

Astroimaging From Somerset

BY PETE RICHARDSON

Astroimaging From Somerset

- *Observatory build.*
- *Equipment used.*
- *Planetary & Lunar imaging.*
- *Deep sky imaging.*

The Observatory Build

Why build an observatory?

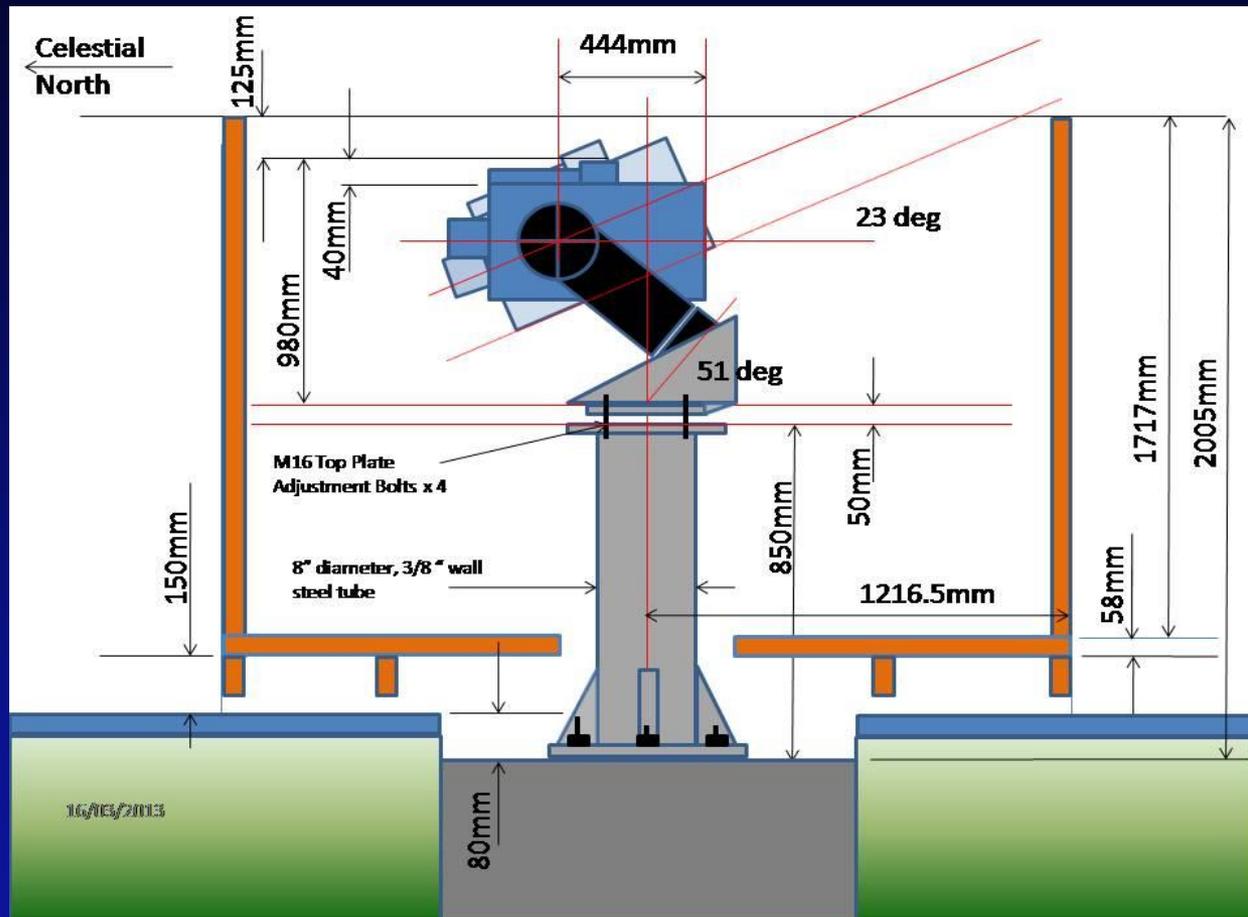
For me the main reasons were:



- *To increase the opportunities for imaging!!*
- *To have the telescope permanently Polar aligned!!*
- *To maintain thermal stability of the optics!!*

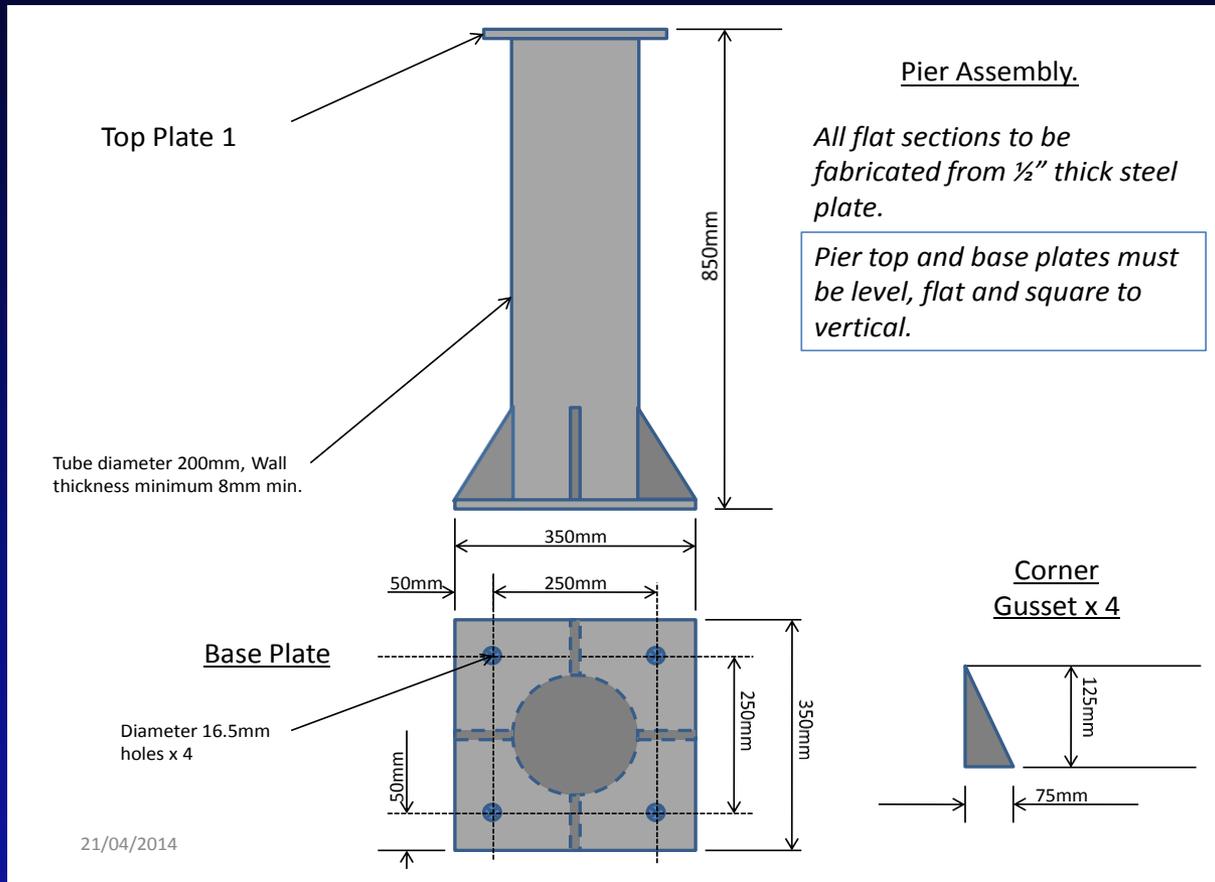
The Observatory Build

Design & Planning...



