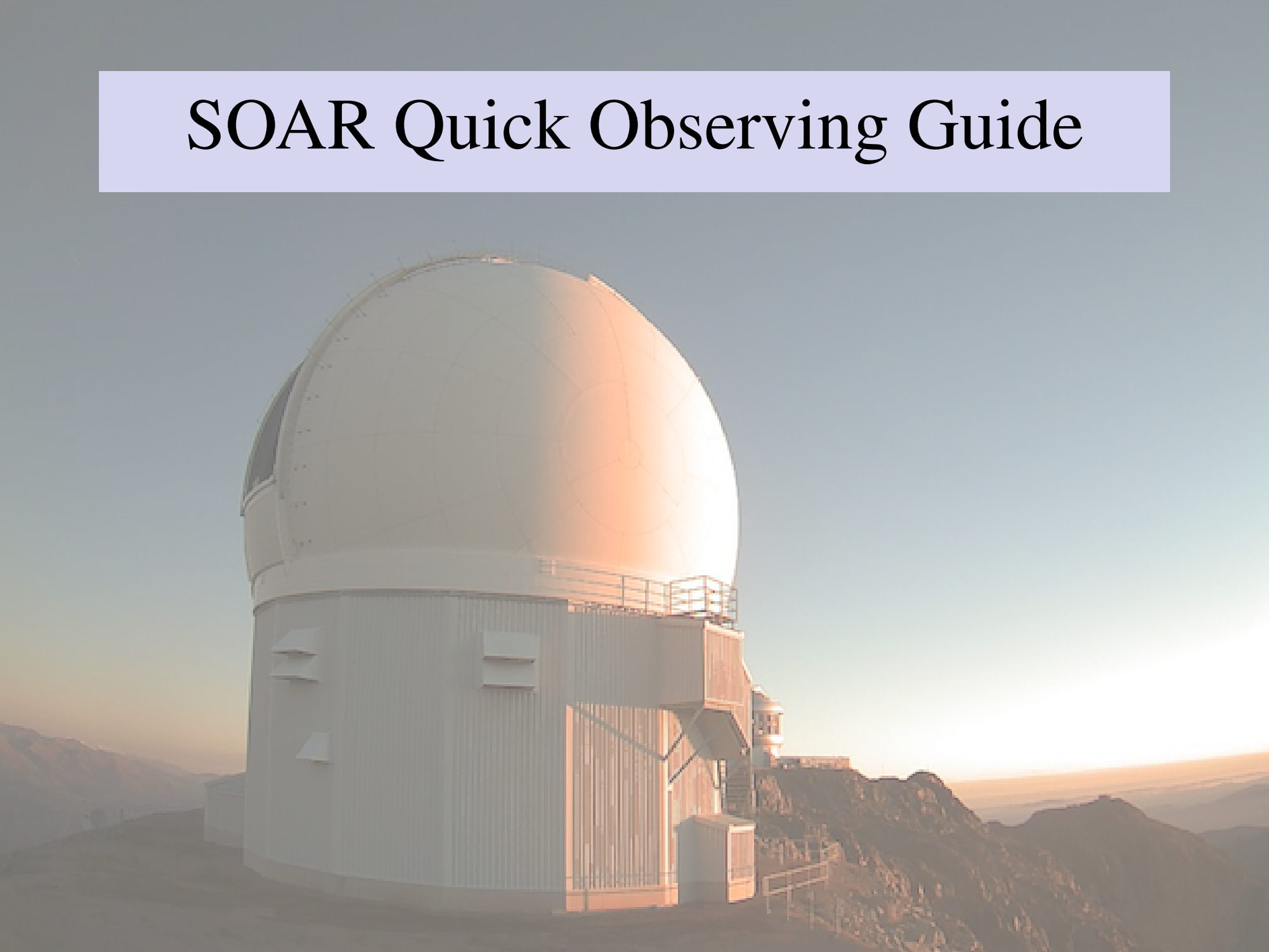
SOAR Quick Observing Guide



- Setup VPN connections for Goodman, NOAO (IRAF) and GACAM
- NOTE: Minimum of 2 preferably 3 monitors required.
- Start up SOAR vpnc in a terminal
  - vpnc /etc/vpnc/vpnc2soar.conf
  - Goodman: vncviewer -Shared 139.229.15.132 &
  - IRAF: vncviewer -Shared 139.229.15.137:4 &
  - GACAM: vncviewer -Shared 139.229.15.168:1 &
- Prepare Goodman Spectrograph Controls
  - Click on GSP_Main-Shortcut Icon to open up Goodman GUI
  - Click on the arrow to run the Goodman GUI.
  - Click on Main $\longrightarrow$ Logon $\longrightarrow$ Then select the partner (brazil, noao, unc, msu, etc) and enter the password that was provided to you by the Support Scientist
  - Click on User $\longrightarrow$ Home Systems $\longrightarrow$ Select All $\longrightarrow$ Then Home Selected
    - WARNING: Before you home systems, make sure the Goodman electronics has been powered on by the Telescope Operator (TO), and that the rotator angle is at 0 deg. Check with the TO.
  - Make sure the Flexure Compensation is **ON**
  - In the Target Control Box of the Collimator Focus enter **1000** $\longrightarrow$ Then click on "Set". Wait until the collimator reaches the position 1000 in the actual indicator box.
  - Click on the CCD Readout Speed pull-up menu and select the desired readout mode.
