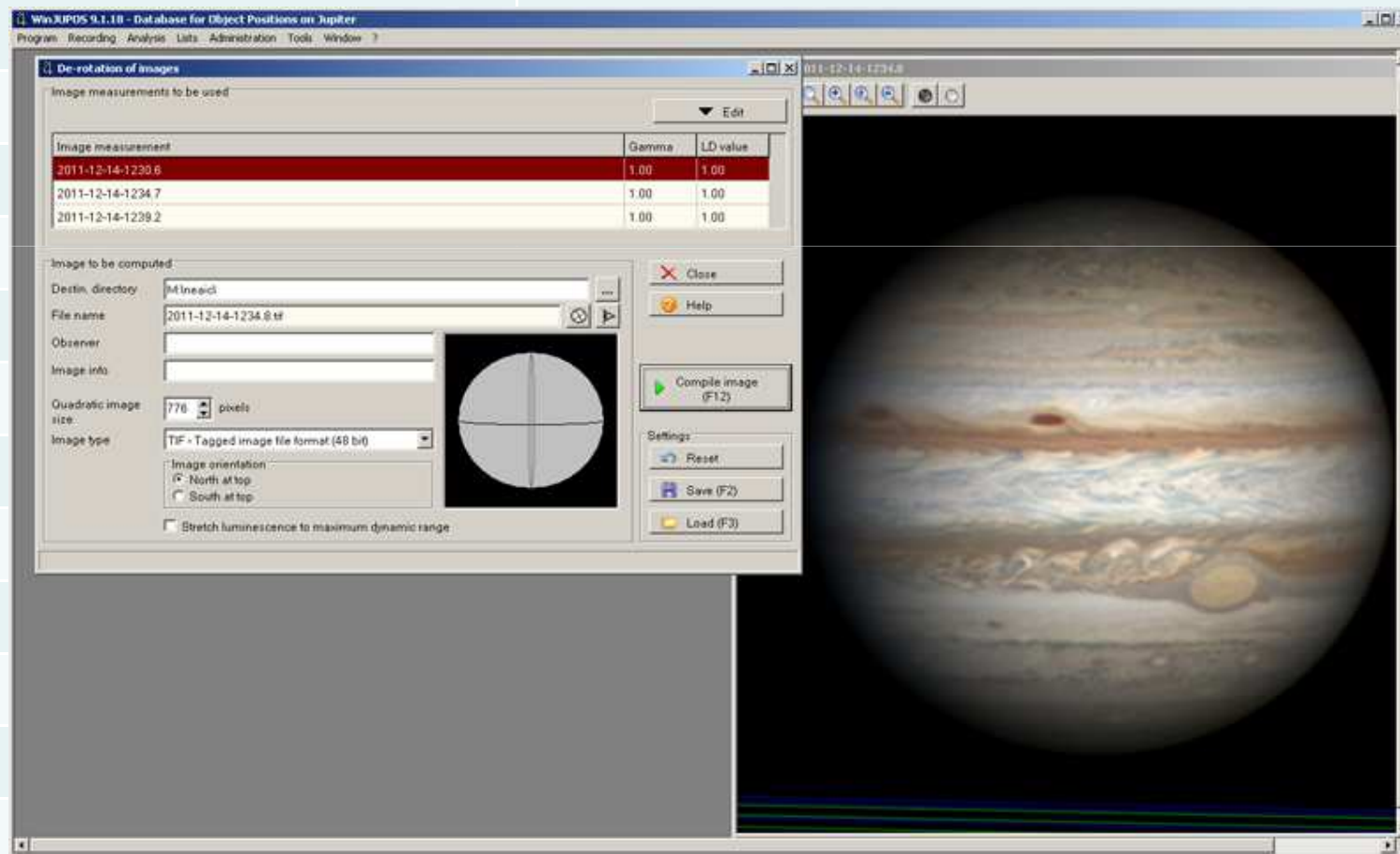
e. Save the measurement in .ims file.

f. Repeat with all images.



