Imaging Capabilities of the MACRO Consortium's Robert L. Mutel Telescope

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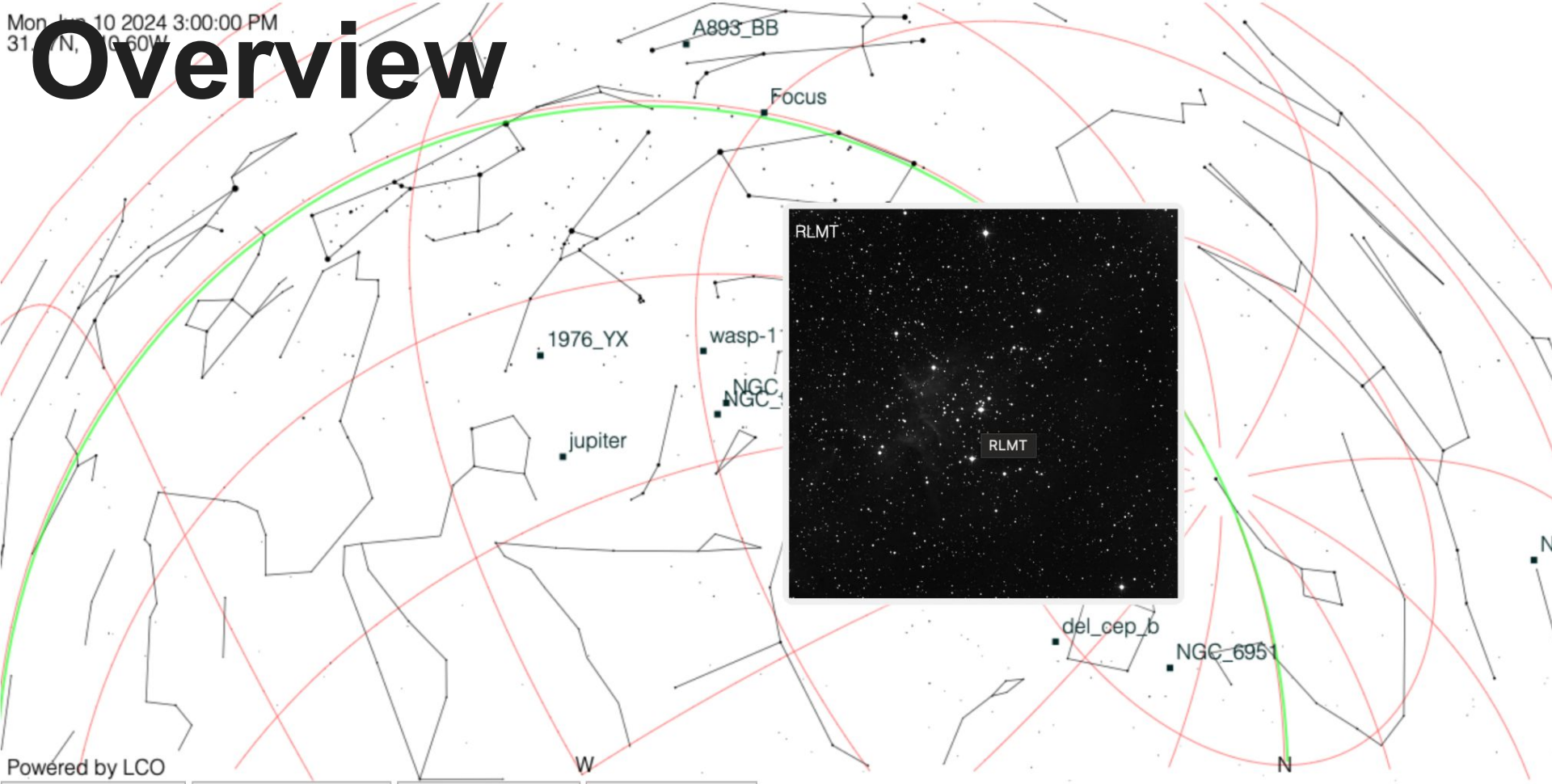
On behalf of the

The MACRO Consortium

AAS 244
Madison, WI

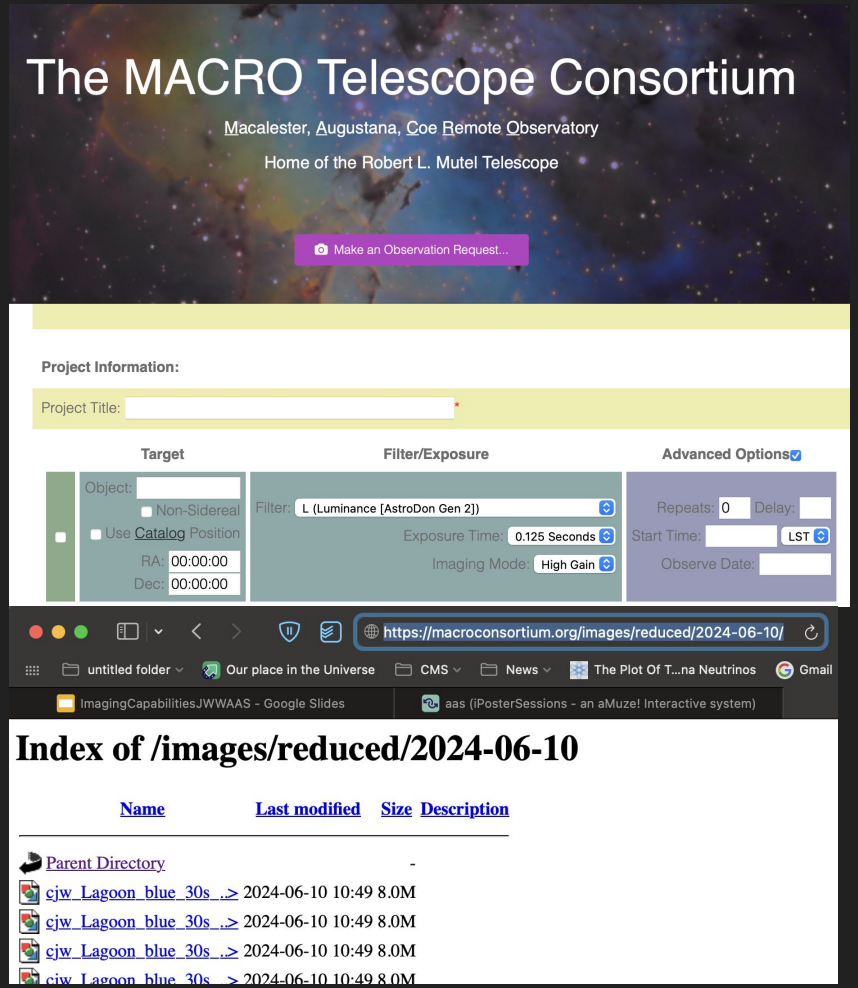
IOWA

Overview


Mon Jun 10 2024 3:00:00 PM
A893_BB
Focus
RLMT
RLMT
1976_YX
wasp-1
jupiter
del_cep_b
NGC_6951
W
N
Powered by LCO
Rewind One Hour
Advance One Hour
Reset to Midnight
Cycle Projection