  - Click on the CCD ROI Mode pull-up menu and select the region of interest (ROI).
  - Click and select the Slit.
  - Click and select the Grating.
  - Click and select the Wavelength Mode.

- Set up Focus Sweep to Determine Best Focus
  - Set Stepsize $\longrightarrow$ 100
  - Set # Exposure $\longrightarrow$ 21
  - Set Mask $\longrightarrow$ 0.45″ Slit
  - Set Readout speed $\longrightarrow$ 400 kKz
  - Set Exposure Time $\longrightarrow$ 1 sec
  - Set Custom CCD ROI Mode
    - Set Parallel Origin $\longrightarrow$ 1900
    - Set Parallel Length $\longrightarrow$ 400
- Measure results to get best focus
  - *specfocus *focus.fits*

Note: Before setting focus set value to -2000

Comparison Lamps

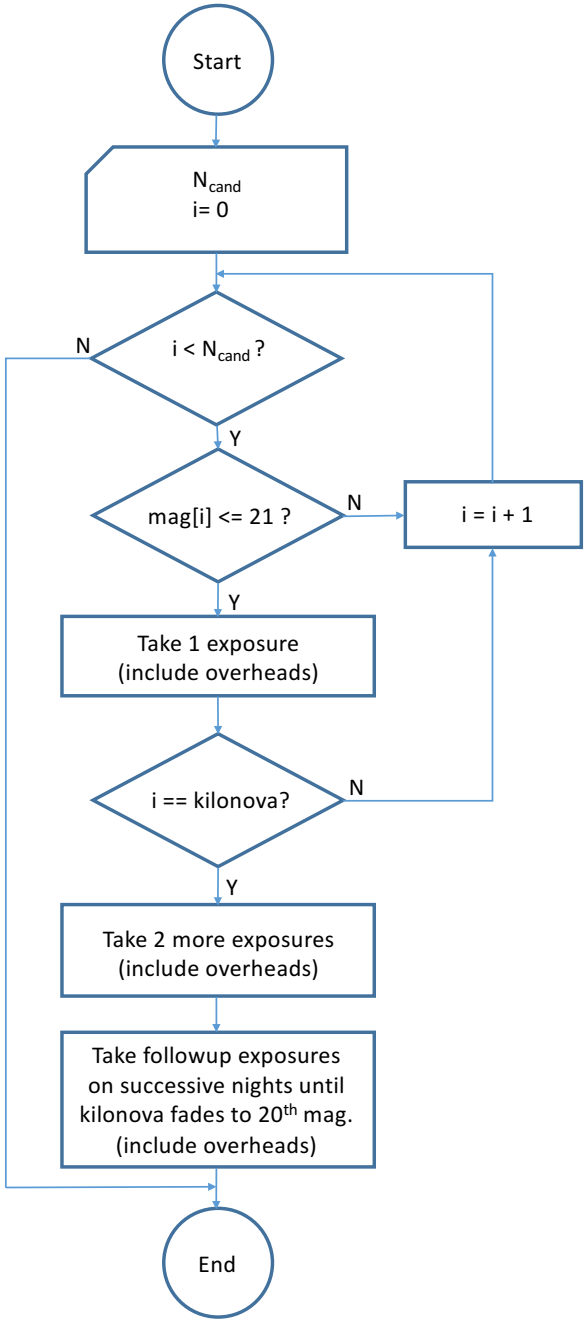
- Set up Instrument Parameters for your science program
  - Set mask $\longrightarrow$ e.g. 1.00″ Slit
  - Set Readout speed $\longrightarrow$ e.g. 200 kKz, ATTN 2
  - Set CCD ROI Mode $\longrightarrow$ e.g. Spectroscopy 2x2
  - Set Grating $\longrightarrow$ e.g. SYZY_400
  - Set Correct Mode $\longrightarrow$ e.g. 400WD
- Take Comparison Lamps
  - Turn ON Lamps e.g. HgArNe
  - Let the Telescope Astronomer know you want to take a Comparison Arc
  - Take 1 image - Verify Good then take 5 more
  - Let the Telescope Astronomer know you have finished with the Comp Arcs
  - Turn OFF Lamps