The Observatory Build

Design & Planning...



The Observatory Build

Laying the Pier Foundation...



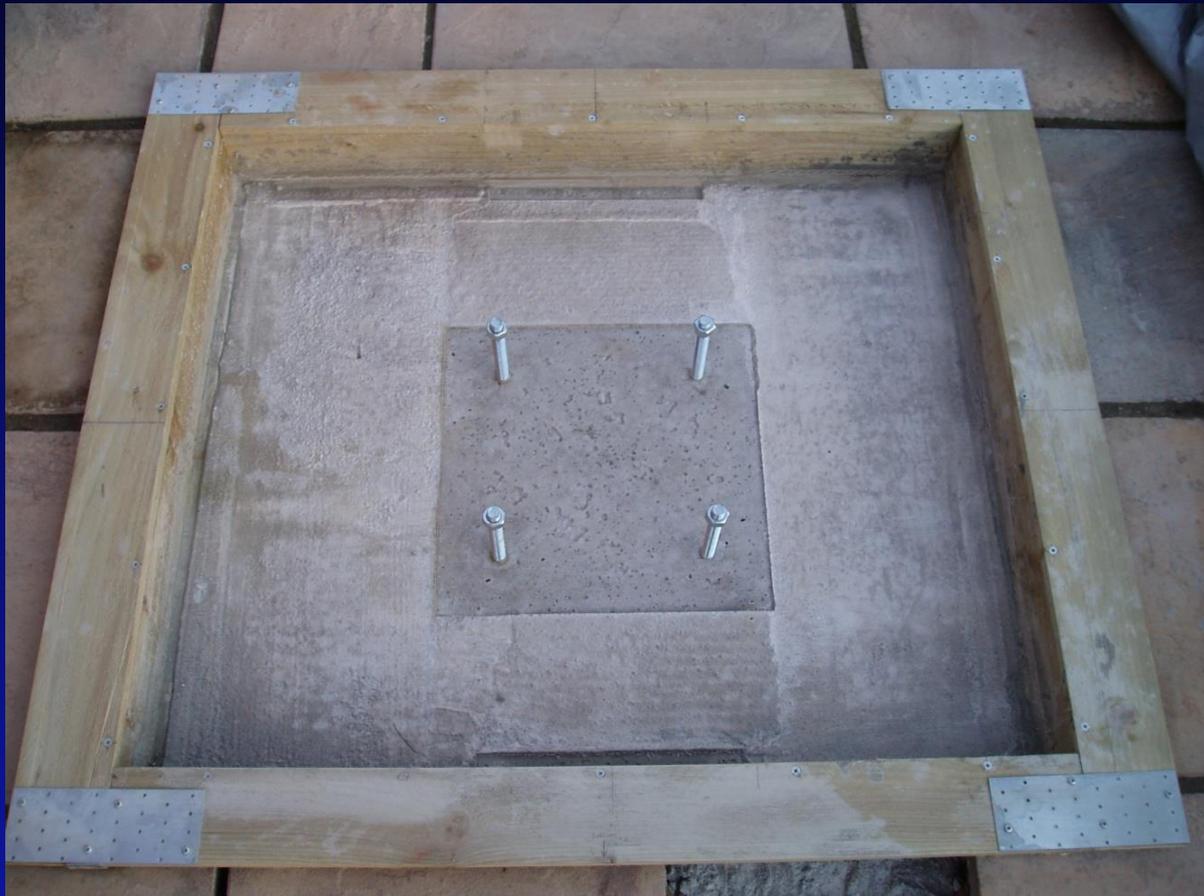
The Observatory Build

Pouring the concrete...



The Observatory Build

The completed foundation...



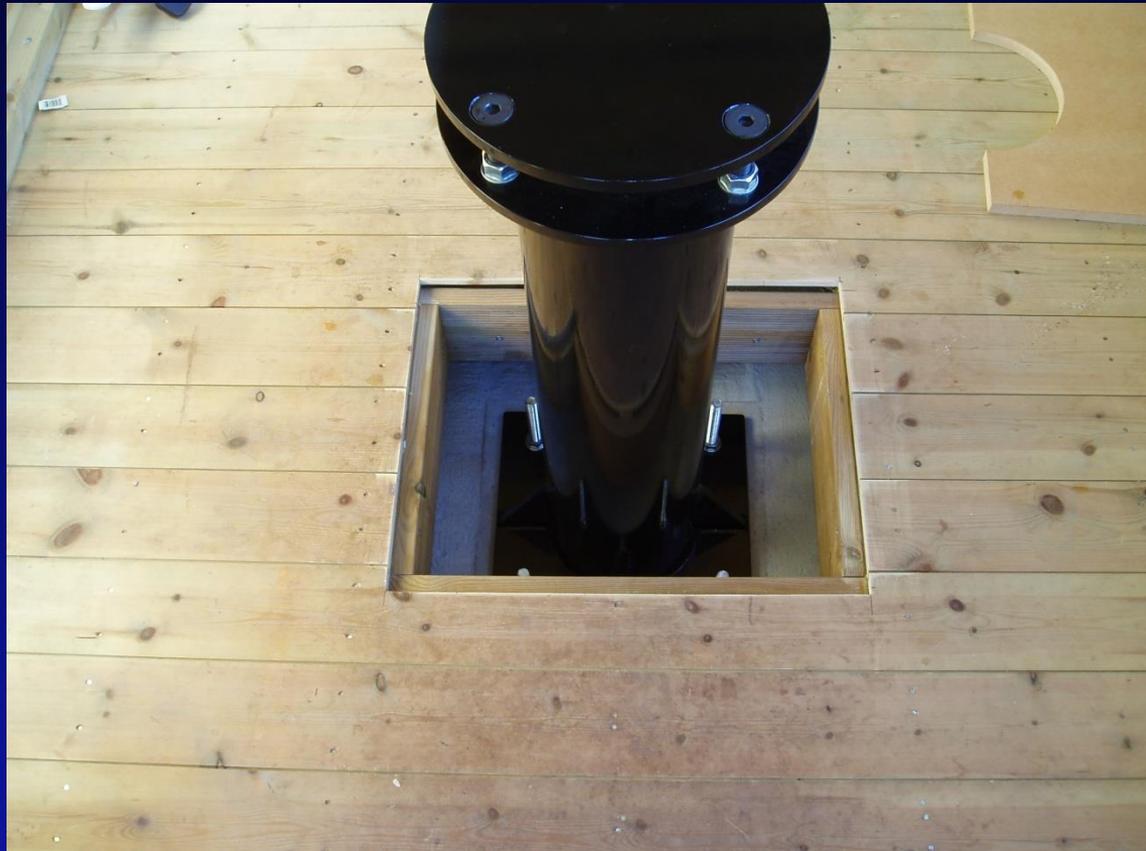
The Observatory Build

The base framework...