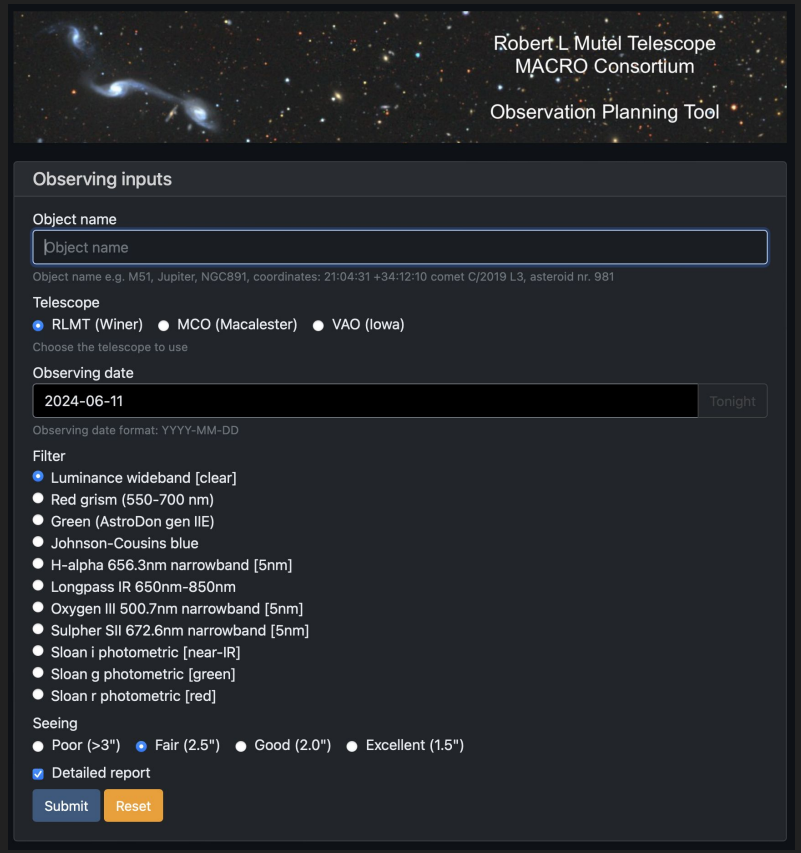
Overview

- The RLMT system allows users to schedule optical observations via the web. (www.macroconsortium.org)
- Observations are scheduled by user priority.
- Images are automatically taken, calibrated, and published to the web.
- Users can specify cadences, non-sidereal objects, exposure times, filters…



Overview

- Obsplanner tool
- Allows students to predict exposure times for a given object for a given filter.



Instrument Description

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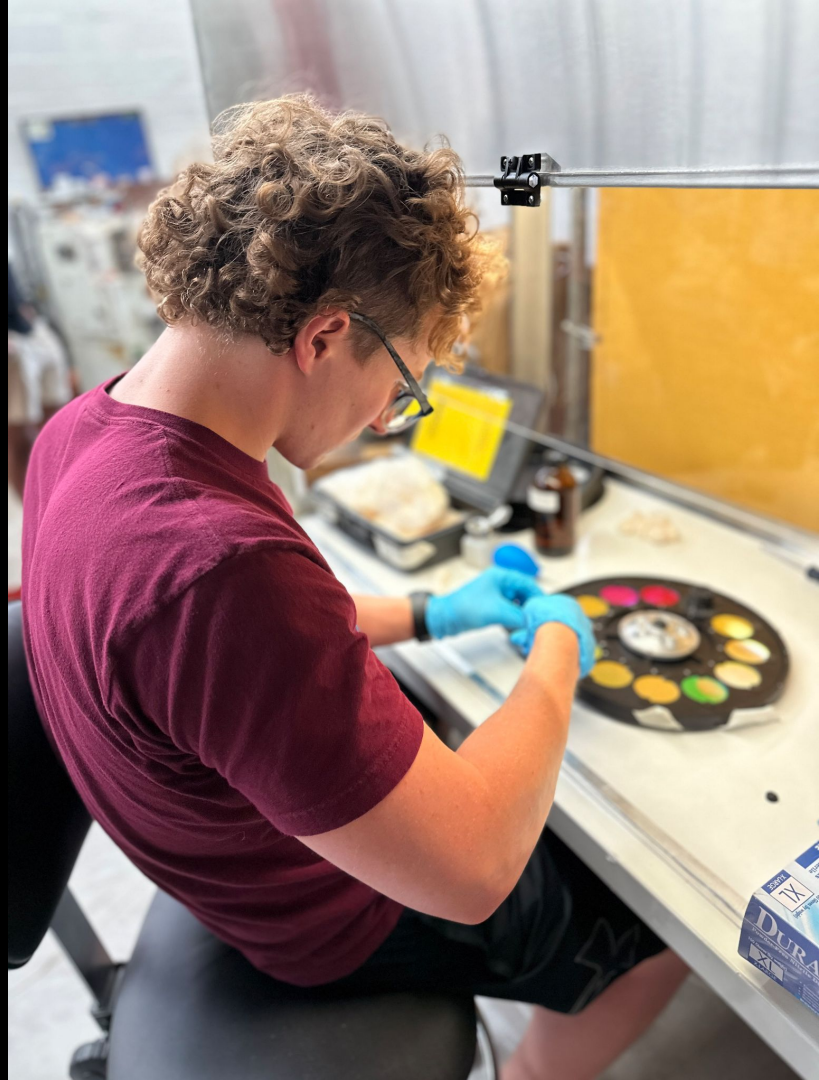
- 0.51 m PlaneWave CDK 20
- *f*/6.8 Dall-Kirkham optics
- Mathis MI750 equatorial mount
- Andor iKon L936 CCD camera
- Two filter wheels
- Water chiller

