



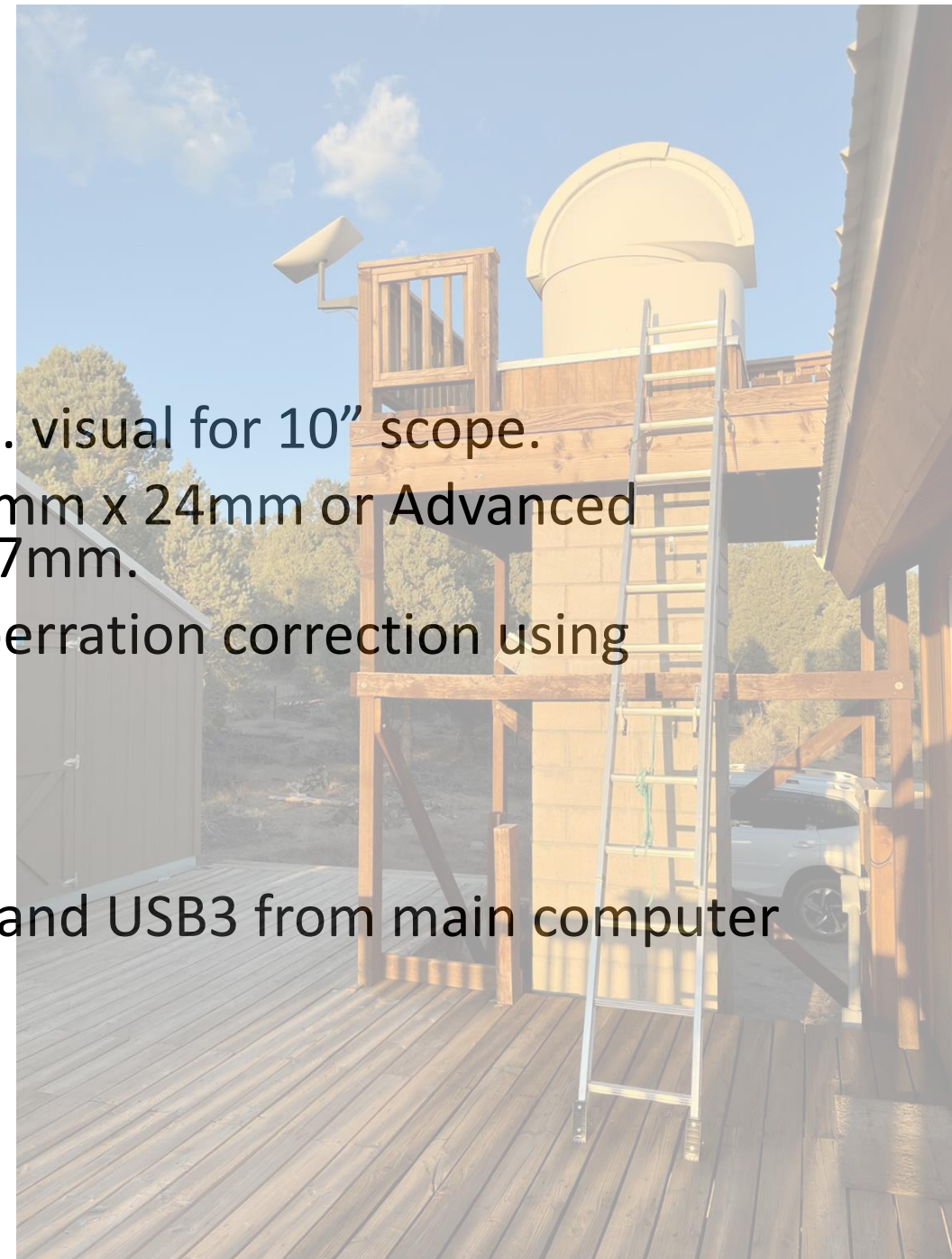
A Wide Field Astrograph for the 4' Dome

Considerations, Construction, and Fielding

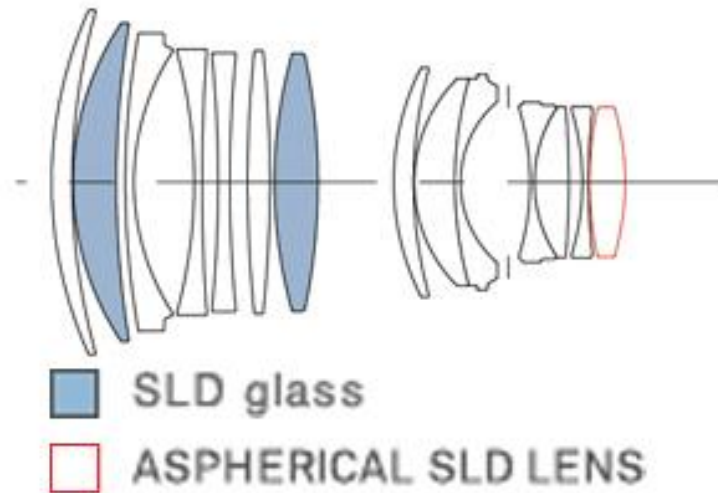
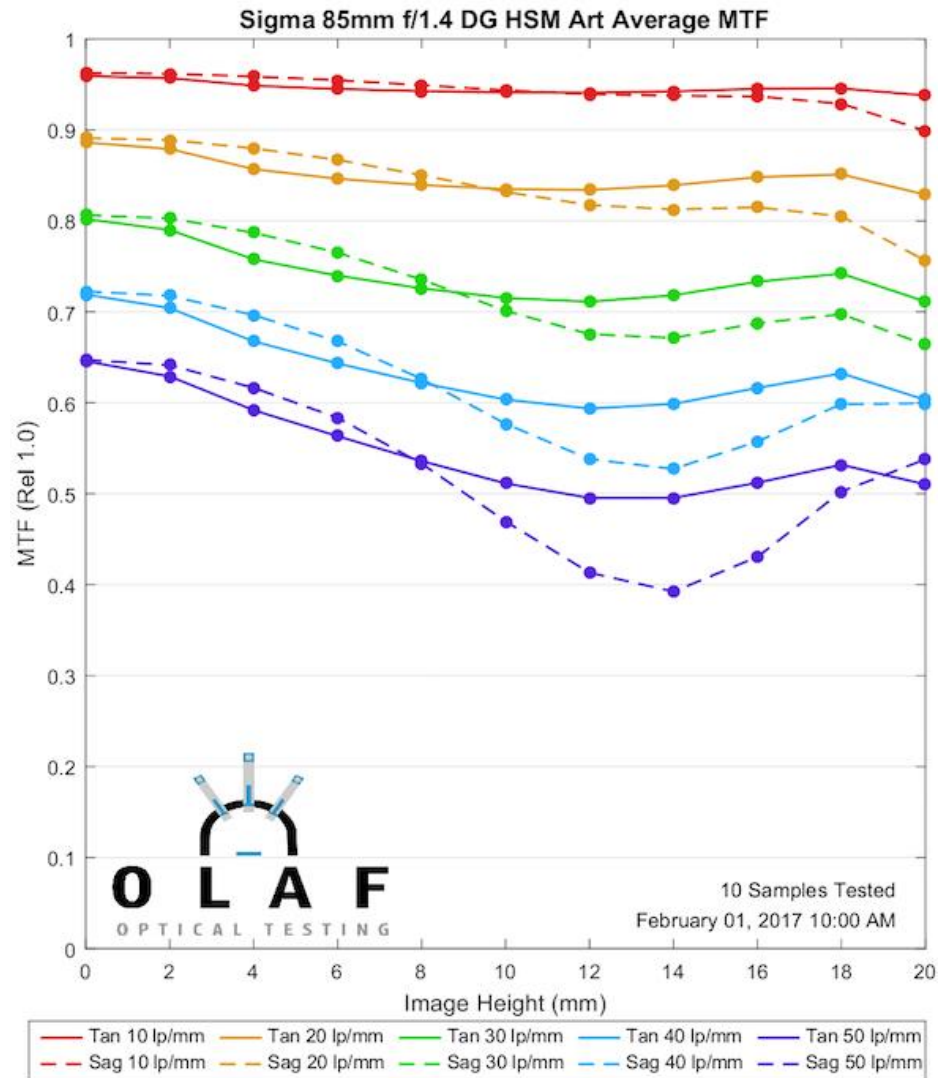
April 2025

Goals 4'Dome Astrograph

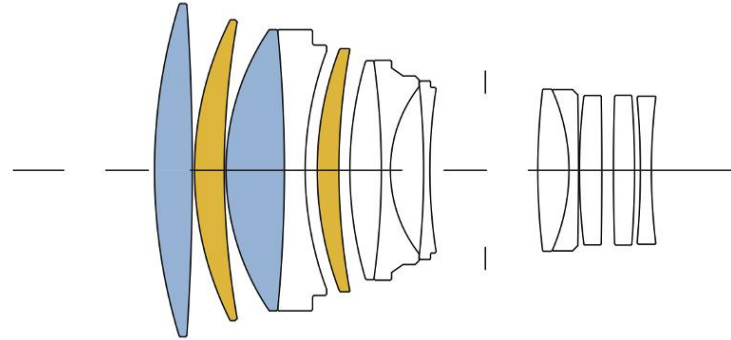
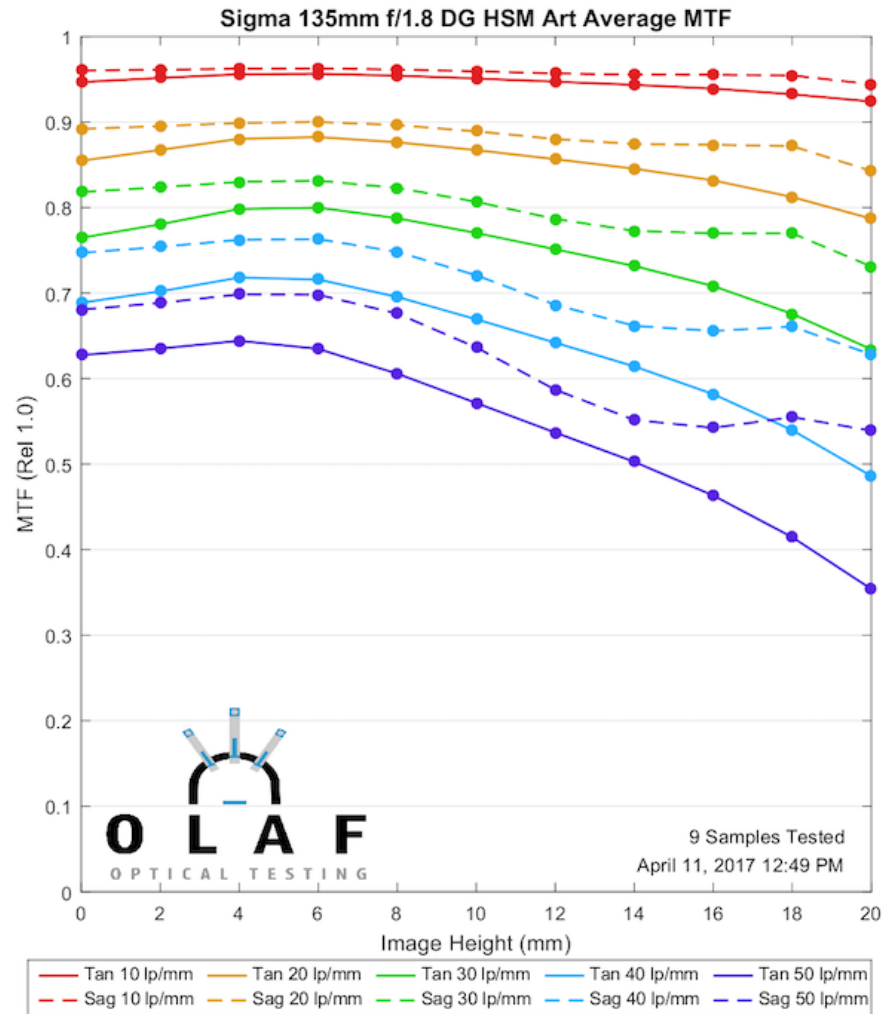
- Wide Field, more than $10^{\circ} \times 10^{\circ}$
- Reasonable magnitude depth, >Mag 15.5, ie. visual for 10" scope.
- One Shot Color camera either full frame, 36mm x 24mm or Advanced Photo System-Classic (APS-C): 23.6mm x 15.7mm.
- Good star geometry at field corners, easy aberration correction using available processing tools.
- Guider telescope or self guiding camera.
- EL panel flip cover
- Self contained module, connections=power and USB3 from main computer
 - Camera power and USB3
 - Focuser, flip cover, power and USB3