The Observatory Build

Installing the Pier...



The Observatory Build

Converting the roof...



The Observatory Build

Converting the Roof...



The Observatory Build

Complete and Ready for First Light!!



Main Equipment – Telescopes

Meade 12" LX200ACF.

*Used for planetary imaging,
deep sky imaging and guiding.*

FL 3040mm, F10.

William Optics Zenithstar 80mm

Refractor.

*Used for deep sky imaging and
guiding.*

FL 545mm, F6.8



Main Equipment - Cameras

ZW Optical ASI120mm
monochromatic high frame
rate camera.

Used for
planetary imaging.

This camera has excellent
sensitivity & resolution.



Main Equipment - Cameras

QSI683wsg

CCD camera.

Monochrome cooled

8 megapixel CCD.

*Used for deep sky imaging
only.*



Main Equipment - Cameras

Orion Starshoot Autoguider

CCD camera.

*Used for autoguiding when
deep sky imaging.*

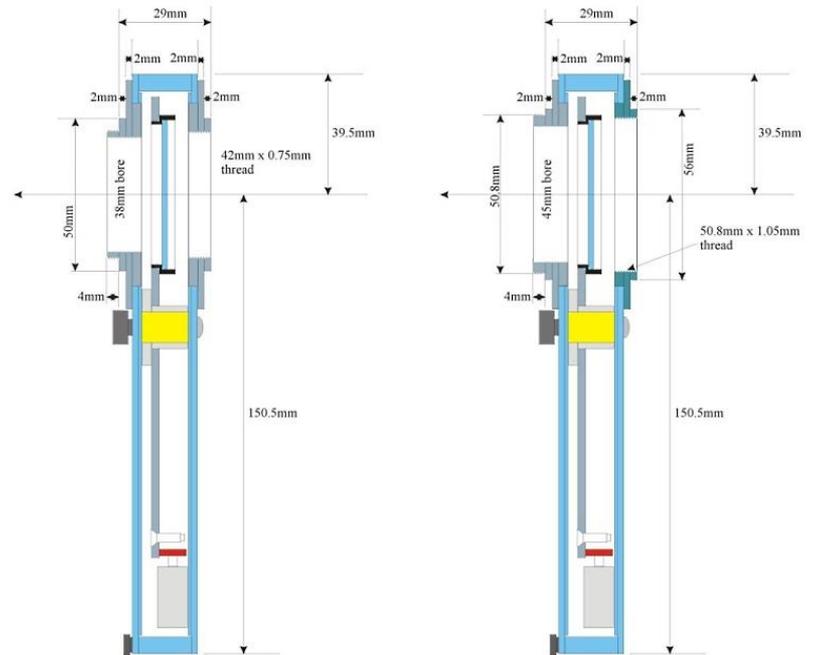


Main Equipment – Filter Wheel

Starlight Express Filter Wheel

Used for planetary imaging in conjunction with the mono ASI120mm camera.

Full colour images are obtained by imaging through red, green & blue filters.





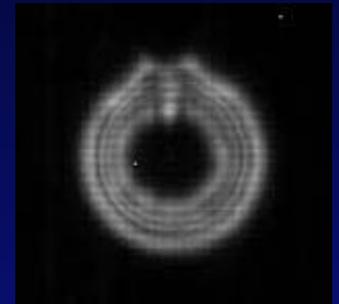
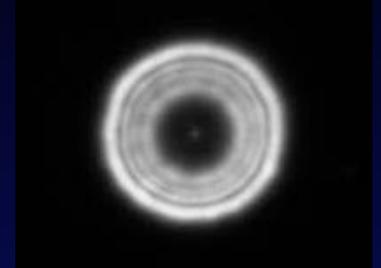
Other Equipment & Accessories:

- *Lakeside electronic focuser*
- *Bader crayford focuser*
- *Lap top computer – core i5 processor, 6Gb RAM.*
- *Barlow lenses, focal reducers/flatteners*
- *Flat frame boxes*
- *Atmospheric Dispersion Corrector.*
- *Kendric Dew Control System (deep sky imaging)*
- *Astronomik LRGB & IR Pass Filters*
- *Various extension tubes, eyepieces, illuminated reticle eyepiece and visual filters.*

Capturing the Moon & Planets

Critical checklist prior to starting capture:

- *Ensure accurate collimation of the optics!!*
- *Ensure thermal equilibrium of the optics!!*
- *Try and ensure images are obtained under the best possible seeing conditions for the location!!*



Capturing the Moon & Planets

Equipment Set-Up:



Capturing the Moon & Planets

Image Acquisition Process Summary:

- *Connect the equipment to laptop PC (camera, filter wheel).*
- *Start the capture software of choice (eg, IC Capture, Firecapture).*
- *Centre the target on camera chip (except for the Moon, this does take some practice!!)*
- *Focus on the target object – critical to spend time here ensuring best focus!! Use features on the subject to gauge the focus point.*
- *Set frame rate and gain settings to achieve the best histogram fill / highest frame rate combination but without introducing too much noise. The histogram should be as close to equal as possible for all filters.*

Capturing the Moon & Planets

Image Acquisition Process Summary:

- *Start the capture – for mono camera's this will involve taking AVI video through the Red, Green & Blue filters (and possibly others, eg Infra Red Pass).*
- *Capture enough video (AVI format) to achieve the maximum number of individual frames. Care must be taken to ensure planetary rotation does not come into effect as this will blur detail (derotation software such as WinJupos can overcome this allowing for longer captures).*

Capturing the Moon & Planets

Image Acquisition: Firecapture 2.2

The screenshot displays the FireCapture 2.2 software interface. The main window is titled "FireCapture 2.2" and shows various control panels. On the left, the "Camera" panel includes "Preview" and "Night mode" checkboxes, and the "Image" panel shows "Use ROI" and "Max (1280x960)" options. The "Control" panel features sliders for Gain (49), Exp. (ms) (13.65), Gamma (50), and Exp. Range (5.00 - 30 ms). The "Data" panel displays FPS (max) at 73.27, FPS (actual) at 72.99, and counts for Captured and Saved images. The "Capture" panel shows the Profile set to "Jupiter", File name "Jup_TIME", Type "AVI", and a Limit of 60 seconds. A live preview window titled "ASI120MM Camera (ZWO Design)" shows a dark, circular image of the Moon. An "oaCapture Histogram" window is open, showing a histogram of the captured image. The right sidebar contains "Options" (Histogram, AutoAlign, Autoguide, CutOut, Darkframe, Flip X, Ephems, Align-Box, Reticle, FocusHelp, DeRotate, Flip Y), "Zooms" (100%), "Pre Processing" (None), and "Settings" (Preview: MAX, RAM: 772 MB, HDD: 91 GB).