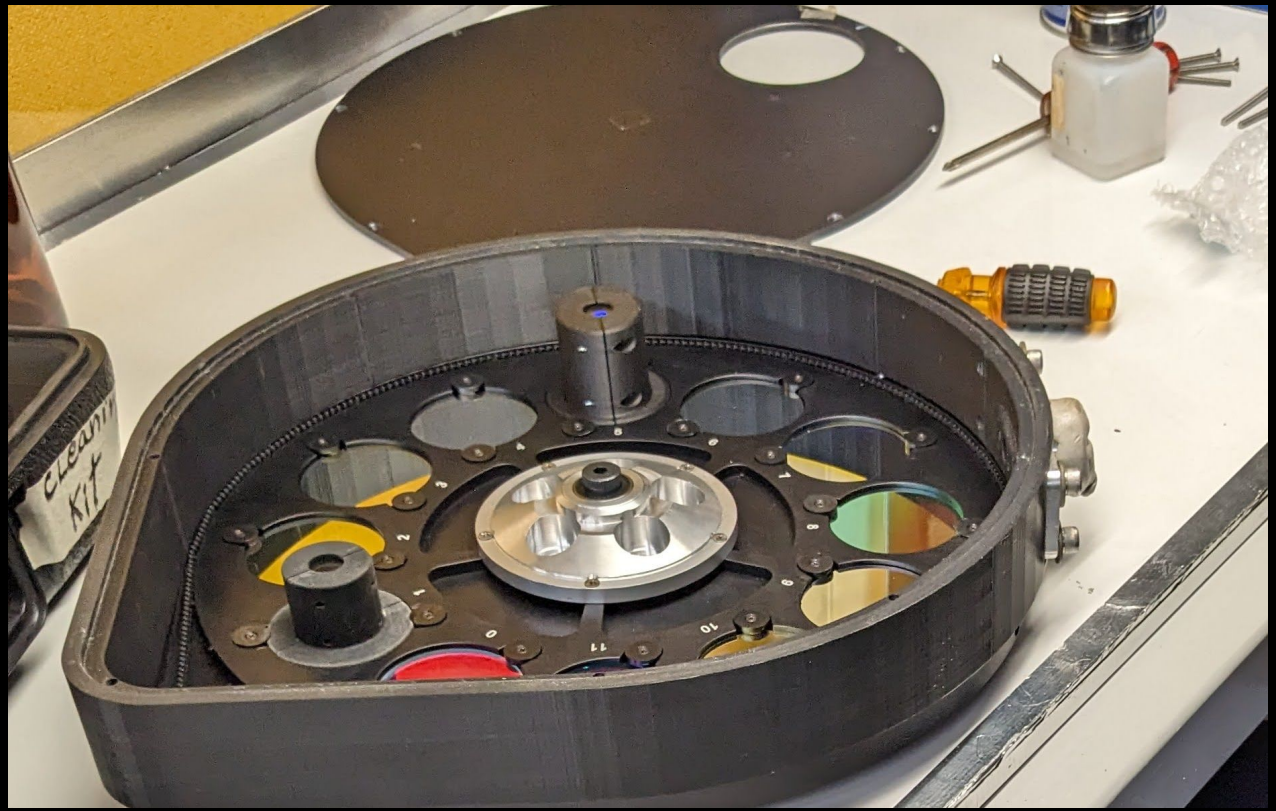
Filter Wheels

- Finger Lakes Instruments CFW3-12
  - Sloan (*u',g',r',i',z',y'*)
  - Low Resolution Grism
  - High Resolution Grism
  - OIII, SII, Ha

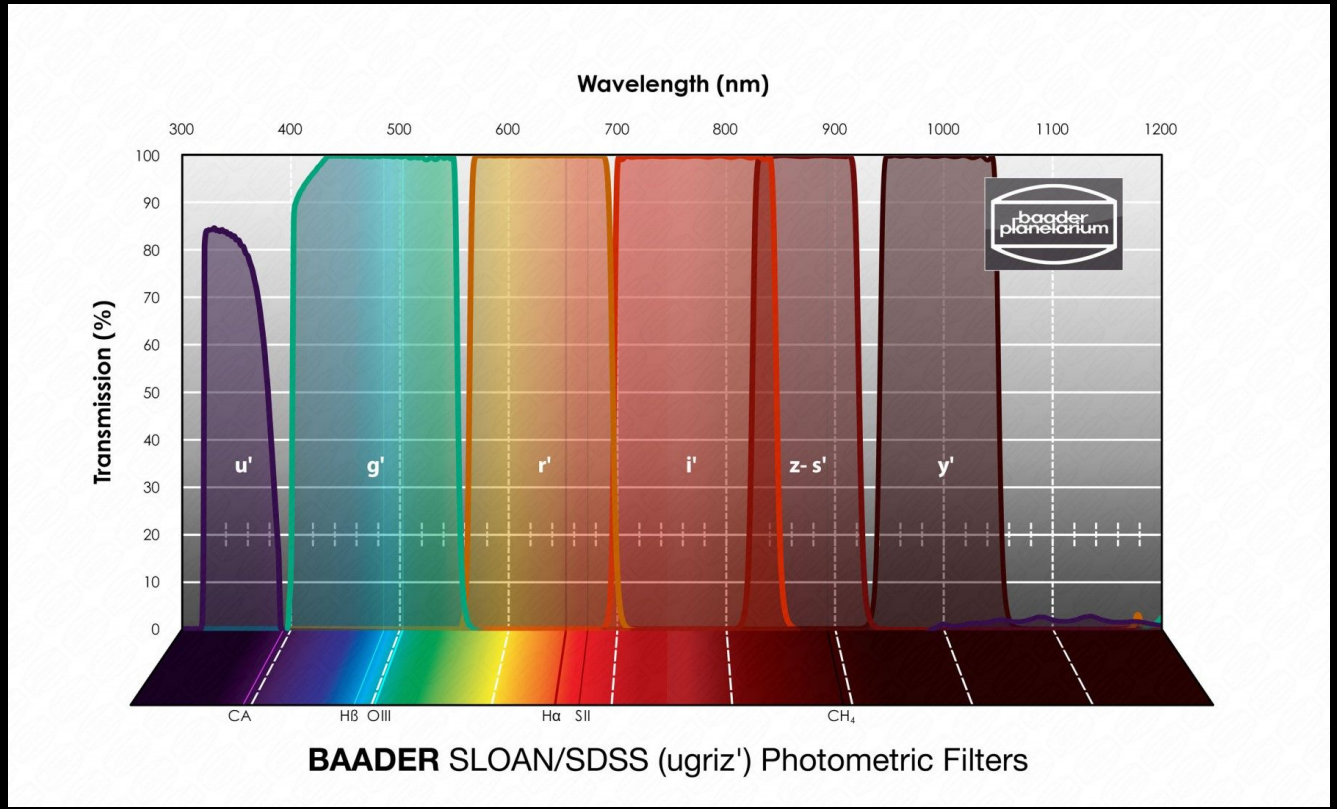
- Finger Lakes Instruments CFW9-5
  - Red, Green, Blue, Lum