Sigma 85mm f/1.4 Art



Sigma 135mm f/1.8 Art MTF



Predicted Performance 85mm vs. 135mm

Pick the higher Etendue

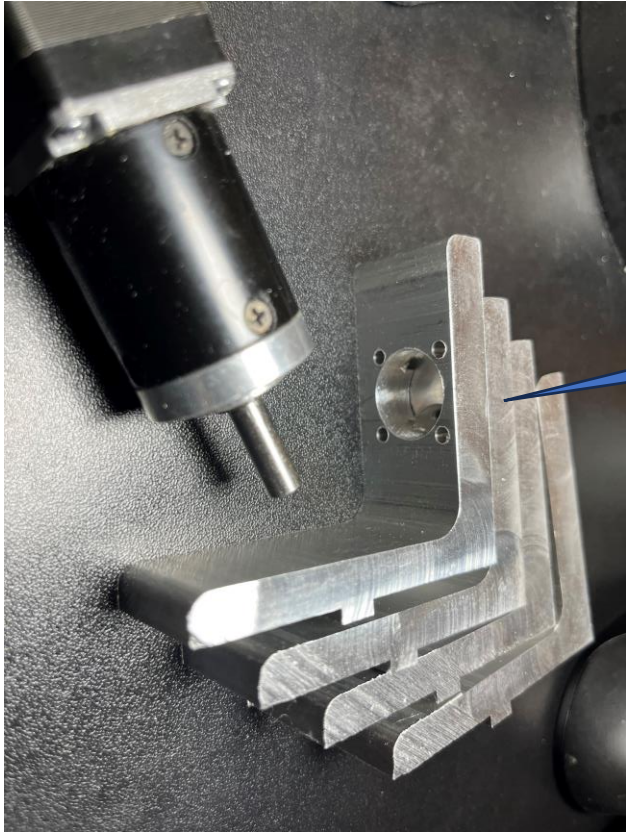
Telescope		1.1951631			Min Extended Object Magnitude	Min Stellar Object Magnitude	Total Electrons Converted per Pixel for Limiting Object magnitude	Max full well Extended Object Magnitude	Max Stellar Object Magnitude		
85	Aperture	1.1951631	inches	30.35714286	15.80	16.1	582.8	10.3	13.3		
	F/Number	2.8	3.346456693	Focal Length	Meteors		698 Stars per sq Deg	12.95129786			
	transmission	0.8		85	20.29149877		115870 Stars per image frame	2150.926323	Galaxies	118,021	Total Objects
		étendue (cm^2 deg^2)		791.94							
Camera ASI2600				9.12 Arc Sec.Pixel IFOV.	35	Merrit etendue					
10	Exposure	120	seconds	10.61 Arc Sec.Pixel IFOV.	4.37 micrometers.	21.22 Arc Sec.	Nyquist				
	Filter	R		6248. Pixel Count"	4176. Pixel Count"						
	Pixel Size	3.76	micrometers	.92 inches.	.62 inches.	1.11 inches.	°diagonal				
	Min S/N	1.5	Signal to Noise	15.74 deg.	10.55 deg.	18.95 deg.	°diagonal				
	QE	0.9		Cameras	3						
	CCD Temperature	-15	°C	overlap	0.20						
	Full Well Depth e-	50000	electrons	FOV	33.65						
	Read noise	1	electrons	25.67		Radius					
							100000		549.6		

Higher Etendue

Test the 85mm Sigma Art for aberrations

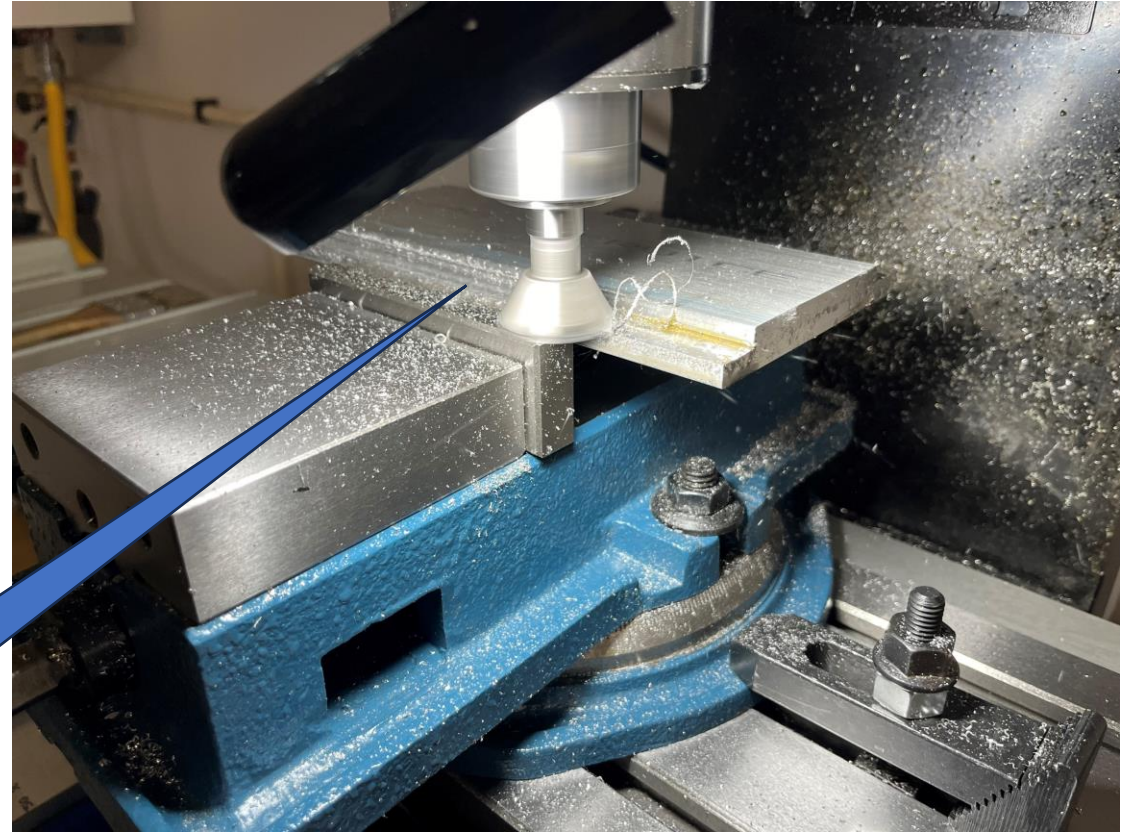
Telescope		1.89820022			Min Extended Object Magnitude	Min Stellar Object Magnitude	Total Electrons Converted per Pixel for Limiting Object magnitude	Max full well Extended Object Magnitude	Max Stellar Object Magnitude		
135	Aperture	1.89820022	inches	48.21428571	16.80	17.1	597.7	11.3	13.3		
	F/Number	2.8	5.31496063	Focal Length	Meteors		1505 Stars per sq Deg	32.73340133			
	transmission	0.8		135	9.400984511		99605 Stars per image frame	2167.029446	Galaxies	101,772	Total Objects
		étendue (cm^2 deg^2)		501.38							
Camera ASI2600				5.74 Arc Sec.Pixel IFOV.	88	Merrit etendue					
10	Exposure	120	seconds	6.68 Arc Sec.Pixel IFOV.	4.37 micrometers.	13.36 Arc Sec.	Nyquist				
	Filter	R		6248. Pixel Count"	4176. Pixel Count"						
	Pixel Size	3.76	micrometers	.92 inches.	.62 inches.	1.11 inches.	°diagonal				
	Min S/N	1.5	Signal to Noise	9.95 deg.	6.66 deg.	11.97 deg.	°diagonal				
	QE	0.9		Cameras	3						
	CCD Temperature	-15	°C	overlap	0.20						
	Full Well Depth e-	50000	electrons	FOV	20.42						
	Read noise	1	electrons	15.83		Radius					
							100000		549.6		