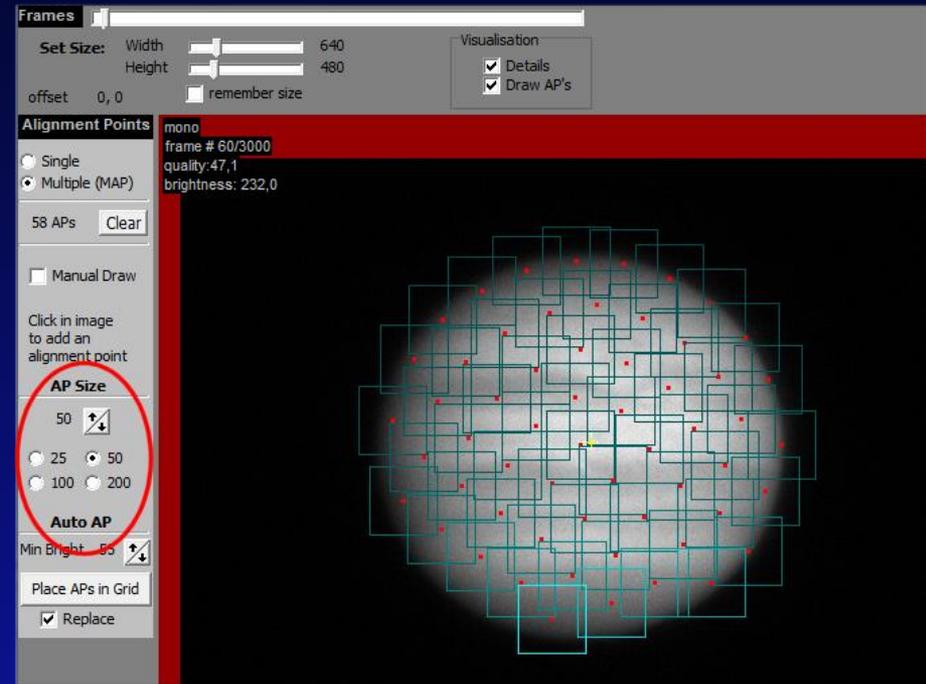
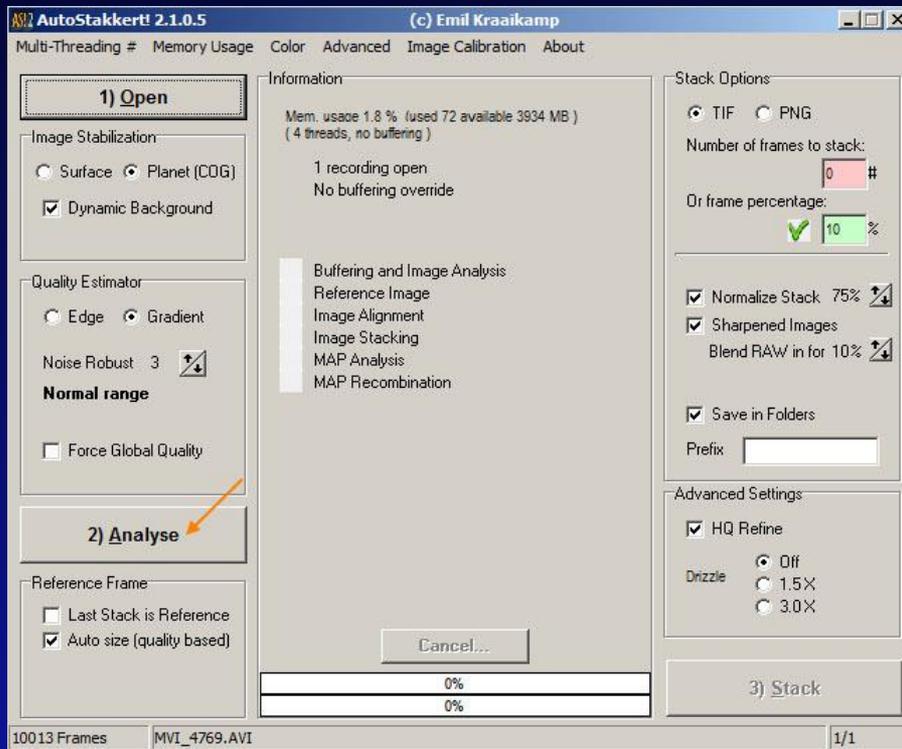
Capturing the Moon & Planets

Image Processing:

- *Registration & stacking – Software such as Autostakkert or Registax will sort through the individual frames and select the ones of the best quality by way of a pre selected ‘reference frame’.*
- *These frames are then combined (stacked) into a single image using a series of alignment points. This would be done for each colour channel.*
- *Sharpening – Registax allows use of ‘Wavelets’ to sharpen the image allowing fine detail to be resolved. Again this would be done for each stacked image for each colour channel.*
- *Final processing – Software such as Adobe Photoshop allows the individual colour channels to be combined into a composite RGB full colour image. Final tweaks such as denoising filters or colour balancing and saturation can be applied.*