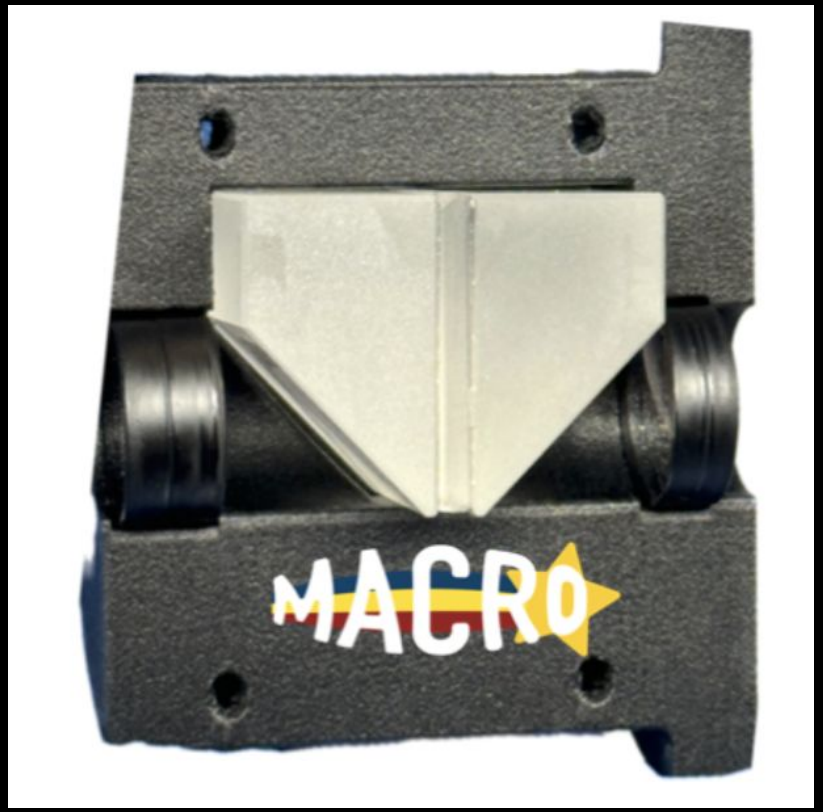
Filter Wheels

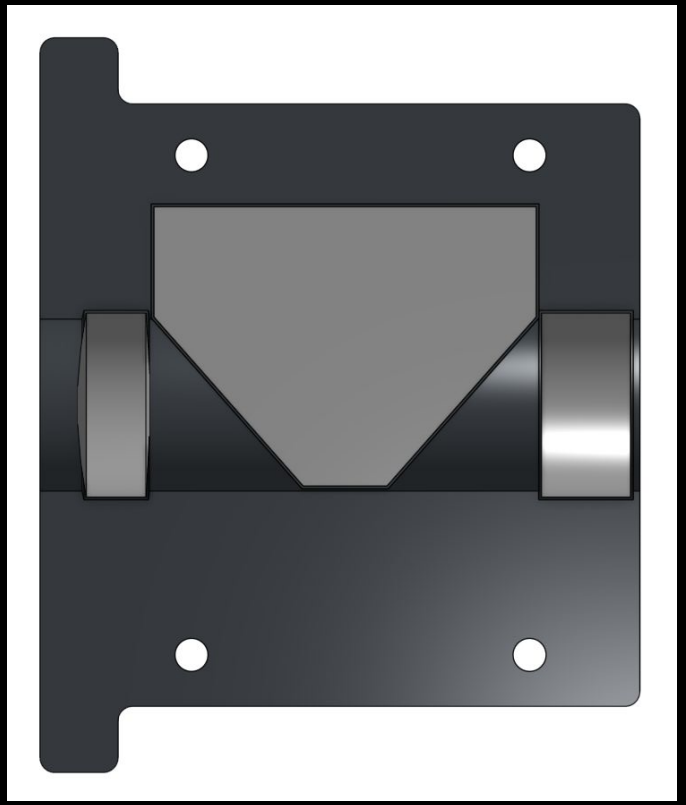


Filter Wheel - Photometric Filters



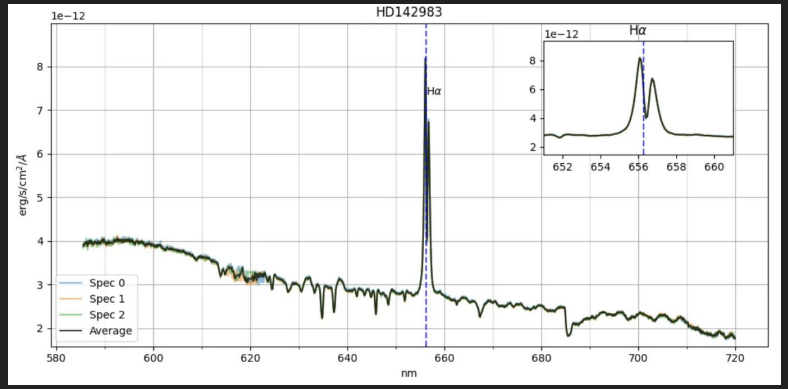
Grisms:



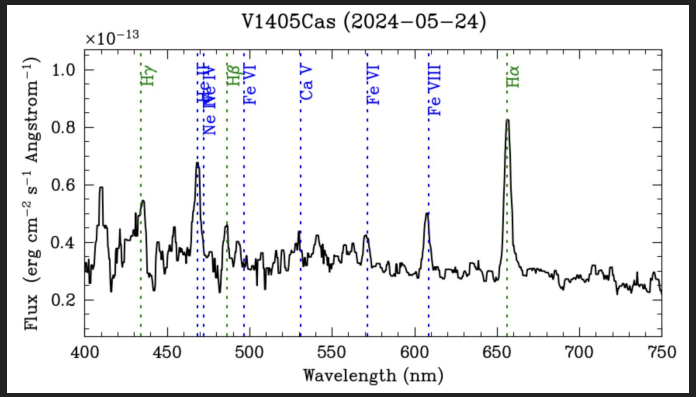


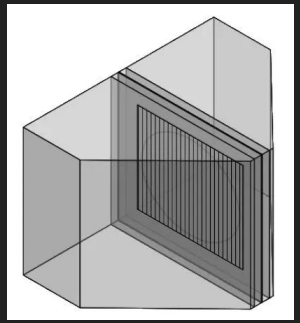
Grisms

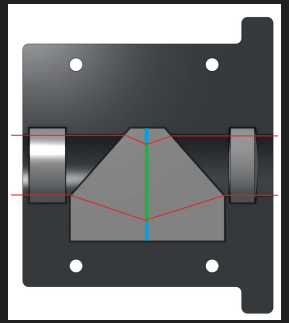
- High Resolution Grism

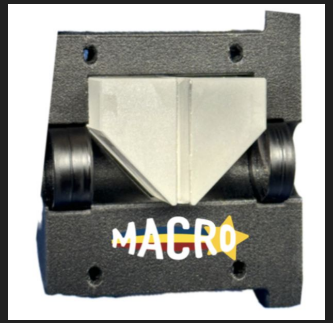


- Low Resolution Grism



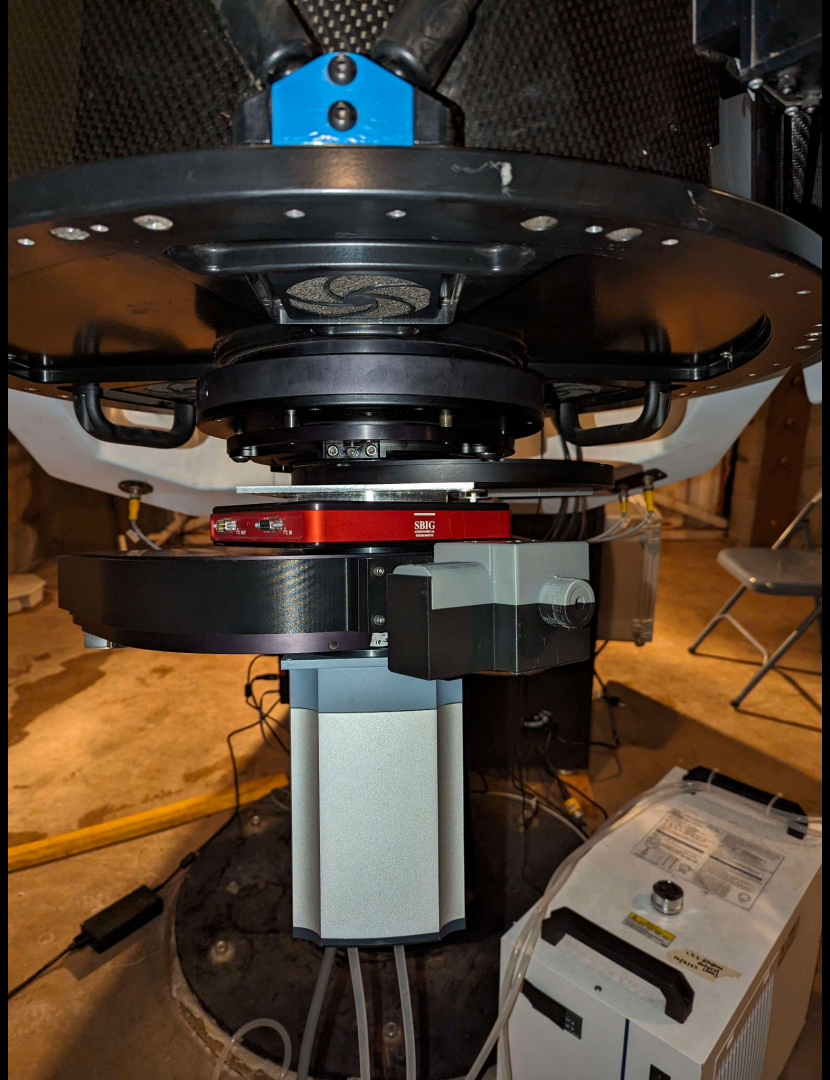




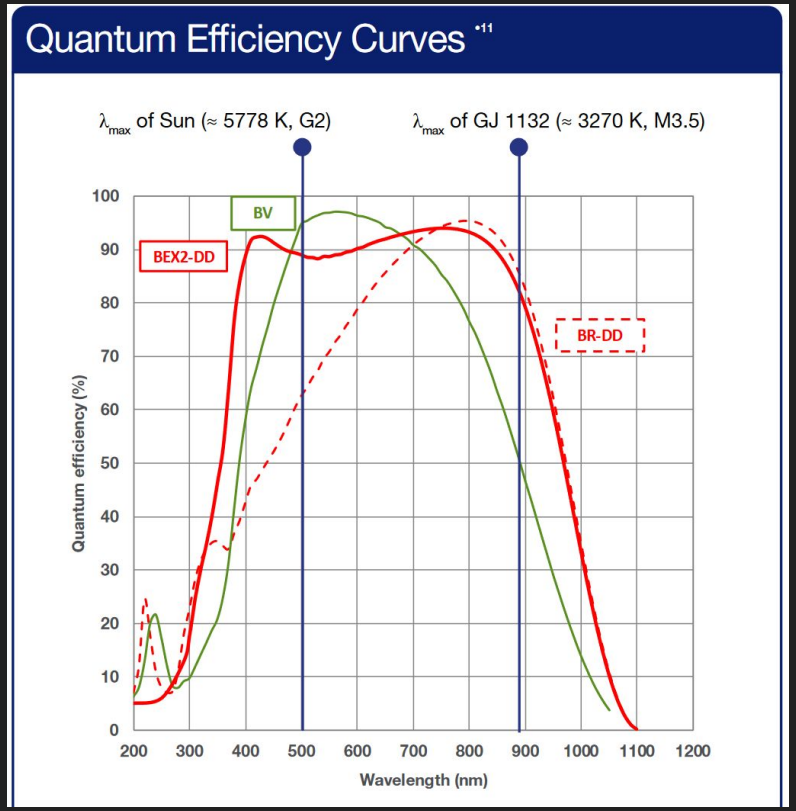


Camera

- Andor iKon 936-L
  - 100˚C ∆T from ambient
  - Operates at -80˚C
  - Water/Glycol-Chilled