- Take Quartz Flats
  - Set Intensity to 100 %
  - Turn Quartz Lamp **ON**
  - Set Exp. Time: 1.0 sec
  - Verify good image in IRAF before continuing
    - display quartz.fits 1
    - implot quartz.fits 480
  - Take 50 more exposures
- Take Bias Images
  - Remember to turn Quartz Lamp **OFF**
  - Update File Name Base to bias
  - Take 50 exposures

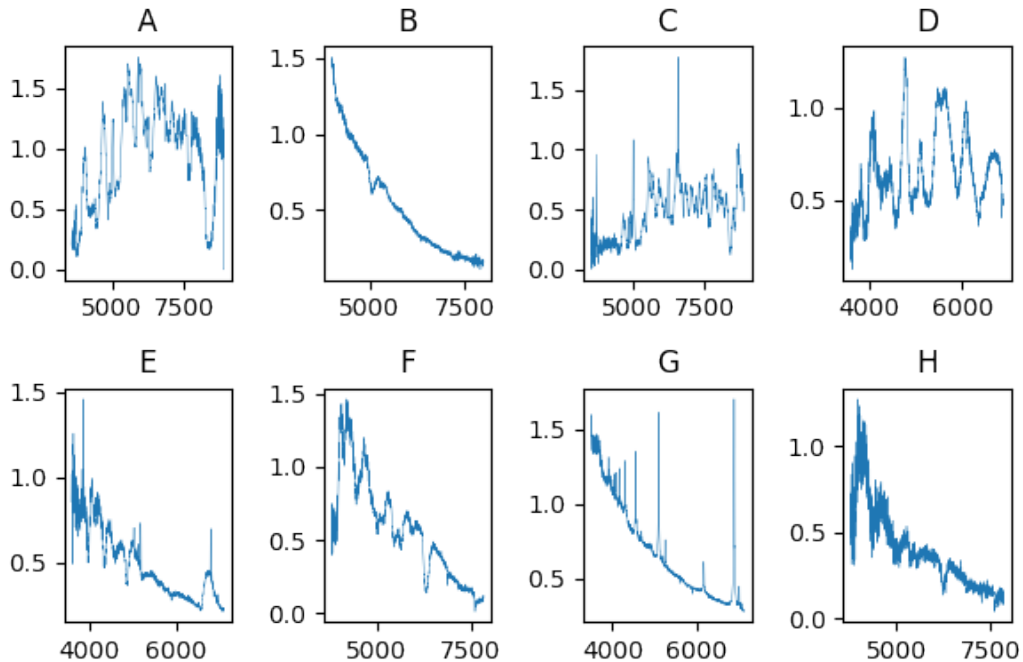
NOTE: Verify the bottom right of GUI says ARM IN or ARM OUT
→ If not restart GACAM GUI.

- Click the Withdraw Mask button to remove the mask from the optical path.
- Within GACAM GUI place the ARM IN
- Click on Control ⟶ Offsets to Open Offset Window
- Click on Exposure ⟶ Exposure to Open Exposure Window
- Click on Scale ⟶ User MinMax to display Scaling window
- Right click ⟶ Check Show Cross-Hair ⟶ UnCheck Lock Cross-Hair
- Drag to move cross hair to center it vertically over center of slit
- Right click ⟶ Check Lock Cross-Hair
- Center Target in Cross-Hair
  - Place ARM IN
  - Take OUT Mask
  - Center Object in cross hair
    - Click on center of object.
    - Click COMPUTE in Offset Window
    - Click APPLY in Offset Window
    - Repeat last 3 steps until Object in center of Cross-Hair
  - Place Mask IN
  - If target is visible in slit then Take ARM OUT
  - OBSERVE !!