Capturing the Moon & Planets

Image Processing: Registration & Stacking Using Autostakkert



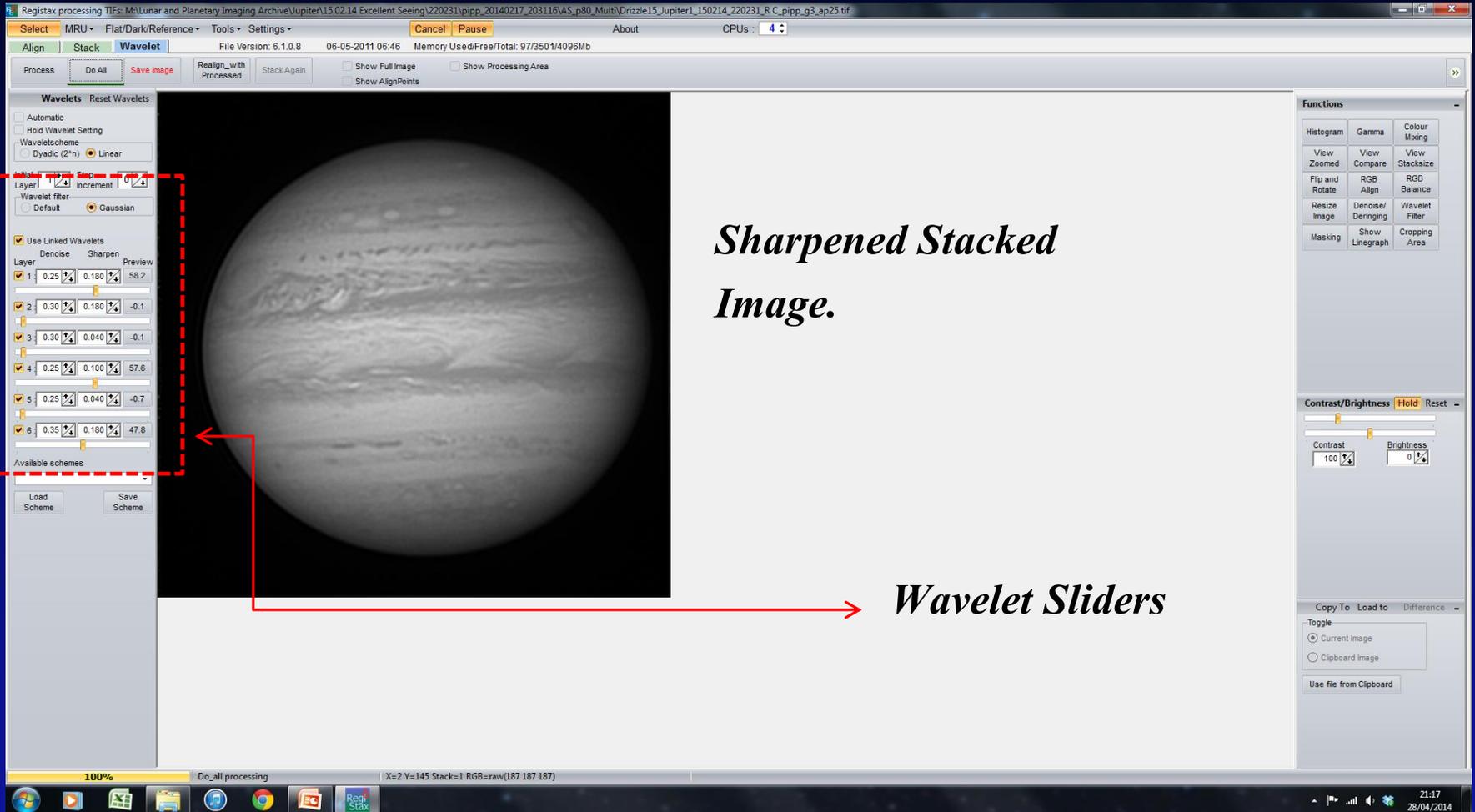
Capturing the Moon & Planets

Image Processing: Image Sharpening Using Registax



Capturing the Moon & Planets

Image Processing: Image Sharpening Using Registax



The screenshot displays the Registax software interface. The main window shows a sharpened stacked image of Jupiter. On the left side, the 'Wavelets' panel is visible, containing a table of wavelet settings. A red dashed box highlights this panel, and a red arrow points from the text 'Wavelet Sliders' to it. The 'Functions' panel on the right includes options for Histogram, Gamma, Colour Mixing, View Zoomed, View Compare, View Stacksize, Flip and Rotate, RGB Align, RGB Balance, Resize Image, Denoise/Deriving, Wavelet Filter, Masking, Show Linegraph, and Cropping Area. Below the Functions panel, there are sliders for Contrast and Brightness, and a Copy To section with options for Current Image, Clipboard Image, and Use file from Clipboard.

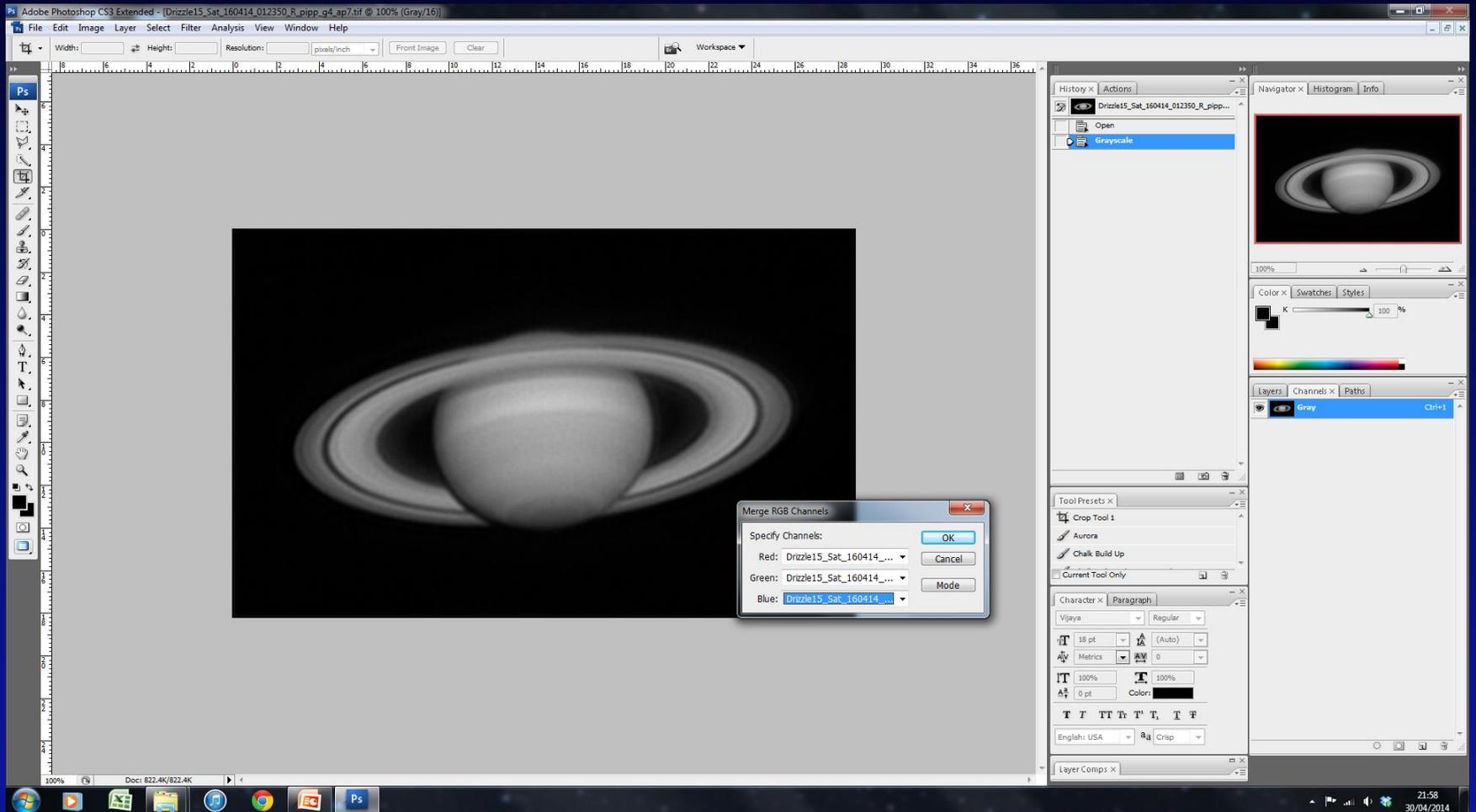
Layer	Denoise	Sharpen	Preview
1	0.25	0.180	58.2
2	0.30	0.180	-0.1
3	0.30	0.040	-0.1
4	0.25	0.100	57.6
5	0.25	0.040	-0.7
6	0.35	0.180	47.8