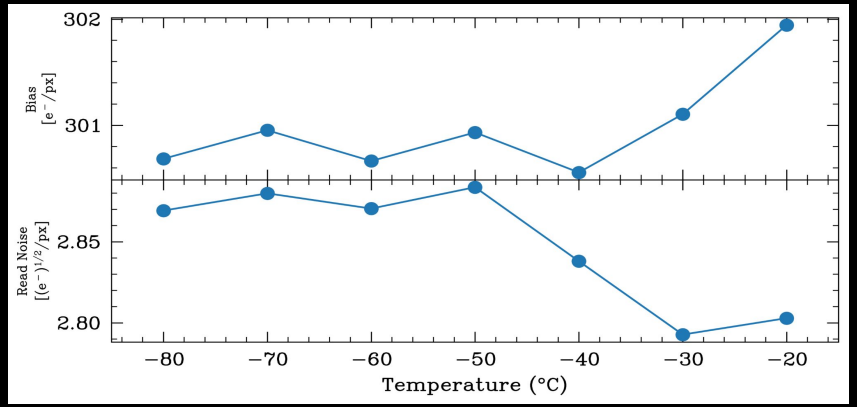
Camera


Quantum Efficiency Curves [11]
λmax of Sun (≈ 5778 K, G2)
λmax of GJ 1132 (≈ 3270 K, M3.5)
BV
BEX2-DD
BR-DD
Quantum efficiency (%)
Wavelength (nm)
0
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1000
1100
1200

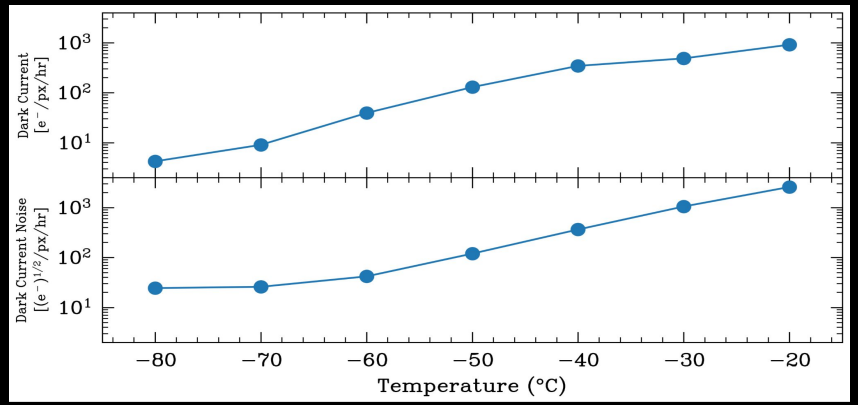
Detector Performance

Detector Performance

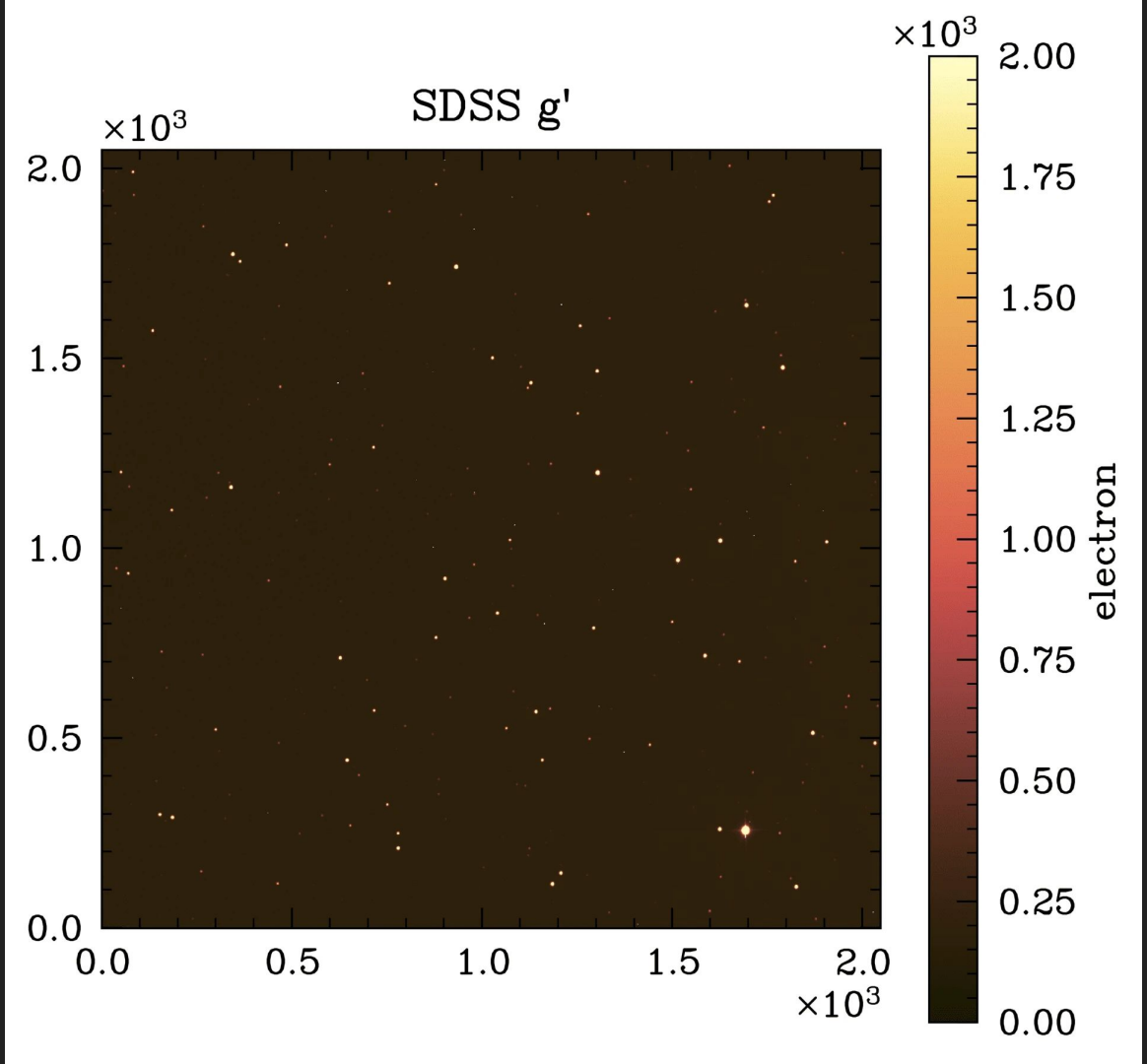
Temperature-dependent bias and read noise properties of the Andor iKon 936-L: 2.9 root-electrons per pixel read noise @ -80˚C