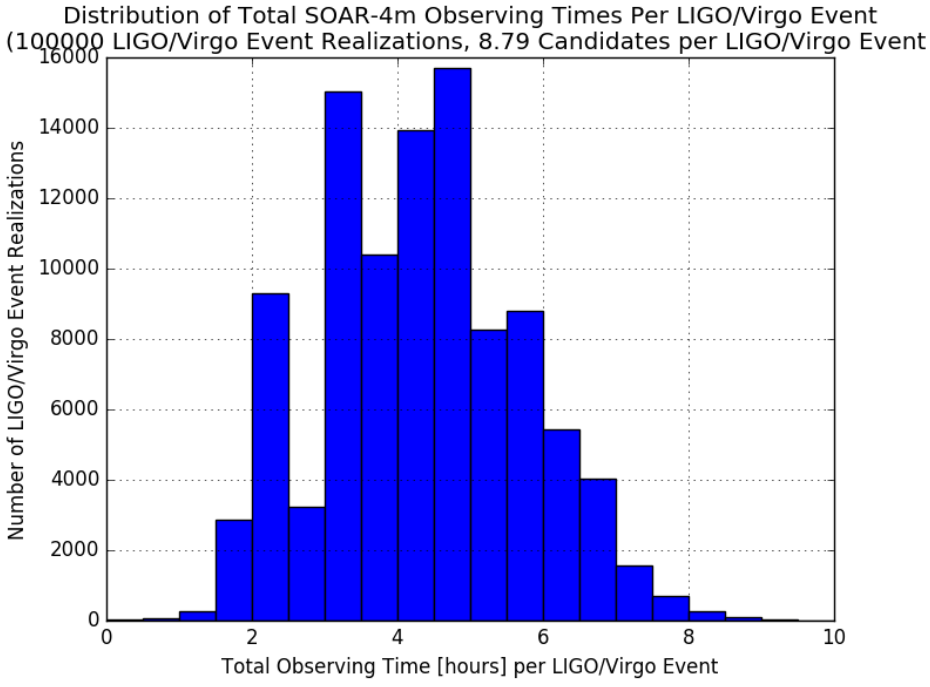
- Instrument Configuration
  - Grating $\longrightarrow$ 400 1/mm
  - Order $\longrightarrow$ 1st
  - Slit $\longrightarrow$ $1.0''$
  - Atmosphere disp. corr.: $\longrightarrow$ Yes
- GW Candidate Identifications
  - Standard Star $\longrightarrow$ **YES**
  - Exposure Time
    - $i \leq 19 \longrightarrow$ 900 sec
    - $i \sim 20 \longrightarrow$ 1200 sec
    - $i \sim 21 \longrightarrow$ 1800 sec
  - # of Exposures
    - For initial identification $\longrightarrow$ 1 exposure per Candidate
    - Only if identified as a kilonova $\longrightarrow$ 2 additional exposures



Left: A simplified flow-chart for a single realization of a simulated SOAR follow-up of a single GW event, where Ncand is the total number of candidates from an imaging search & discovery program. For the simulations here, Ncand is either 8 or 9, but averages overall to 8.79.