A Few Components to Make



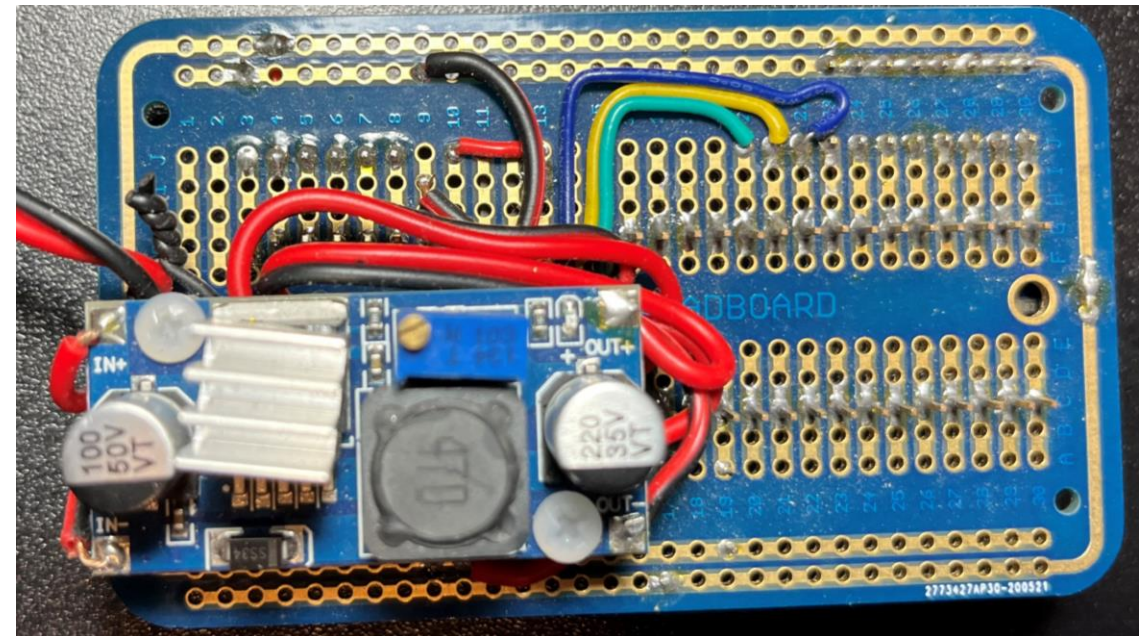
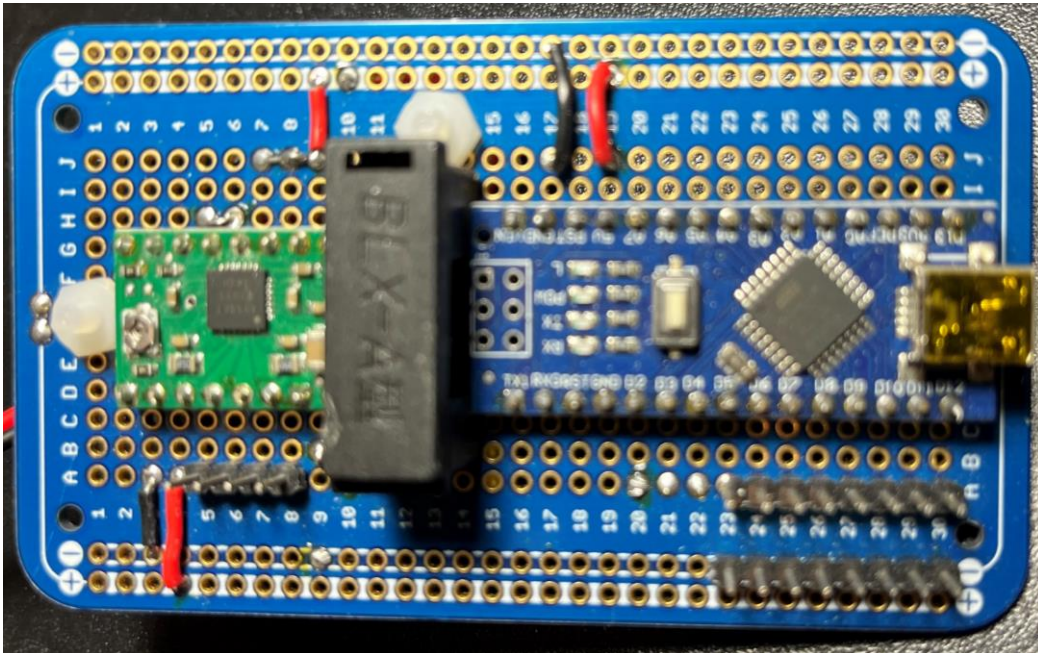
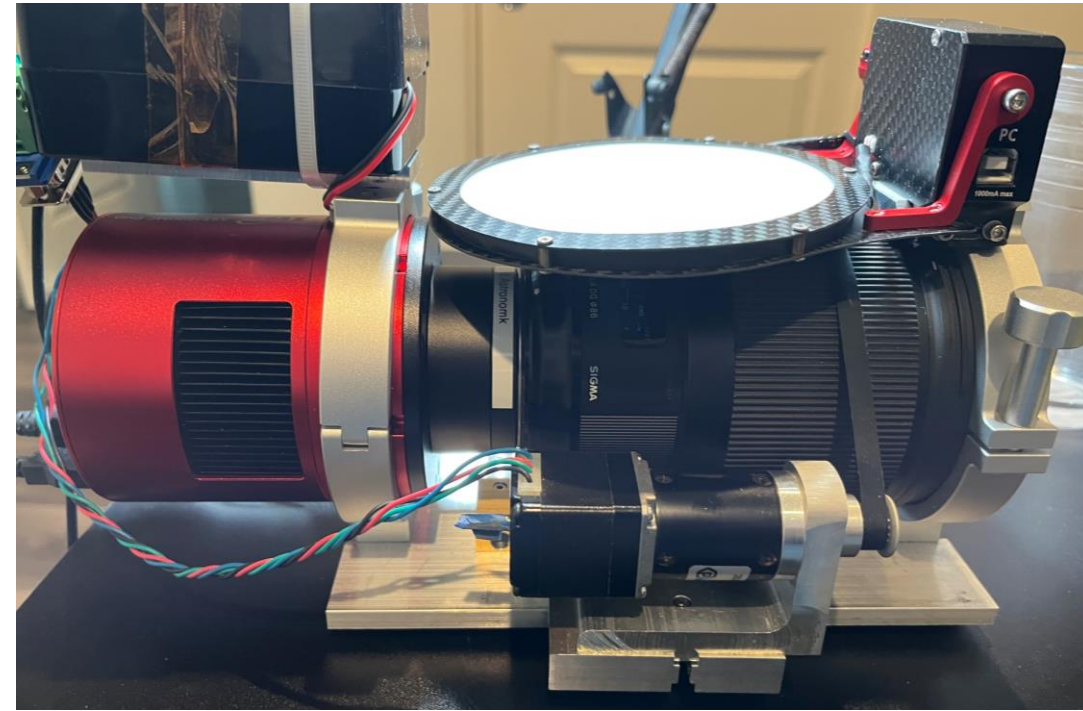
Focus Stepper
Brackets

Making the
Dovetail Plate



DYI ASCOM Focuser

- myFocuserPro2 ASCOM Firmware
- NANO and A4988 Stepper Driver, Configurable Stepper Board
- Geared Stepper motor



DB9 4-Wire Bipolar Geared Stepper

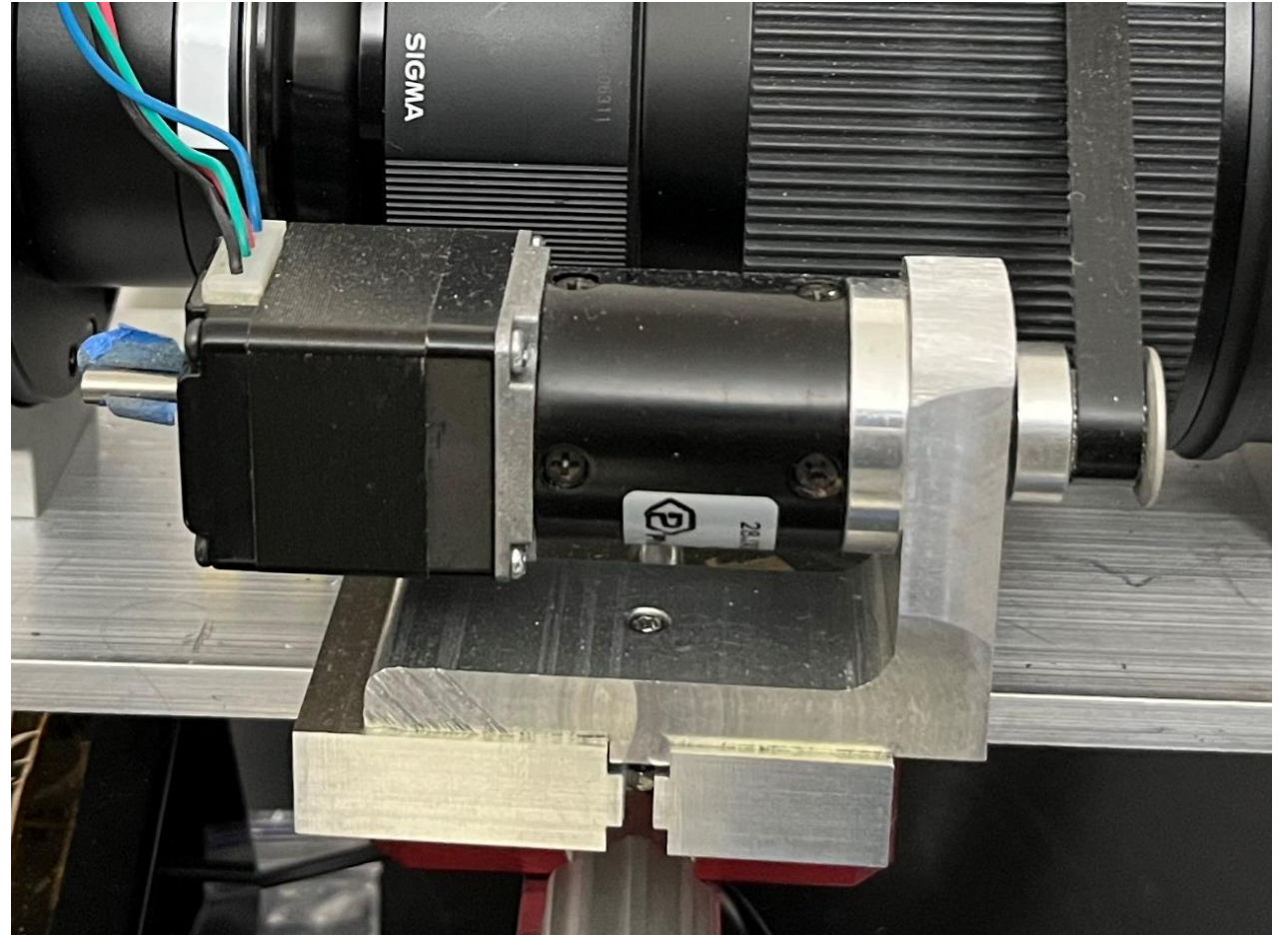
Nema Small geared stepper
BiPolar...

Blue B-
Red B+

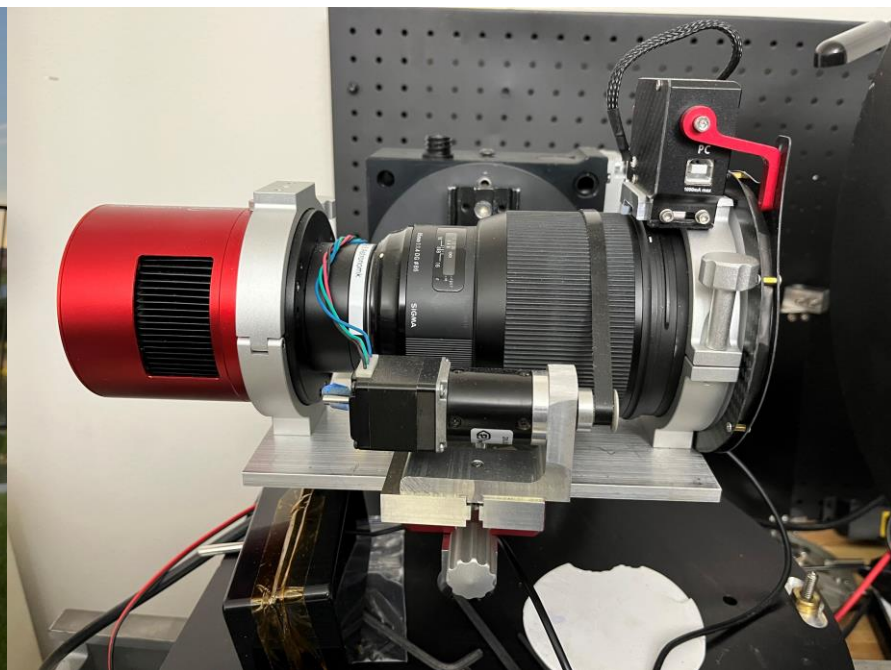
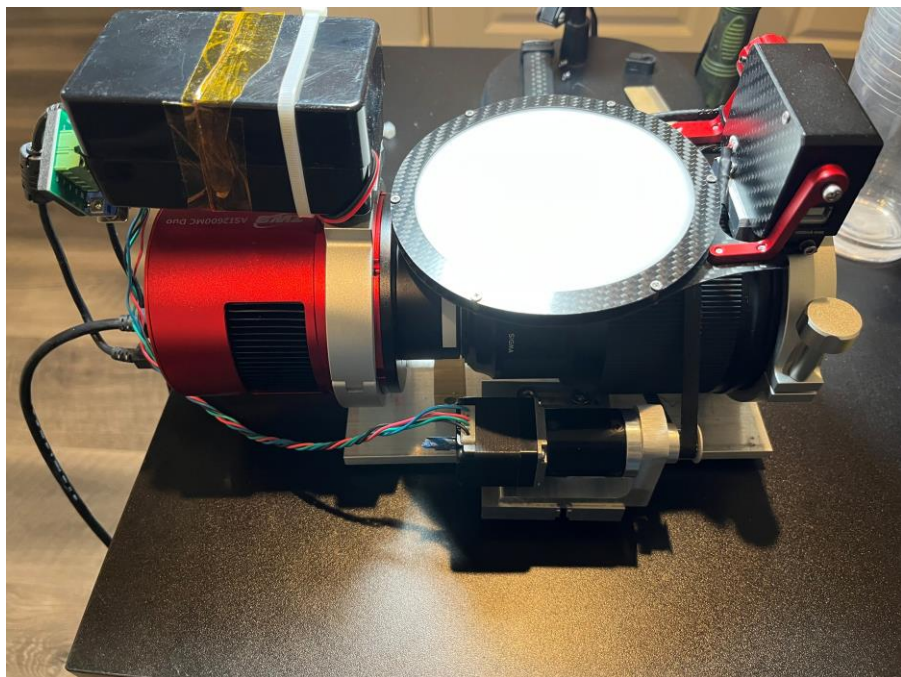
Green A-
Black A+