Temperature-dependent dark current and estimated noise properties: Dark current of 4.2 electrons per pixel per hour at -80˚C.



System Performance

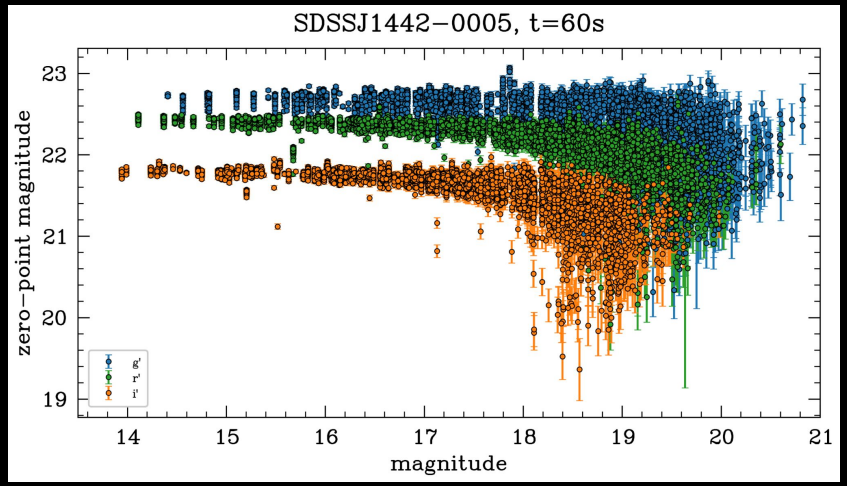

SDSS g'
×10^3
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
×10^3
×10^3
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
electron

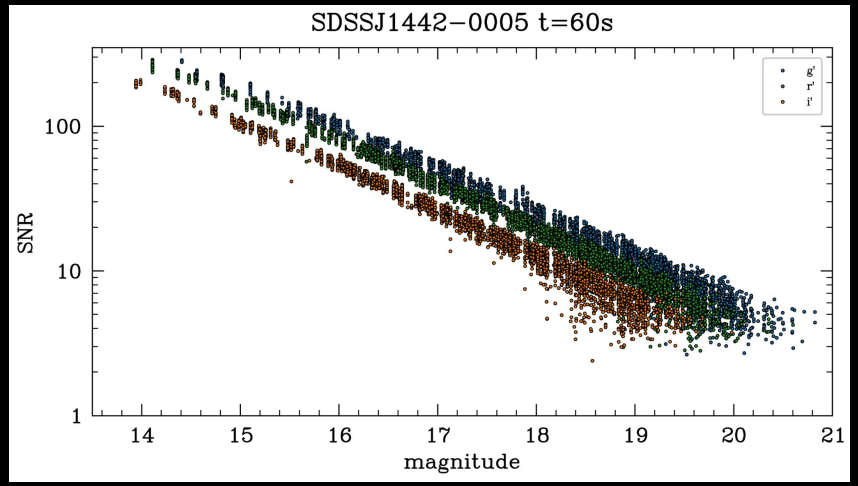
System Performance

The zero point magnitude in Sloan g', r', and i' filters estimated from 10 images of the SDSSJ1442-0005 field. Results:

g'=22.43 +/- 0.81,
r'=22.17+/-0.86,
i'=21.53+/-0.79

Signal-to-noise ratio in the same field, *dominated by the source's Poisson noise or the sky's Poisson noise* at very dim magnitudes. For photometric modes, the detector-generated noise makes only a negligible contribution.





Imaging Calibration

Imaging Calibration

Images taken by the system are automatically calibrated and published on the web for download by users.

Calibration Steps:

1 - Master bias subtraction

2 - Master dark frame subtraction

3 - Divide out a normalized flat frame

4 - Cosmic Ray removal

5 - Seeing/ZP Mag calculations

Imaging Calibration

Calibration images can be acquired with skyflats, or using a screen + lamps in the observatory.

Imaging Calibration

Raw and Reduced copies of the images and the calibration images used are published to the web.

Calibration files used are added to the Reduced image's FITS header.

Each morning a summary email is sent to users.

Observing statistics

Total number of observing projects: 9

Total number of images: 224

Moon phase range: 23% - 28%

Median zenith seeing: 3.0 +/- 0.5 arcsec

Total observing time: 7.7 hrs

Code	Observer	N image	Time (min)	UT range
irm	alexandrea-moreno	36	9	1222 - 123759
ige	anna-fox	2	8	75043 - 75524
ice	connor-stomp	1	17	71049 - 71049
xwg	wgolay	6	4	74706 - 114858
ibb	ryan-paris	1	17	35722 - 35722
ide	olivia-kasych	1	1	35421 - 35421
ica	caroline-roberts	3	25	104604 - 110602
iab	isabella-burgos	3	12	120736 - 121655
ibc	hannah-hehn	3	8	34405 - 35405
ida	leila-assadi	1	4	115150 - 115150
iac	hayden-ersbo	3	6	115832 - 120335
icd	carson-simon	3	51	80924 - 85011
idd	mackenzie-kanach	3	10	80006 - 104810
ibf	paige-e-pearson	1	8	111459 - 111459
icf	ashley-rankin	1	17	73647 - 73647
itq	salvatore-quaid	2	25	101356 - 102750
icc	natalie-santiago	3	51	91533 - 95042
ibe	ella-crawford	3	25	112358 - 114140