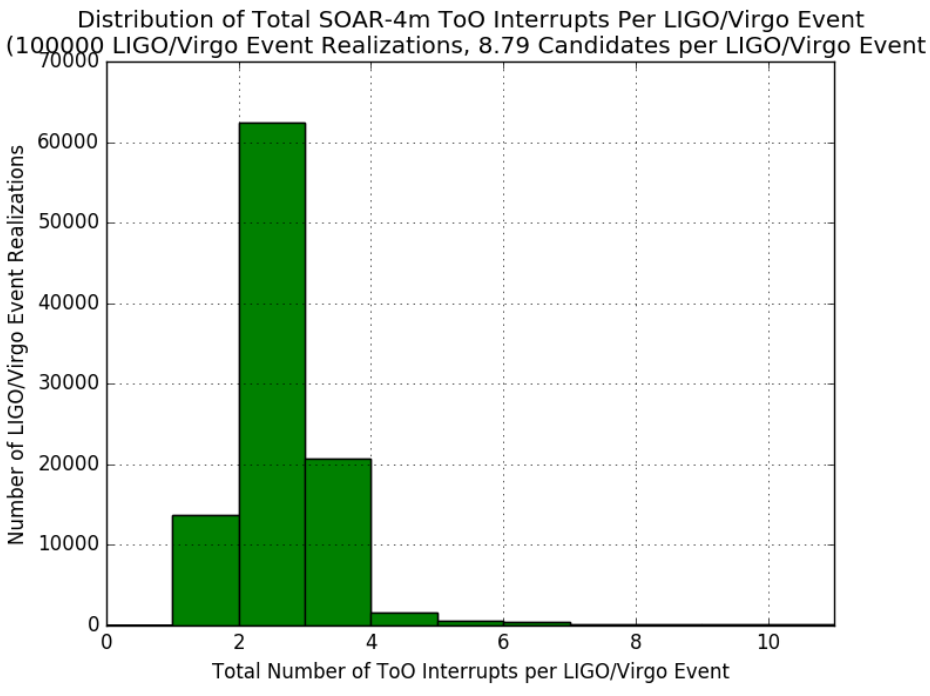


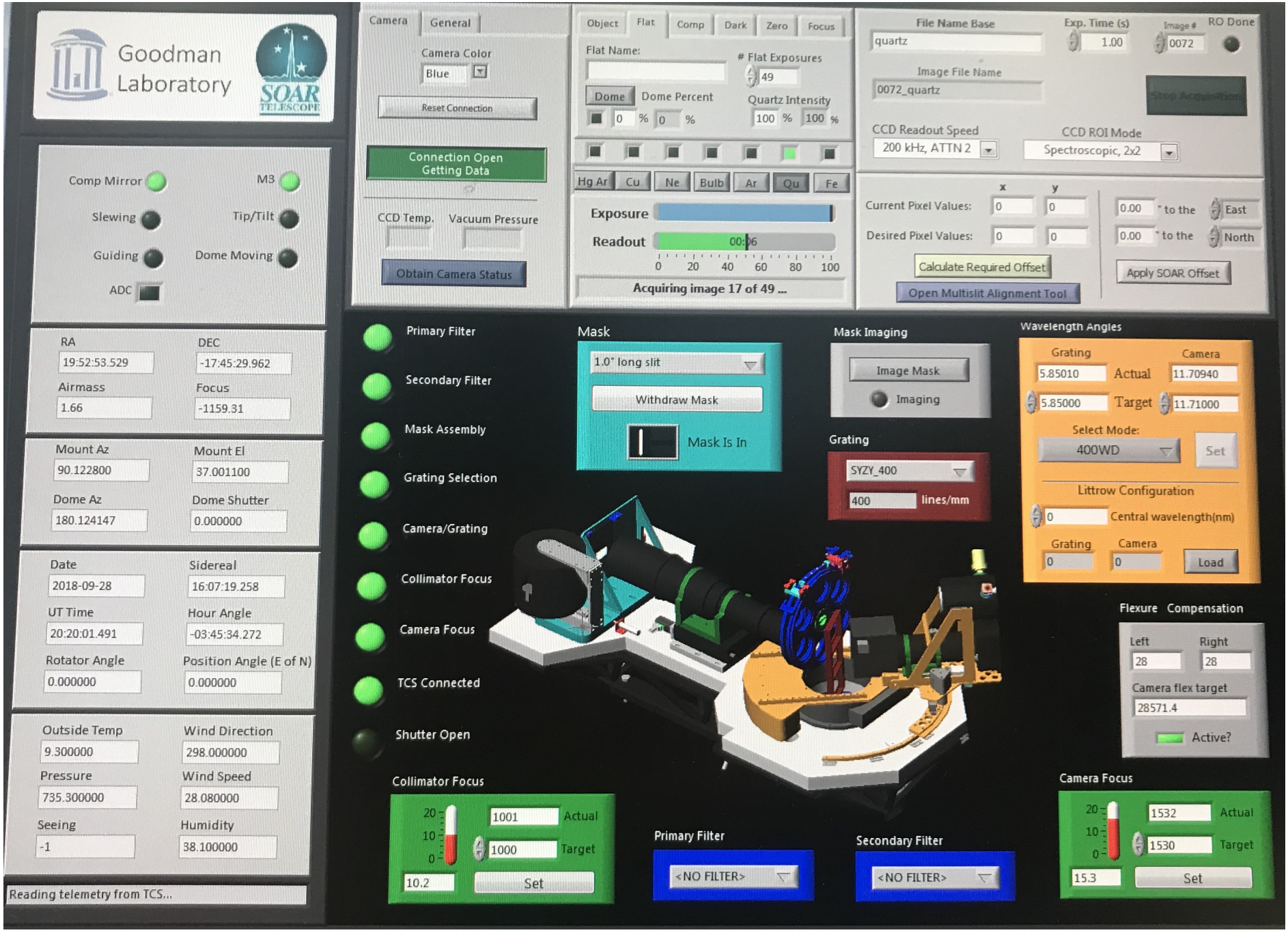
Above: Examples of SOAR spectra from an as- sortment of SNe: A=2010as (Ib/c), B=2015L (I-p), C=2010ae (Ia-p), D=2016bro (Ia), E=2018nw (II), F=2018po (Ia), G=2017ijn (IIn), H=2017hvt (Ia).