Sharpened Stacked Image.

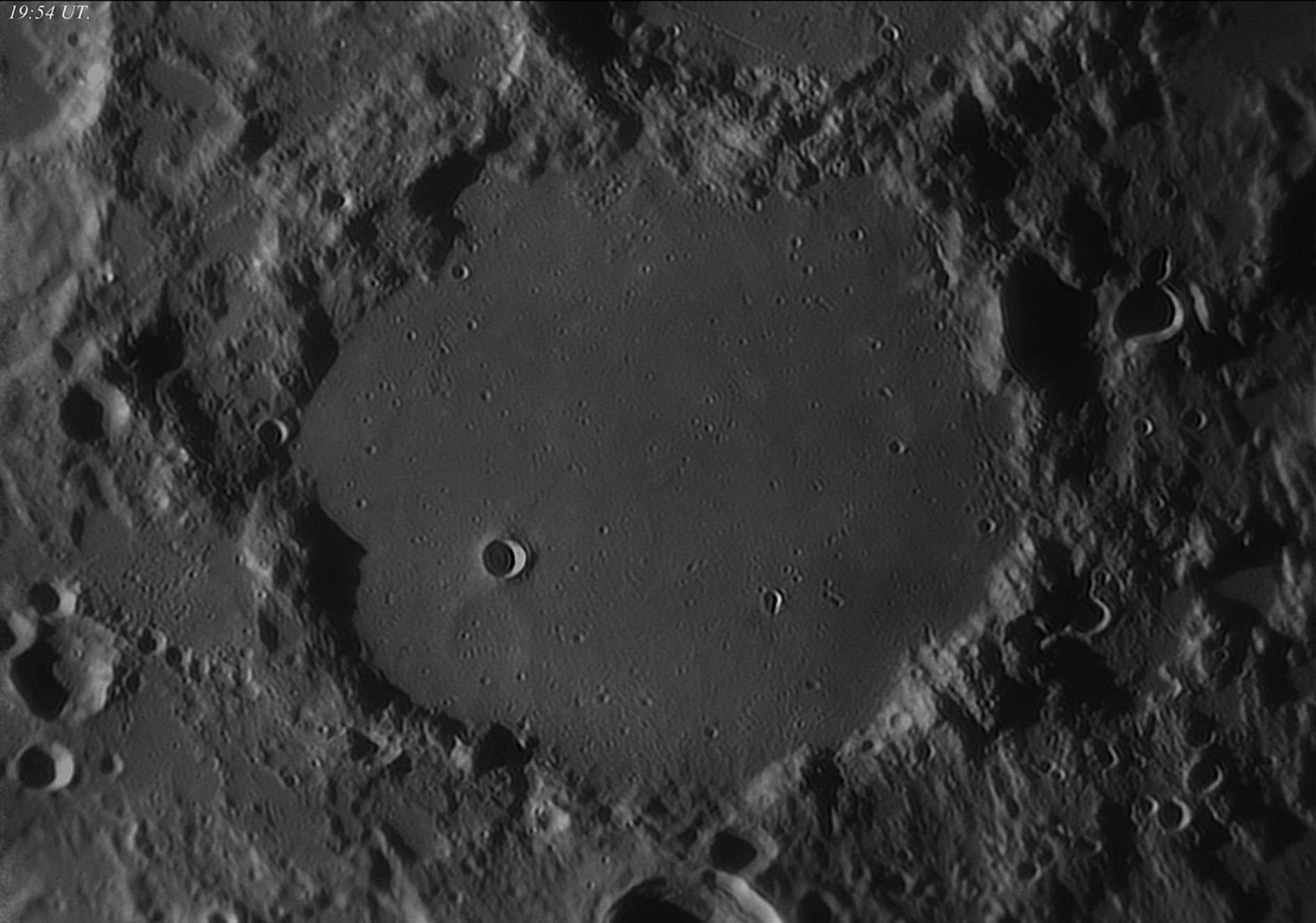
Wavelet Sliders

Capturing the Moon & Planets

Image Processing: Creating an RGB Image In Photoshop



19:54 UT.



Lunar Crater Ptolemaeus, 09.03.2014, Somerset UK.

LX200ACF 12", ASI120mm Camera.

Pete Richardson.

03:51 UT.