RoboFocus Stepper Colors

DB9	HURST(standard)	NIPPON PF	
1 coil A	BLK	YEL	
2 coil A	WHI	ORG	
3 coil B	BLU	BLK	
4 coil B	RED	BRN	
5 common	BLK/WHI-BLU/WHI	RED-RED	

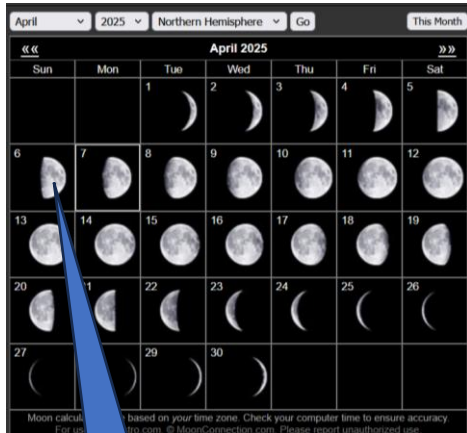


85mm F/2.8 Astrograph Bench Alignment, Field Testing



Telescope		1.1951631			Min Extended Object Magnitude	Min Stellar Object Magnitude	Total Electrons Converted per Pixel for Limiting Object magnitude	Max full well Extended Object Magnitude	Max Stellar Object Magnitude
85	Aperture	1.1951631 inches		30.35714286	15.80	16.1	582.8	10.3	13.3
	F/Number	2.8	3.346456693	Focal Length	Meteors		698 Stars per sq Deg	12.95129786	
	transmission	0.8		85	20.29149877		115870 Stars per image frame	2150.926323 Galaxies	
		étendue (cm^2 deg^2)		791.94					
Camera ASI2600									
10	Exposure	120 seconds		9.12 Arc Sec.Pixel IFOV.	35	Merrit etendue			
	Filter	R		10.61 Arc Sec.Pixel IFOV.	4.37 micrometers.	21.22 Arc Sec.	Nyquist		
	Pixel Size	3.76 micrometers		6248. Pixel Count"	4176. Pixel Count"				
	Min S/N	1.5	Signal to Noise	.92 inches.	.62 inches.	1.11 inches.	°diagonal		
	QE	0.9		15.74 deg.	10.55 deg.	18.95 deg.	°diagonal		
	CCD Temperature	-15 °C		Cameras	3				
	Full Well Depth e-	50000 electrons		overlap	0.20				
	Read noise	1 electrons		FOV	33.65			9.78	
				25.67		Radius	10.15		
						Focal length	19.67054264	499.6317829	

Rosette Field 85mm at F/2.8 60 sec ASI2600mc-Duo APS-C Format L-3 Astronomik filter, image DeBayered, Converted to Gray scale, Bortle 4-5