Left: Results of the simulation (using 100,000 realizations): histogram of the total durations of SOAR ToO interrupt time [in hours] for a single LVO O3 event.

Right: Results of the simulation (using 100,000 realizations): histogram of the total number of SOAR ToO interrupts for a single LVO O3 event. (Note that the number of interrupts does not scale exactly as the total duration of interrupt time, since the number of hours per interrupt will vary between the "search & discovery" phase and the follow-up phase of the observations for a given kilonova event.)




Goodman Laboratory
SOAR TELESCOPE
Camera
General
Camera Color
Blue
Reset Connection
Connection Open
Getting Data
CCD Temp.
Vacuum Pressure
Obtain Camera Status
Object
Flat
Comp
Dark
Zero
Focus
Flat Name:
Flat Exposures
49
Dome
Dome Percent
Quartz Intensity
Hg Ar
Cu
Ne
Bulb
Ar
Qu
Fe
Exposure
Readout
00:06
Acquiring image 17 of 49 ...
File Name Base
quartz
Exp. Time (s)
1.00
Image #
0072
RO Done
Image File Name
0072_quartz
Stop Acquisition
CCD Readout Speed
200 kHz, ATTN 2
CCD ROI Mode
Spectroscopic, 2x2
Current Pixel Values:
Desired Pixel Values:
Calculate Required Offset
Open Multislit Alignment Tool
to the East
to the North
Apply SOAR Offset
Comp Mirror
M3
Slewing
Tip/Tilt
Guiding
Dome Moving
ADC
RA
19:52:53.529
DEC
-17:45:29.962
Airmass
1.66
Focus
-1159.31
Mount Az
90.122800
Mount El
37.001100
Dome Az
180.124147
Dome Shutter
0.000000
Date
2018-09-28
Sidereal
16:07:19.258
UT Time
20:20:01.491
Hour Angle
-03:45:34.272
Rotator Angle
0.000000
Position Angle (E of N)
0.000000
Outside Temp
9.300000
Wind Direction
298.000000
Pressure
735.300000
Wind Speed
28.080000
Seeing
-1
Humidity
38.100000
Reading telemetry from TCS...
Primary Filter
Secondary Filter
Mask Assembly
Grating Selection
Camera/Grating
Collimator Focus
Camera Focus
TCS Connected
Shutter Open
Mask
1.0" long slit
Withdraw Mask
Mask Is In
Mask Imaging
Image Mask
Imaging
Grating
SYZY_400
400
lines/mm
Wavelength Angles
Grating
Camera
5.85010
Actual
11.70940
5.85000
Target
11.71000
Select Mode:
400WD
Set
Littrow Configuration
0
Central wavelength(nm)
Grating
Camera
0
0
Load
Flexure Compensation
Left
Right
28
28
Camera flex target
28571.4
Active?
Collimator Focus
1001
Actual
1000
Target
10.2
Set
Primary Filter
<NO FILTER>
Secondary Filter
<NO FILTER>
Camera Focus
1532
Actual
1530
Target
15.3
Set