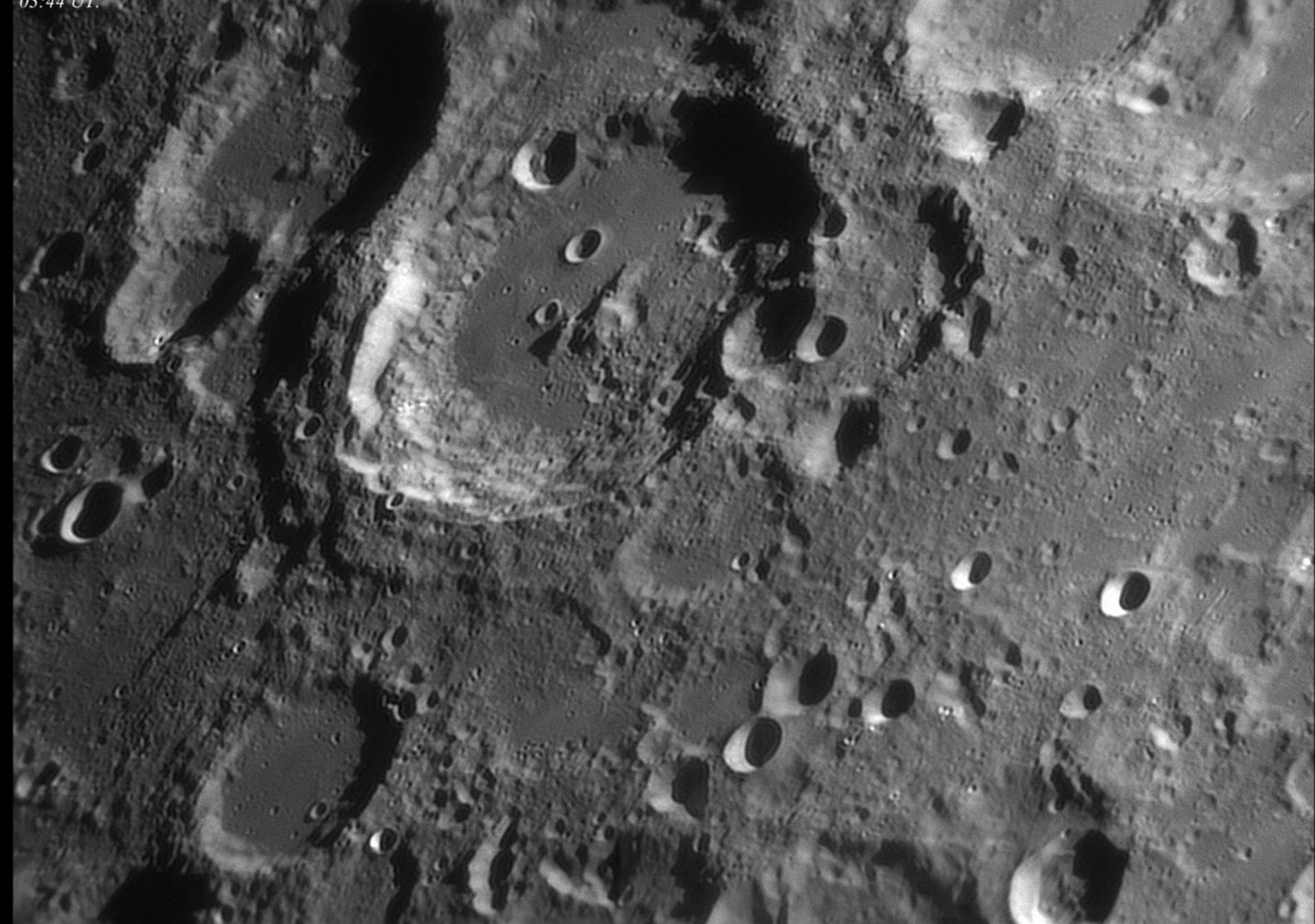


Lunar Craters Clavius & Blancanus, 23.11.13, Somerset UK.

LX200ACF 12". ASI120mm Camera.

Pete Richardson.

05:44 UT.



Lunar Crater Maurolycus, 23.11.13, Somerset UK.

LX200ACF 12". ASI120mm Camera.

Pete Richardson.

23:14 UT.



*Jupiter 19.01.2014, Somerset UK.
LX200ACF 12", ASI120mm Camera.*

Pete Richardson.

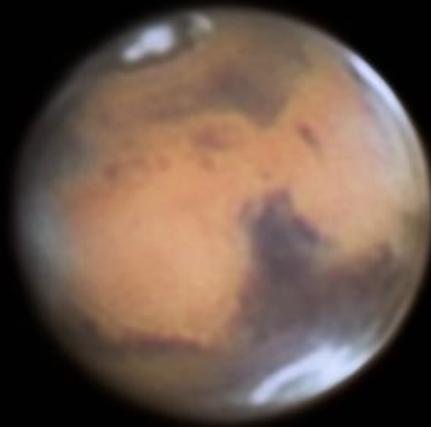
22:14 UT.



*Saturn 15.05.2014,
Combined RGB WinJupos Derotation.
Somerset UK.
LX200ACF 12", ASI120mm Camera.*

Pete Richardson.

23:08 UT.



*Mars 23.04.14, Somerset UK.
LX200ACF 12", ASI120mm Camera.*

Pete Richardson.

Capturing Deep Sky Objects

Critical checklist prior to starting capture:

- *Ensure accurate collimation of the optics!!*
- *Ensure correct balance of the optical tube!! A slight weight bias to the east forkarm and the primary mirror end minimises guiding errors.*
- *Ensure thermal equilibrium of the optics!!*
- *Try and ensure images are obtained under the best possible seeing conditions & transparency for the location!!*
- *Select a suitable target!! (ie matched for CCD FOV and imaging location – not too faint!!). A good planetarium software is invaluable here where FOV indicators can be set to mimic individual equipment set-ups.*

Capturing Deep Sky Objects

Equipment set-up:



Capturing Deep Sky Objects

Autoguiding:

- *This technique is employed to enable long exposures by way of very accurate tracking. This is achieved using a second telescope (the Guidescope) which is fixed to the main imaging telescope. A mag 2.0 to 4.0 star is centred, focused & guiding software (eg Phd guiding) reads the drift of this star away from a target point and sends corrections to the mount to keep the star fixed in position. Only very high end mounts have the ability to track unguided.*



Capturing Deep Sky Objects

Image Acquisition Process Summary:

- *Connect the equipment to laptop PC (imaging camera, guide camera, filter wheel).*
- *Start the capture & guiding software of choice (eg, Maxim DL, Phd Guiding).*
- *Slew to a magnitude 3.0 – 4.0 star near to the main imaging target of choice and centre star on CCD (capture single test exposure (2s) to verify star is centred).*
- *Perform focus routine (Focusmax)*
- *Slew to main target and centre on chip (capture single test exposure (60s) to verify target is centred).*
- *Check and find suitable guide star.*
- *Start autoguiding via Phd (Phd will perform an auto calibration routine first to establish mount Periodic Error)*
- *Perform another test exposure to ensure accurate guiding.*
- *Set number and duration of exposures. Start main capture sequence.*

Capturing Deep Sky Objects

Image Acquisition: Maxim DL Pro V5

The screenshot displays the Maxim DL Pro V5 software interface. The main window shows a deep sky image of a galaxy cluster, with a toolbar at the top and a menu bar (File, Edit, View, Analyze, Process, Filter, Color, Plug-in, Window, Help). The image is titled "MS1-004L.fit".