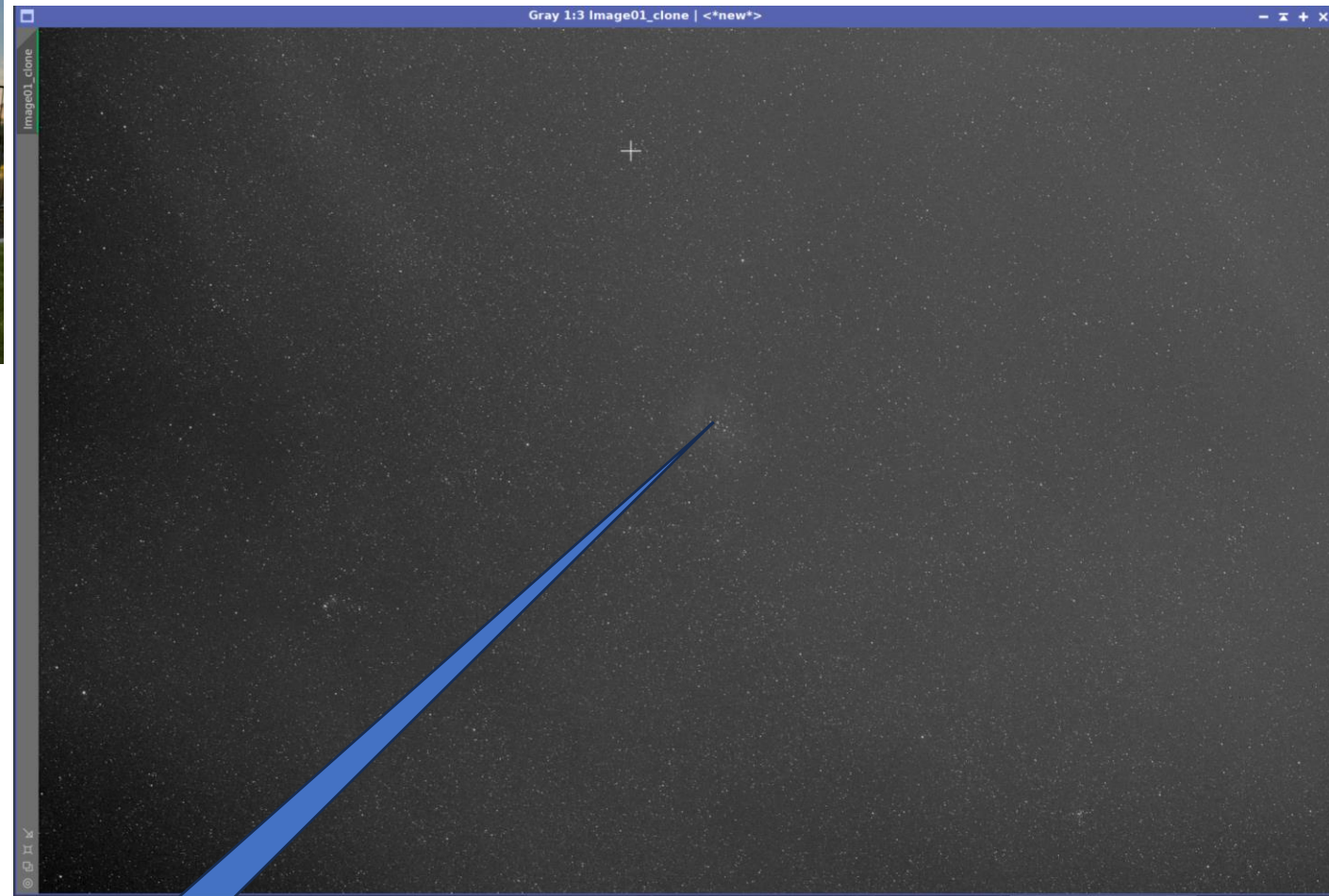
Moon

APS-C

Advanced Photo System "Classic"
25.1mm x 15.7mm Sensor

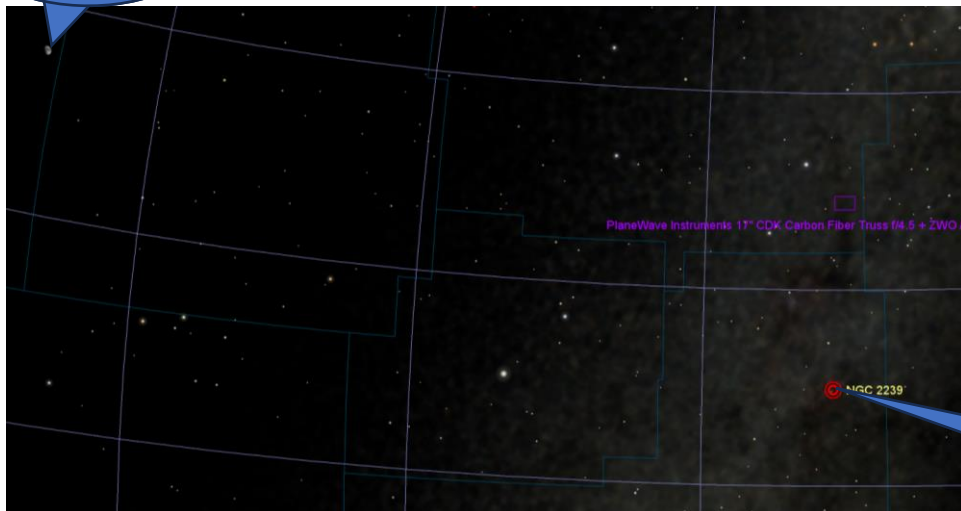


April 6, 2025 First Quarter Moon about 45° from the Rosette and High Clouds



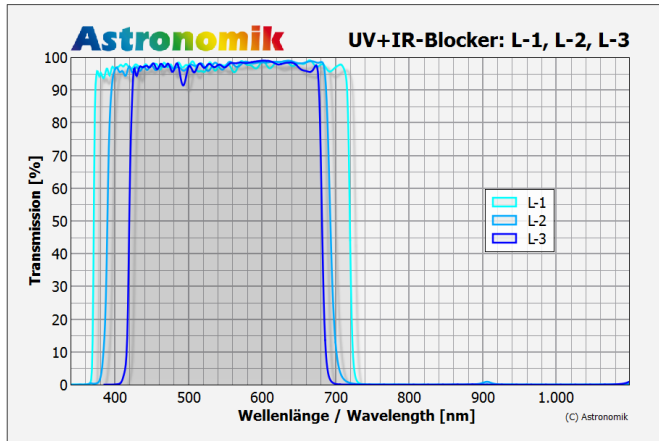
15.7° x 10.5° Field of View

Rosette



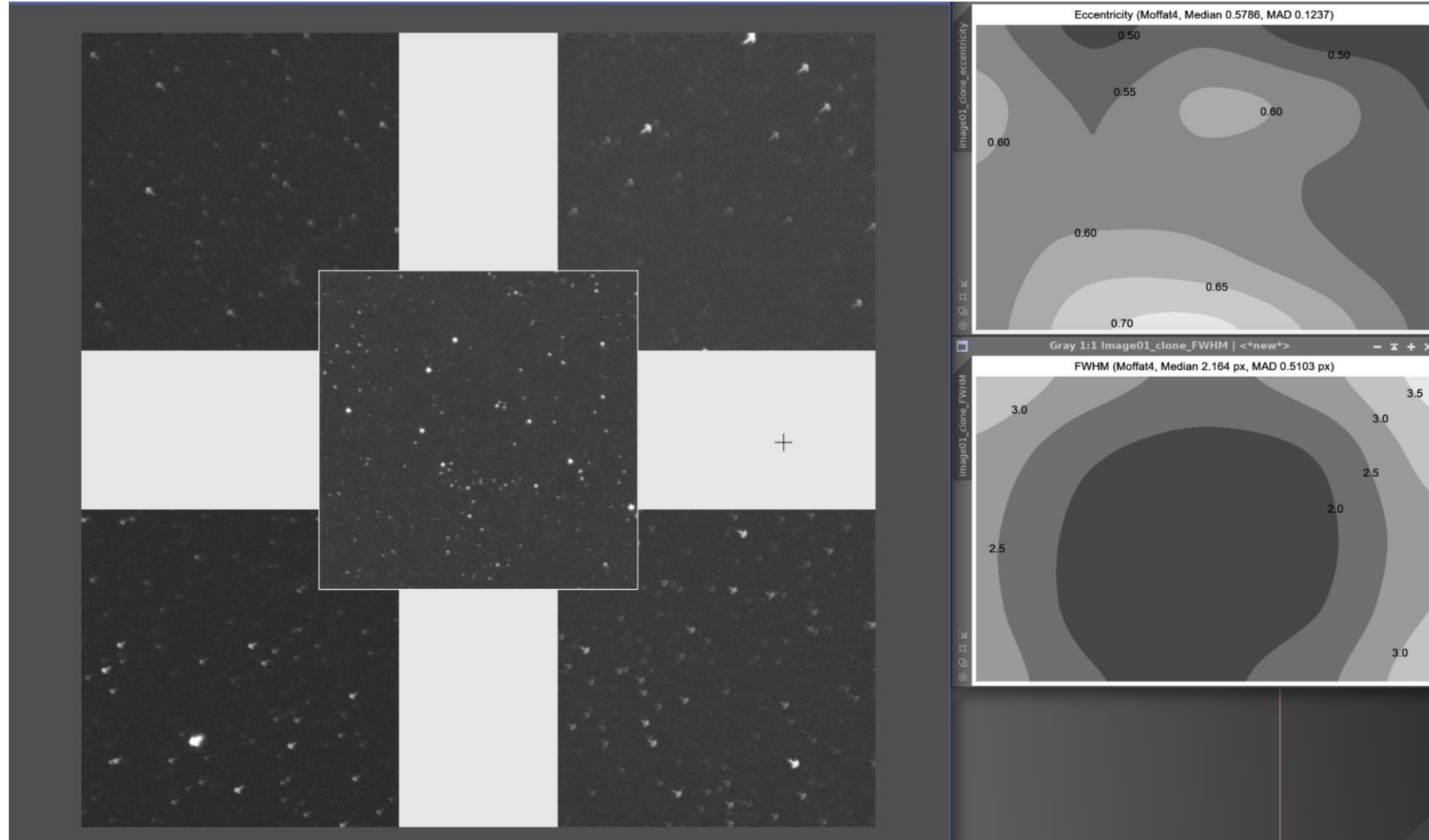
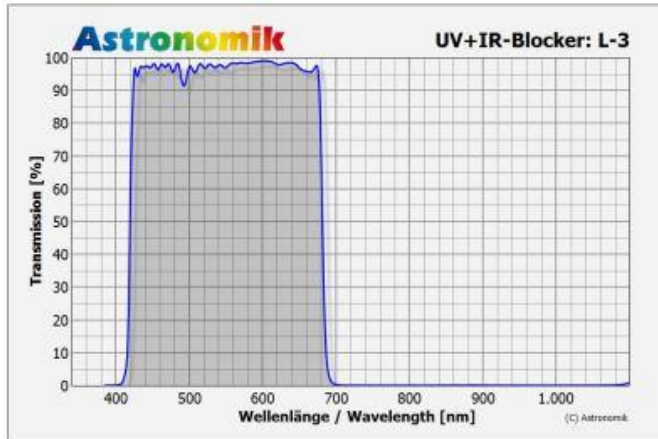
Rosette Field 85mm at F/2.8 60 sec ASI2600mc-Duo APS-C Format

L-3 Astronomik filter, image DeBayered, Converted to Gray scale



A lot of coma at the corners even using the APS-C camera format

435nm to 675nm



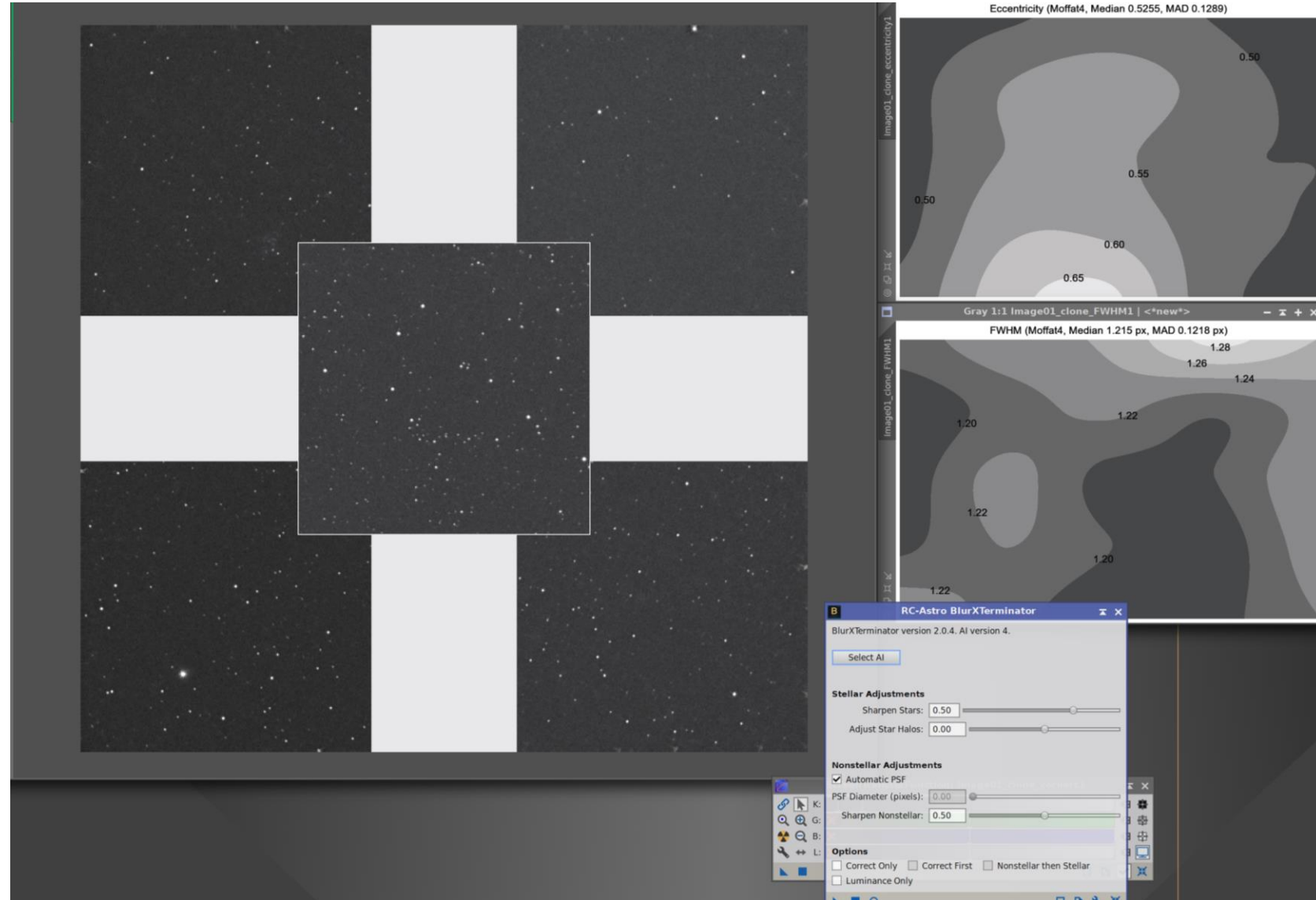
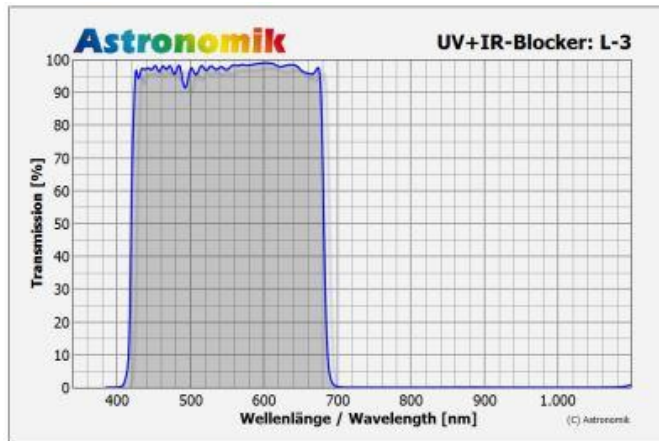
Rosette Image: 85mm at F/2.8 60 sec ASI2600mc-Duo