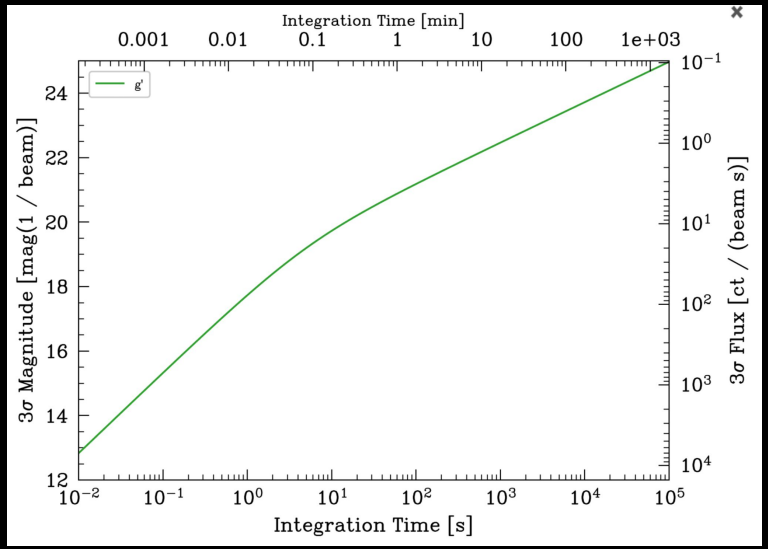
Next Steps

Next Steps

Signal-to-noise Model:

Dependent on seeing, relative Rayleigh scattering and Mie scattering, moon phase, etc.

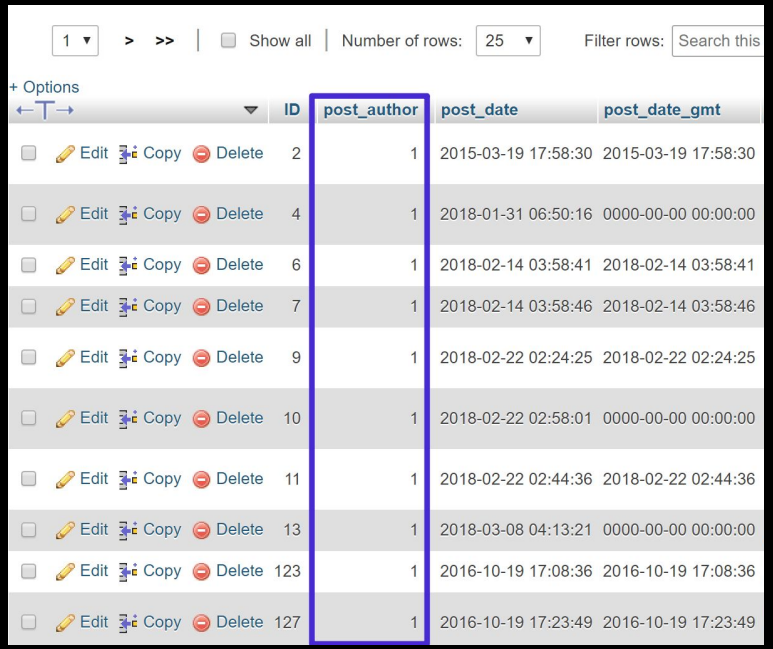
We plan to characterize the time-dependent properties of the Winer Observatory site using this model. A sample plot generated by our model is shown right for the predicted properties of the site.



Next Steps

Move to Database Schema-

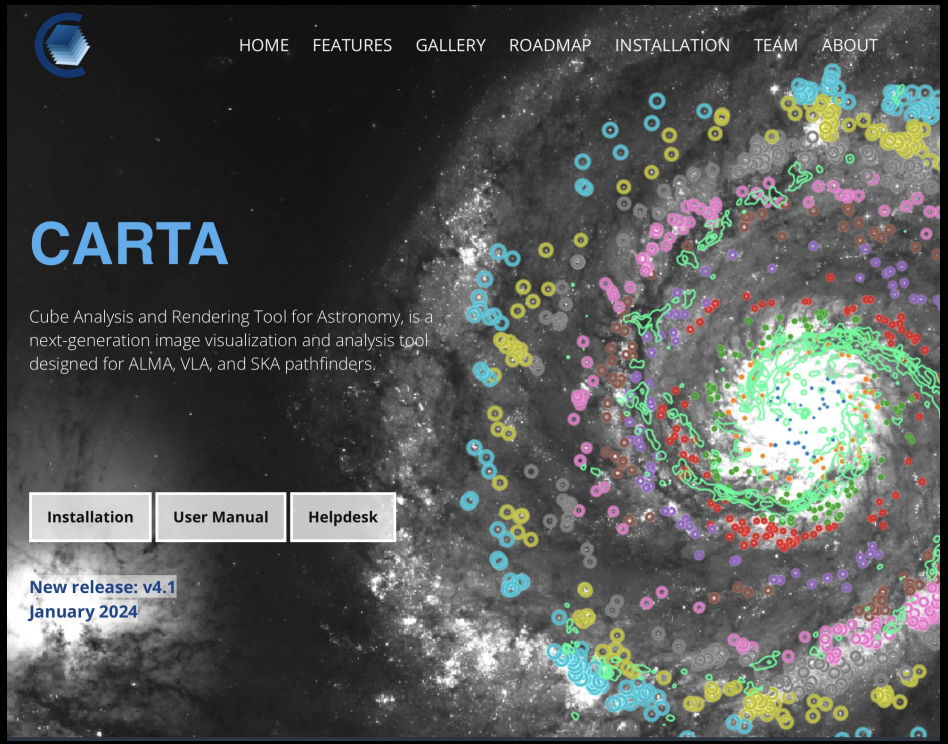
- Target scheduling, tracking, and results all stored in a database.
- Allows unscheduled targets to be rescheduled.
- Allows sorting and searching for specific targets and filters and exposure times.



Next Steps

Server-side analysis tools:

- CARTA
- Jupyter notebooks
- Allows easy access to images for students
- Easier for computer labs to not need specific analysis tools installed across all campuses



Thank you!