2. De-Rotation

- The der-otation module can be found under the tools menu.
- Press Edit and Add each of the **IMAGE MEASUREMENT FILES** you want to stack.
- Choose the output file type and image orientation you want your final image to look.
- Press **COMPILE IMAGE**.



Single vs Derotated



SINGLE IMAGE



10 IMAGE DEROTATED IMAGE

The Final Image

1. North or South up?
2. Use UT time of the green channel if your are doing RGB.
3. Include Central Meridian info. This info can be obtained with WinJupos Ephemerides Tool.
For Jupiter and Saturn Include the THREE Central Meridian Info.
4. Include observer information Name and Location.
5. When using De-Rotation indicate your total capture time.

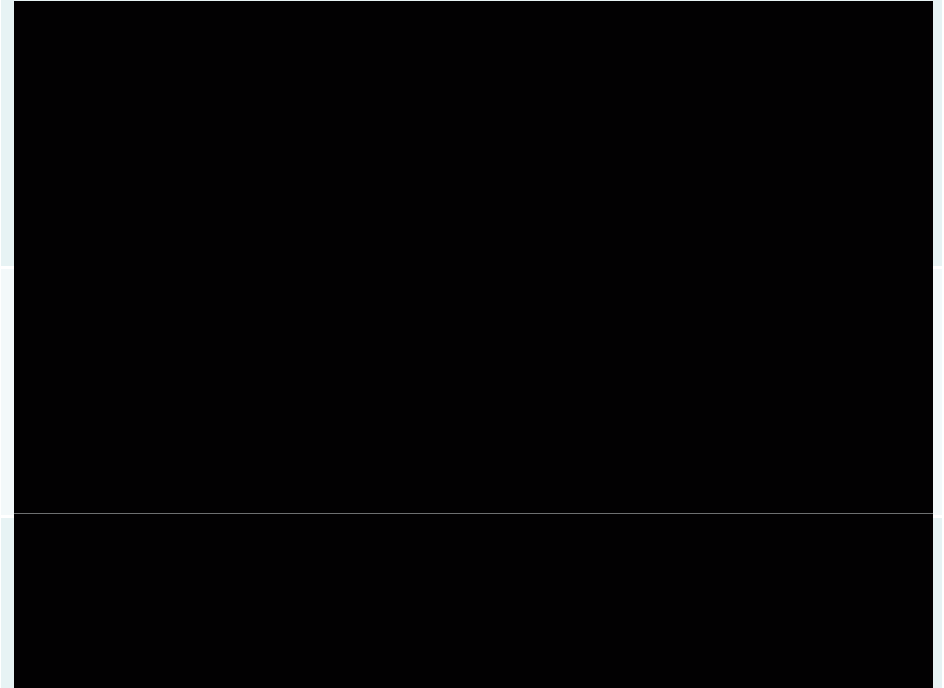


Post Processing/Archiving

Review all Jupiter and Saturn videos for possible impacts.
Play video with a media player or scan videos using Registax.

Archive your data! Use compression to reduce data volume.

Burn compressed archives on Blue-Ray Discs or store on removable hard drives.



Software Info

Capture Software

FireCapture	http://firecapture.wonderplanets.de/

Stacking Software

Registax	http://www.astronomie.be/registax/
AutoStakkert 2.0	http://www.autostakkert.com/
Winjupos	http://www.grischa-hahn.homepage.t-online.de/astro/winjupos/index.htm

Impact Detection Software

JID	http://www.pvol.ehu.es/software/	

Where to Submit Your Images

Join the ALPO Mailing List

ALPO Jupiter	http://tech.groups.yahoo.com/group/ALPO_Jupiter/
ALPO Mars	http://tech.groups.yahoo.com/group/marsobservers/
ALPO Mercury	http://tech.groups.yahoo.com/group/ALPO_Mercury_Discussion/
ALPO Saturn	http://tech.groups.yahoo.com/group/Saturn-ALPO/
ALPO Venus	http://tech.groups.yahoo.com/group/Venus-ALPO/
ALPO Japan	http://alpo-j.asahikawa-med.ac.jp/indexE.htm

International Outer Planets Watch (IOPW)	http://www.ehu.es/iopw/
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