L-3 Astronomik filter, Image DeBayered, Converted to Gray scale

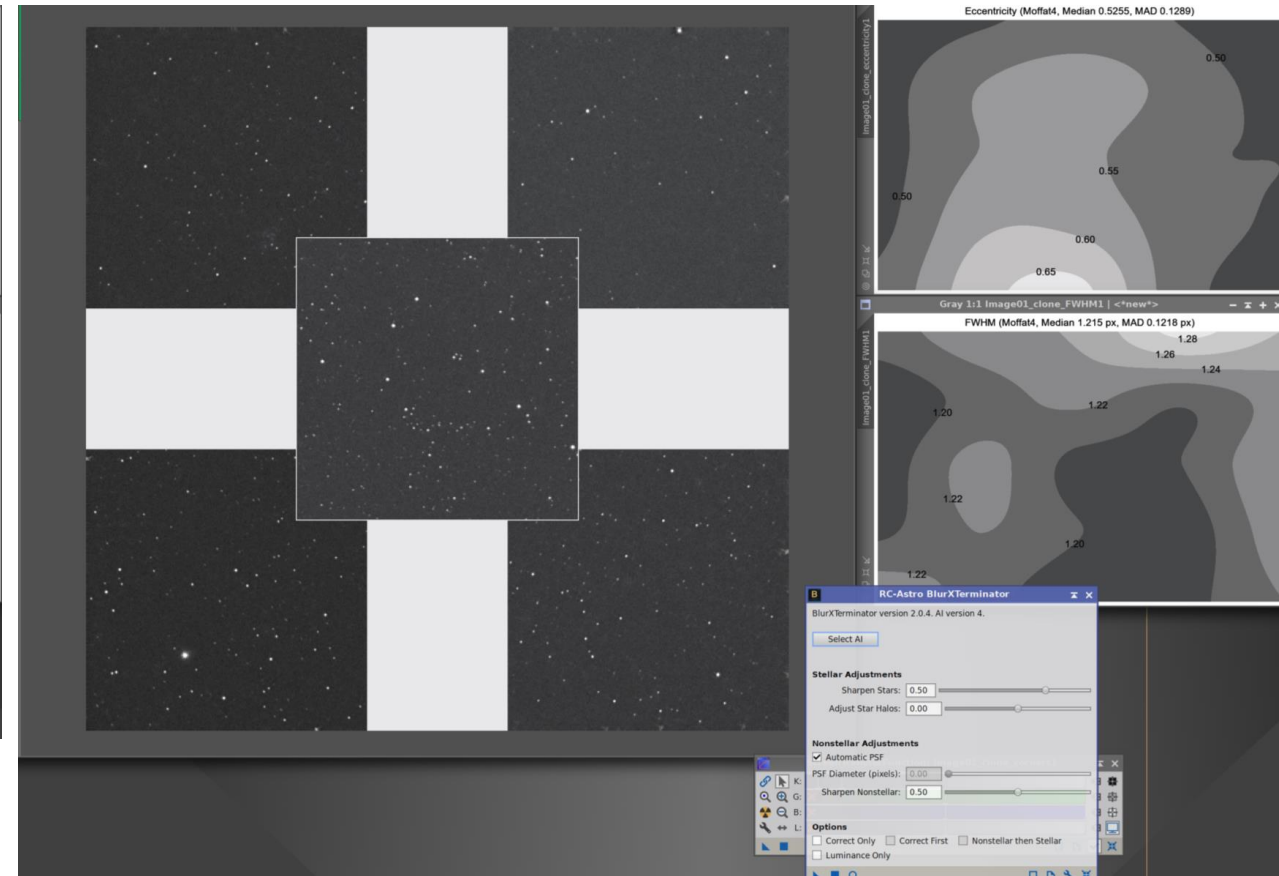
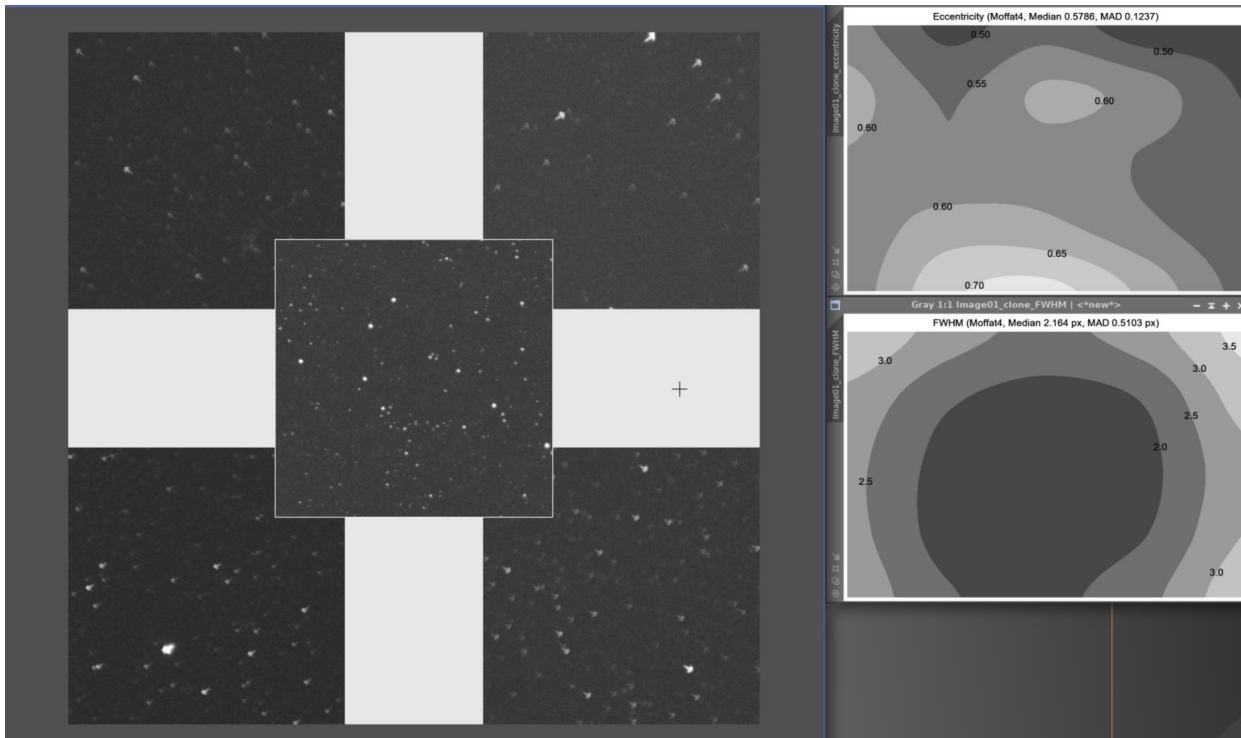
Added “RC-Astro BX (Blur X-Terminator)” Processing Tool

Image is “workable” using the BX processing tool, F/2.8, and L-3 filter

435nm to 675nm

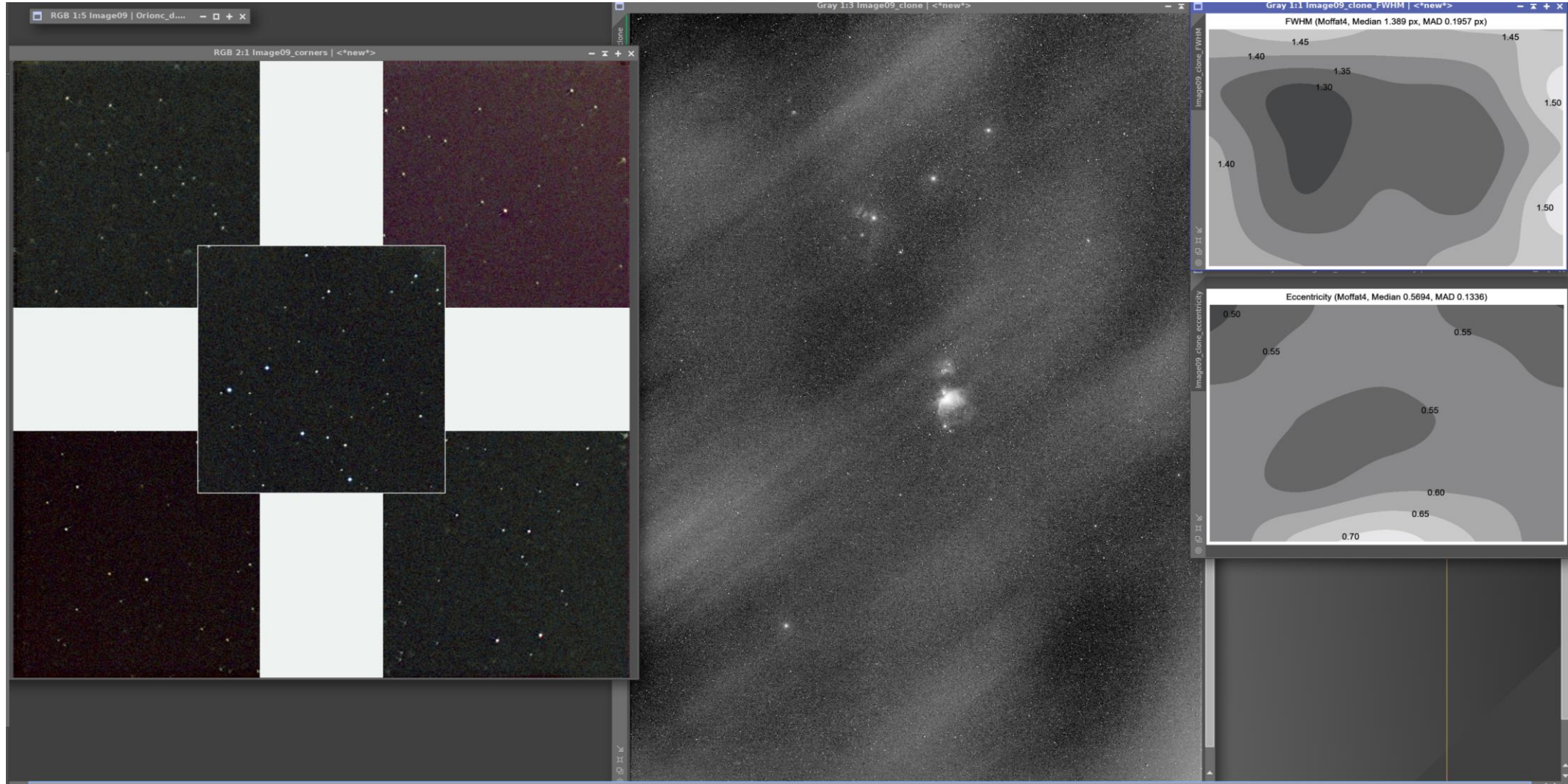


Before vs. After BX Processing



First Light on a Moon Lit Bad Night -BX used-

85mm Sigma Art at F/2.8, ASI 2600mc-Duo camera, 60sec unguided Bortle 4-5



Dark-Flat-Bias Setup

Darks:

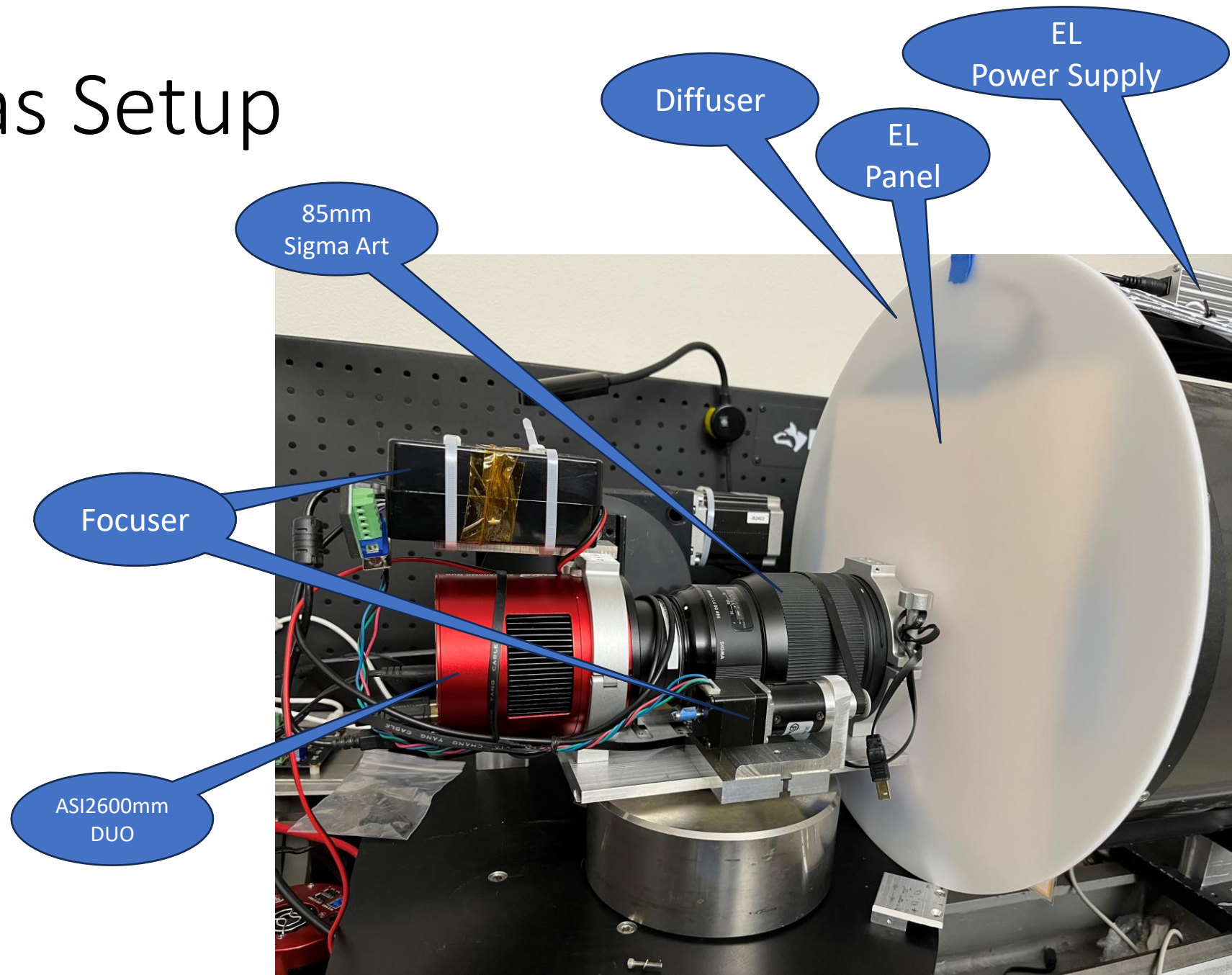
60 seconds
120 seconds
300 seconds

Flats:

0.5 seconds

Bias:

~0 seconds



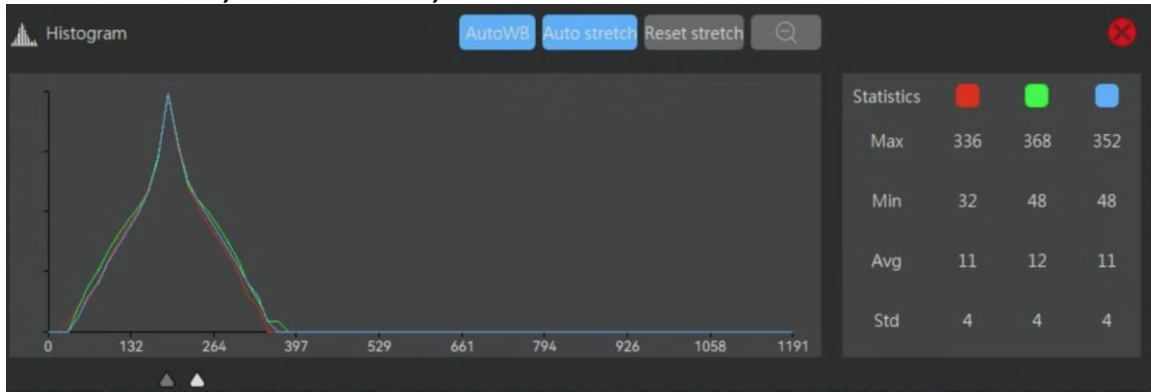
Find the Gain and Offset Settings ASI 2600MC-DUO (Single Frames)

Try the ASI2600mm DUO settings

Gain = 100

Offset = 20

Bias: -10°C, Gain=100, Offset=20



These Settings Will Be Used

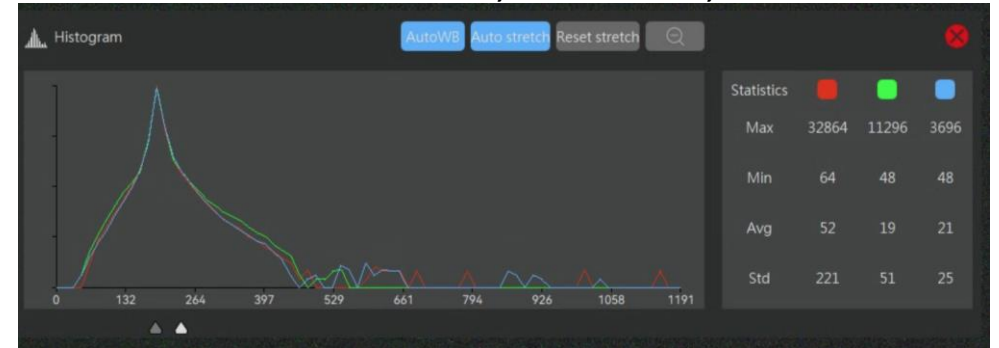
Gain = 100

Offset = 20

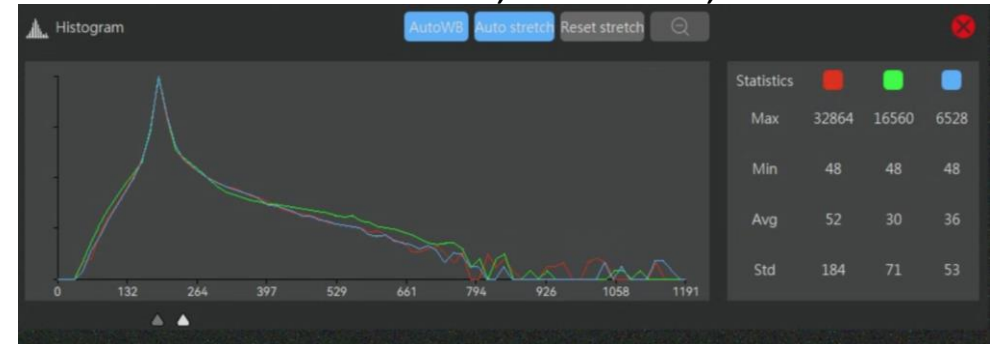
Dark 60 seconds: -10°C, Gain=100, Offset=20



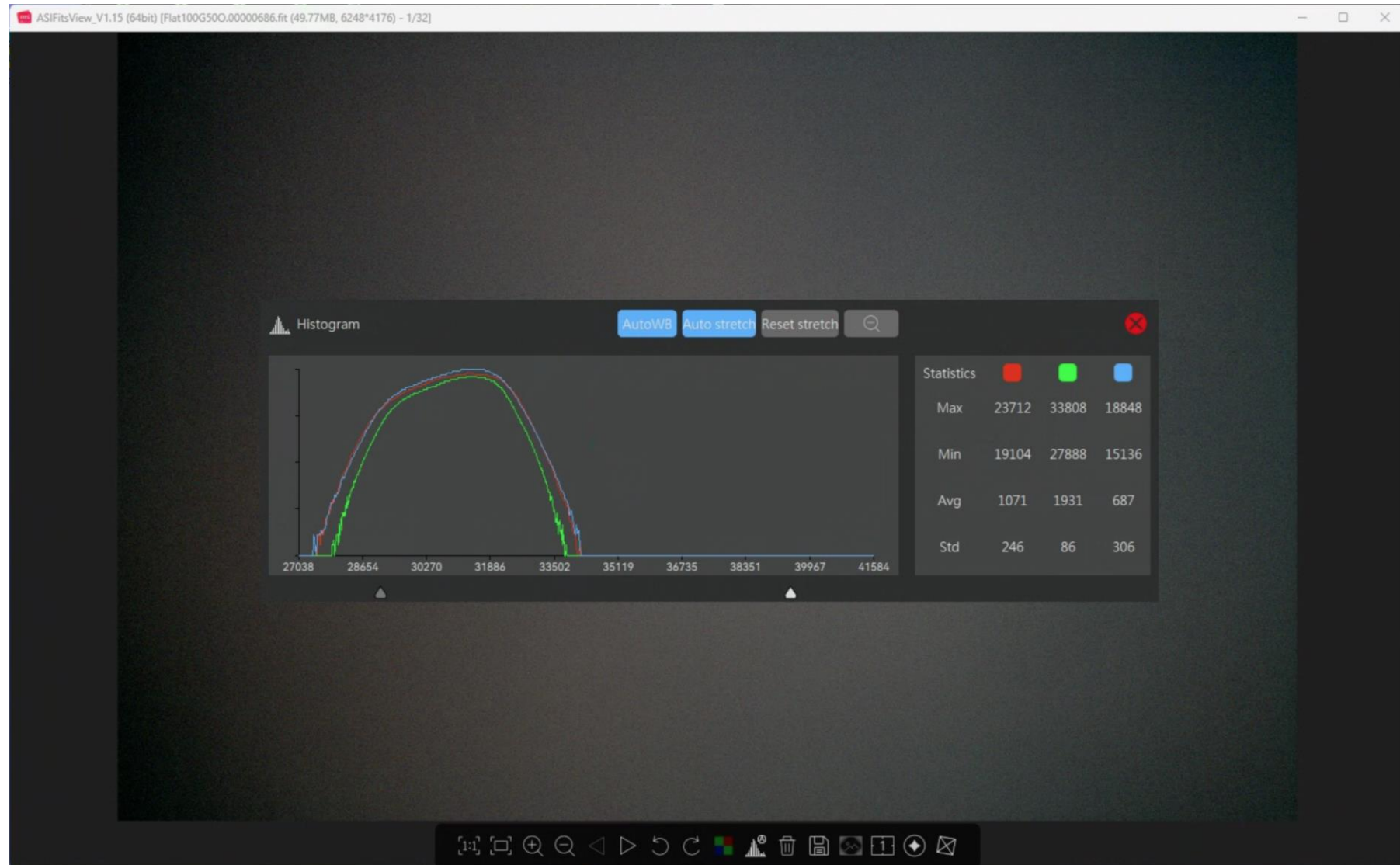
Dark 120 seconds: -10°C, Gain=100, Offset=20