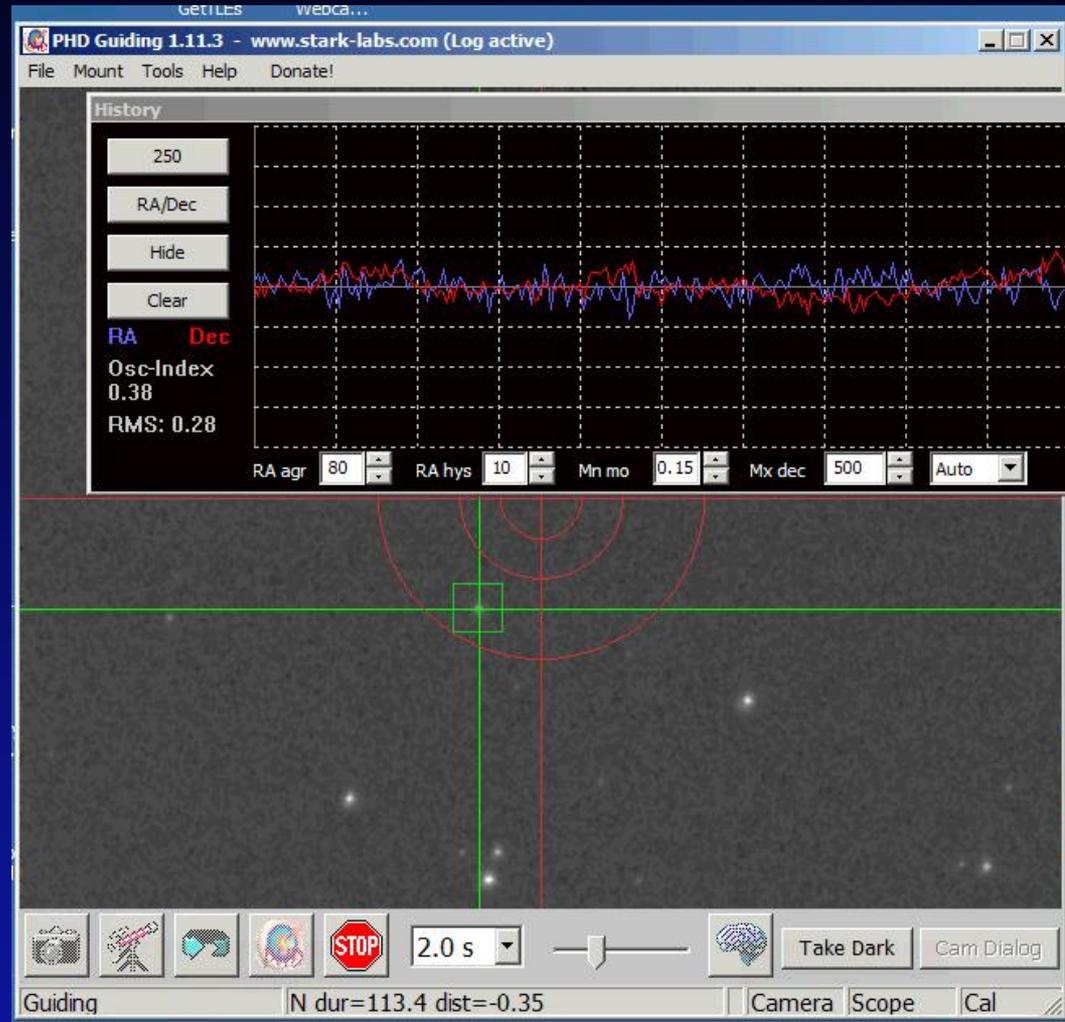
Two control panels are visible:

- Camera Control:** This panel includes sections for "Expose", "Guide", and "Setup". It features a "Find DSO" dropdown, "Readout Mode" (Normal), "Speed" and "ISO" settings, and "Filter Wheel" (No Filters). It also shows "X Binning" (2) and "Y Binning" (Same). The "Subframe" section includes "On" and "Mouse" checkboxes, and "X: 0 Y: 0 W: 384 H: 255" coordinates. The "Camera 1 Information" and "Camera 2 Information" sections both show "Camera Idle" and "Cooler is off".
- Screen Stretch:** This panel shows a histogram of the image. It includes "Minimum" and "Maximum" sliders, with values 865.29 and 1676.4 respectively, and an "Update" button.

The Windows taskbar at the bottom shows the system tray with the time 19:37 and date 29/04/2014. The status bar at the bottom of the software window displays "For Help, press F1", "3040x2024", and "50%".

Capturing Deep Sky Objects

*Image Acquisition:
Phd Guiding*



Capturing Deep Sky Objects

Image Acquisition:
Focusmax.

The screenshot displays the FocusMax software interface, which is used for image acquisition and analysis. It consists of several windows:

- Vcurve Sequence:** This window shows the V-curve position control settings. The Frame Width is set to 100. The Initial position is 29365, the Center is 30225, and the Final position is 31085. The Half Width is 860, and the Step Increment is 57. The V-curve plot shows a series of blue circles forming a V-shape, with a red line indicating the fit.
- FocusMax MySystem:** This window shows the current position and temperature. The Position is 30225 and the Temperature is 13.5. The Half Flux Diameter is 1.27. The window also includes a graph of the V-curve and a small inset showing the star's position.
- System Profile:** This window shows the system profile for the current system. The System is MySystem. The Mean Slope is 0.047638, the Total Used is 1, and the Mean Position Intercept Diff is 2.72. The window also includes a table of system profiles.

Use	Date	Time	PI Diff	L Slope	R Slope	Comments
Y	2006/03/16	20:50:11	2.72	-0.047637	0.047638	

Capturing Deep Sky Objects

Image Processing Summary:

- *Image Calibration* – A series of calibration frames (darks, flats, flat darks and bias frames) are used initially to calibrate the 'light' frames. This process removes noise and other defects such as dust doughnuts in the optical train and any vignetting from the light images.
- *Colour conversion (for OSC CCD Cameras)* – raw images are converted to colour in Maxim DL. For a mono CCD this step would be omitted.
- *Registration* – Software such as Maxim DL will sort through the individual frames and will perform a 'best quality' selection. Manual selection can also be used to remove any bad frames (eg satellite trails)
- *The individual frames are then combined (stacked) into a single image using an auto-starmatching algorithm. This would be done for each filtered colour channel for a mono CCD.*
- *Final processing* – Software such as Adobe Photoshop allows the individual colour channels to be combined into a composite RGB for a mono CCD full colour image. Final tweaks such as denoising filters, image stretching (curves), levels (histogram) or colour balancing and saturation can be applied to achieve an appealing deep sky image.





795 IN CASSIOPEIA, SOMERSET UK,
LX200ACF 305MM, QSI683WSG CAMERA.

PETE RICHARDSON



MELOTTE 15 IN IC1805, 23.11.2014, SOMERSET UK,
LX200ACF 305MM, QSI683WSG CAMERA.

© PETE RICHARDSON





M42, M43 & NGC1977 in Orion, Somerset UK.

William Optics 80mm Apo, Orion Starshoot Pro V2 Camera.

Pete Richardson.

The End.

I hope you enjoyed the talk!!

For more images see

www.peterrichardsonastro.com