Dark 300 seconds: -10°C, Gain=100, Offset=20

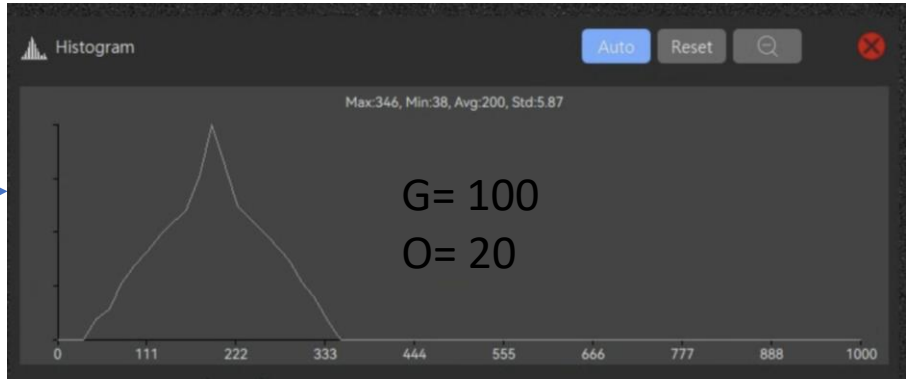
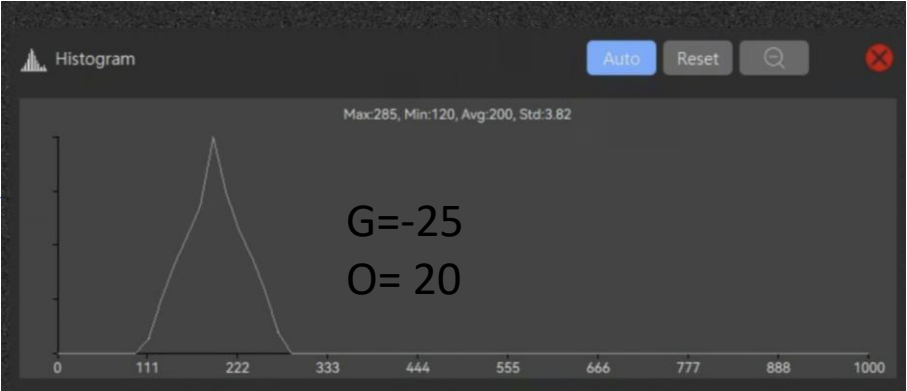
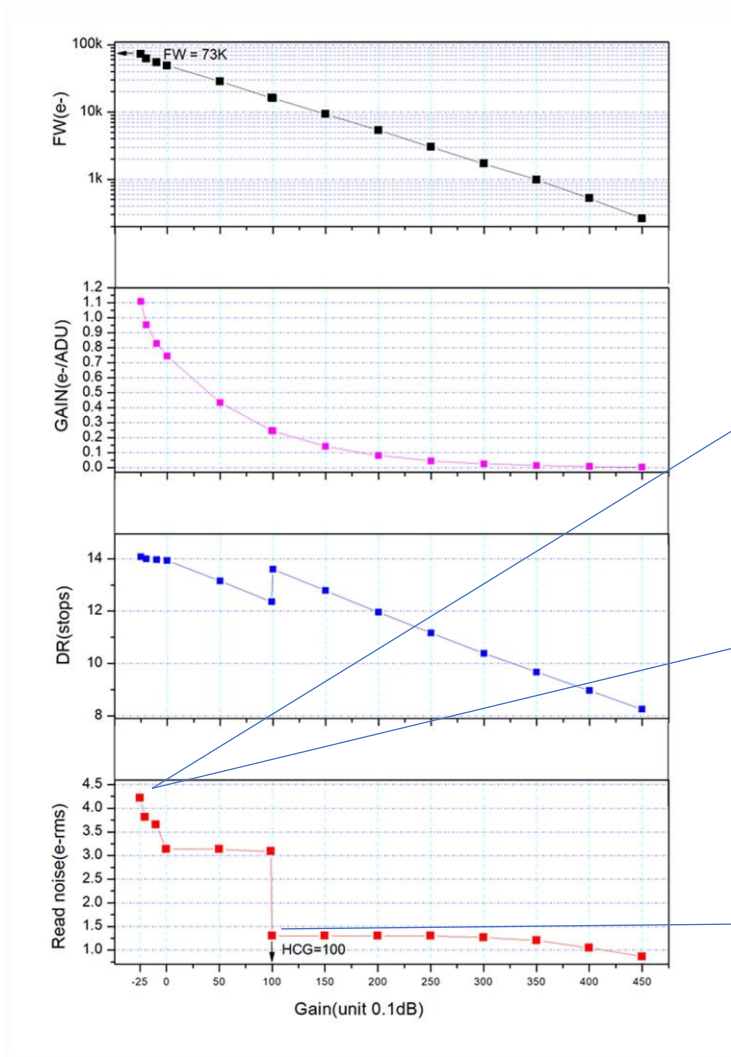


Flat Frame Histogram

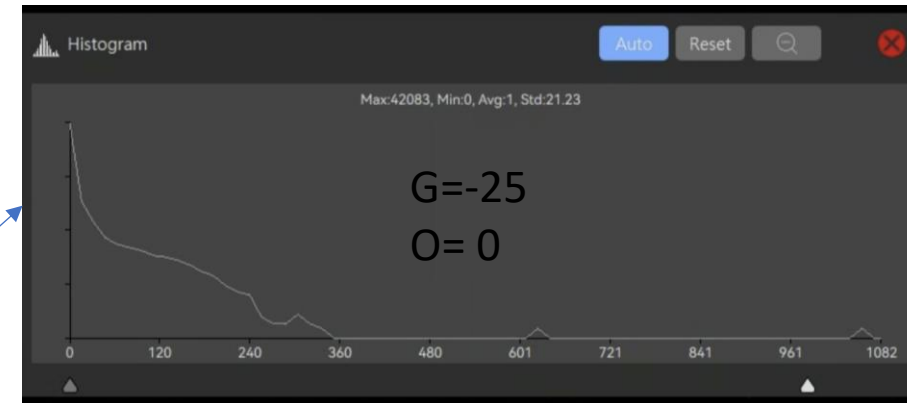
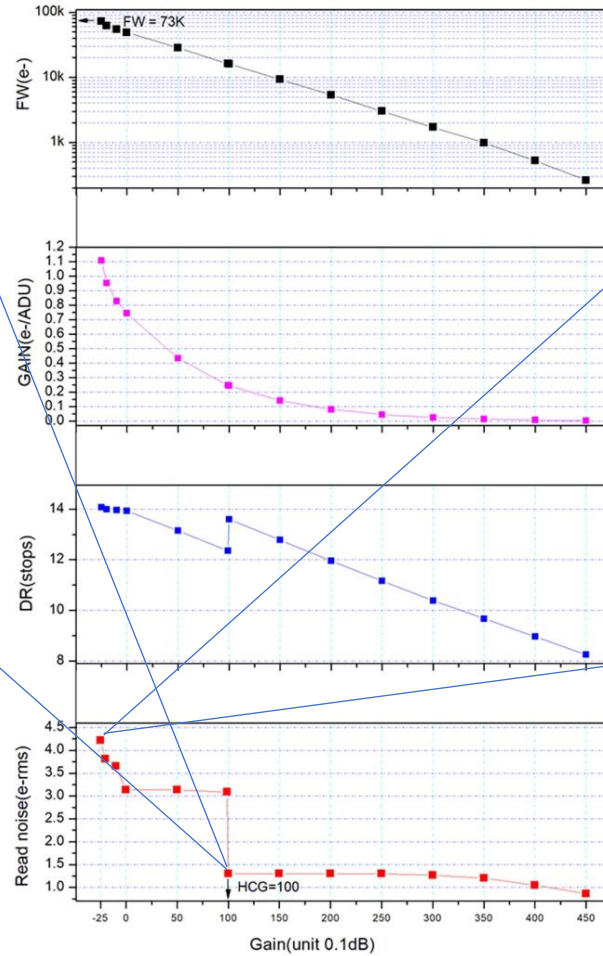


A Reminder of the ASI260mm Gain and Offset Findings

ASI260mm Gain-Offset Settings Determination Using Bias Frame Histogram -10°C



ASI260mm -10°C 600 Seconds Dark Integration Histograms

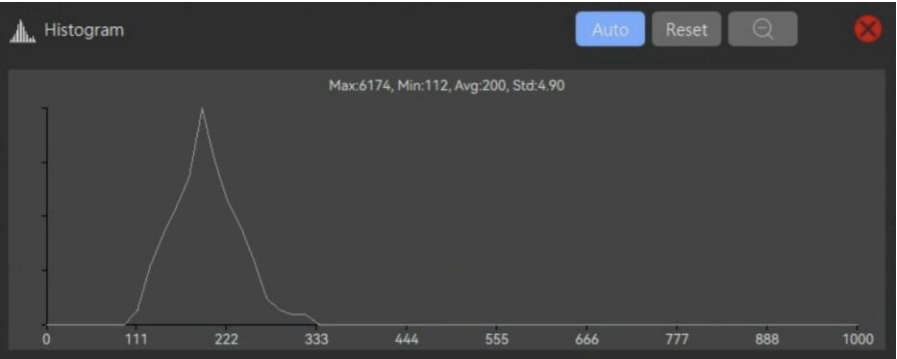


Will use -10°C Gain=100, Offset=20

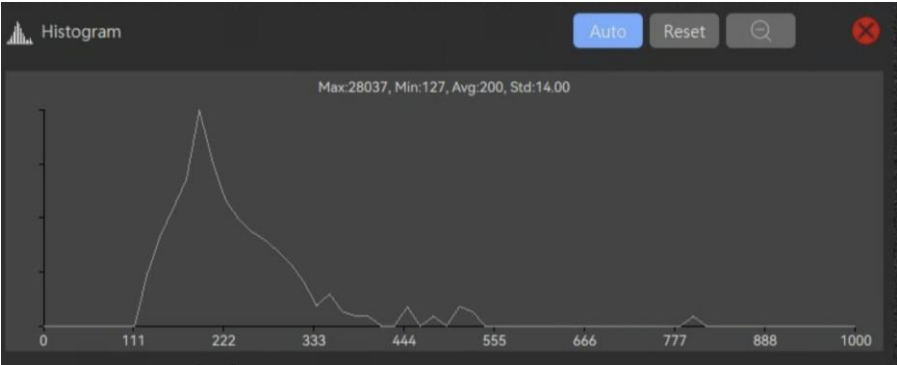
ASI260mm -10°C Dark Integration Histograms (Single Frame)

Gain=-25

Offset=20



60 sec



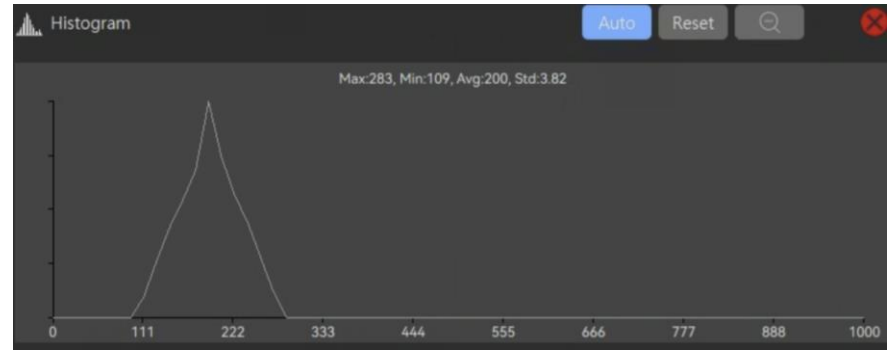
300 sec



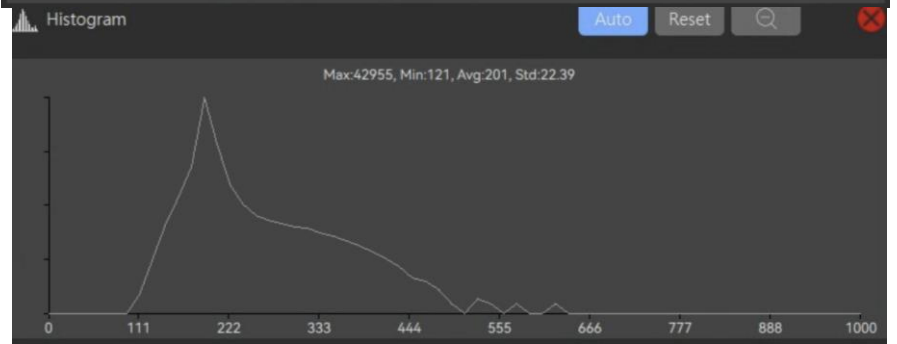
120 sec



600 sec
First



Bias



600 sec
Last

April 7, 2025 Coma Berenices (4) 120 second Moon $\sim 40^\circ$ West in Leo 2 days past first quarter Bortel 4-5

Mag >15 stars reached

Small galaxies like NGC 4565 mag 9.5, easily seen

Processing:

Bias, Dark, Flat

DeBayered



Its Ready to Field