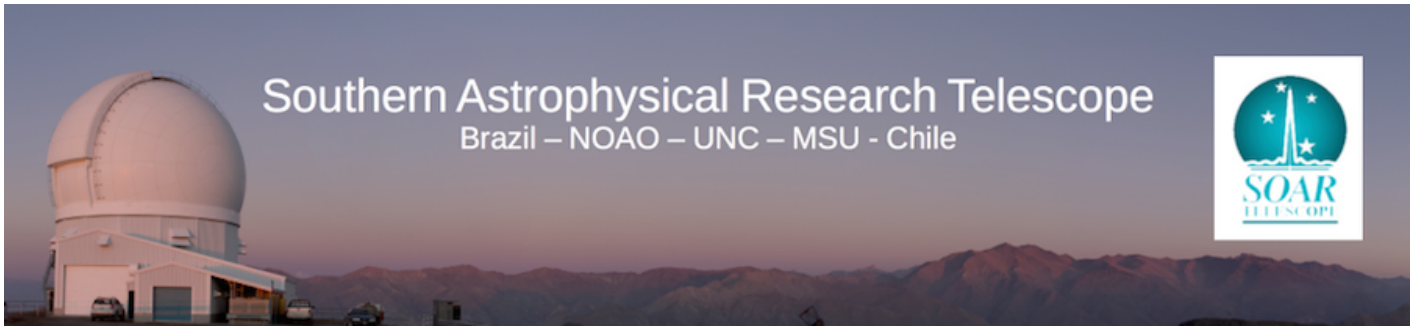

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SOAR AEON Home Page

What is AEON?

Updated September 13, 2019

The Astronomical Event Observatory Network (AEON) is a facility ecosystem for accesible and efficient follow up of astronomical transients and Time Domain science. At the heart of the network, Las Cumbres Observatory [1] has joined forces with the NOAO [2] and the SOAR 4.1m [3] and Gemini 8m [4] telescopes to build such a network for the LSST [5] era. SOAR is the pathfinder facility for incorporating the 4m and 8m class telescopes into AEON.

After successful testing SOAR and NOAO have offered AEON-mode observations for the 2019B in shared-risk mode to a number of approved programs that would potentially benefit from this new operation scheme. **For 2020A, this mode is also being offered to other SOAR partners**; interested Chilean and Brazilian observers should consult the respective calls for proposals.

AEON brings a new observing mode for SOAR: a highly automated observing queue run with minimal human intervention. At present, guide star acquisition, and the on-slit acquisition of the science target (for spectroscopic observations), are the only tasks done manually. As has always been the case, Telescope Operators also assess the observing conditions and have the authority and means to start/stop the AEON-queue based on weather or because of technical reasons. Other than these, the AEON-queue on SOAR is created automatically by a scheduler software at Las Cumbres Observatory which takes all requests submitted by the various program PIs, and sorts them according to a number of parameters, which include (but not limited to) position on the sky, distance to the Moon and airmass constraints, SOAR minimum and maximum elevation limits, time window specified in the observing request,

Supported Configurations

SOAR AEON Configuration for 2019B: Goodman High Throughput Spectrograph (GHTS) + red camera

- Two low-resolution spectroscopic modes (R~900):
    - 400M1: 400 l/mm grating, 300-700 nm, 1” slit, 2x2 binning
    - 400M2: 400 l/mm grating, 500-900 nm, 1” slit, 2x2 binning
- One hi-resolution mode (R~12000): 2100 l/mm grating, 0.45” slit, centered @ 650nm (63nm coverage), 1x1 binning
- Imaging Mode: 2x2 binning, SDSS-g, r, i filters and the VR wide filter
- Atmospheric Dispersion Corrector (ADC) always IN
- Guide Star and on-slit target acquisition: manual
- Calibrations: scripted, ran every afternoon by SOAR staff. Publicly available at the LCOGT Observation Portal.

SOAR AEON Configuration for 2020A: Goodman High Throughput Spectrograph (GHTS)

We will support both the red and blue cameras, but only one on any given night.

Supported red camera configurations:

- Two low-resolution spectroscopic modes (R~900):
    - 400M1: 400 l/mm grating, 300-700 nm, 1” slit, 2x2 binning
    - 400M2: 400 l/mm grating, 500-900 nm, 1” slit, 2x2 binning
- Two medium-resolution modes (R~1400):
    - 600Mid: 600 l/mm grating, 435-702 nm, 1” slit, 2x2 binning
    - 600Red: 600 l/mm grating, 630-893 nm, 1” slit, 2x2 binning
- Two high-resolution modes (two gratings):
    - (R~2900): 1200 l/mm grating, 1” slit, 2x2 binning, 575-700 nm
    - (R~12000): 2100 l/mm grating, 0.45” slit, centered @ 650 nm (63 nm coverage), 1x1 binning

Supported blue camera configurations:

- Two low-resolution spectroscopic modes (R~900):
    - 400M1: 400 l/mm grating, 300-700 nm, 1” slit, 2x2 binning
    - 400M2: 400 l/mm grating, 500-900 nm, 1” slit, 2x2 binning

- Three medium-resolution modes (two gratings):
    - (R~1400) 600UV: 600 l/mm grating, 301-569 nm, 1” slit, 2x2 binning
    - (R~1400) 600Blue: 600 l/mm grating, 350-616 nm, 1” slit, 2x2 binning
    - (R~2200) 930 Custom: 600 l/mm grating, 630-893 nm, 1” slit, 2x2 binning

Both cameras:

- Imaging Mode: 2x2 binning, SDSS-g, r, i filters and the VR wide filter
- Atmospheric Dispersion Corrector (ADC) always IN
- Guide Star and on-slit target acquisition: manual
- Calibrations: scripted, ran every afternoon by SOAR staff. Publicly available at the Las Cumbres Observation Portal.

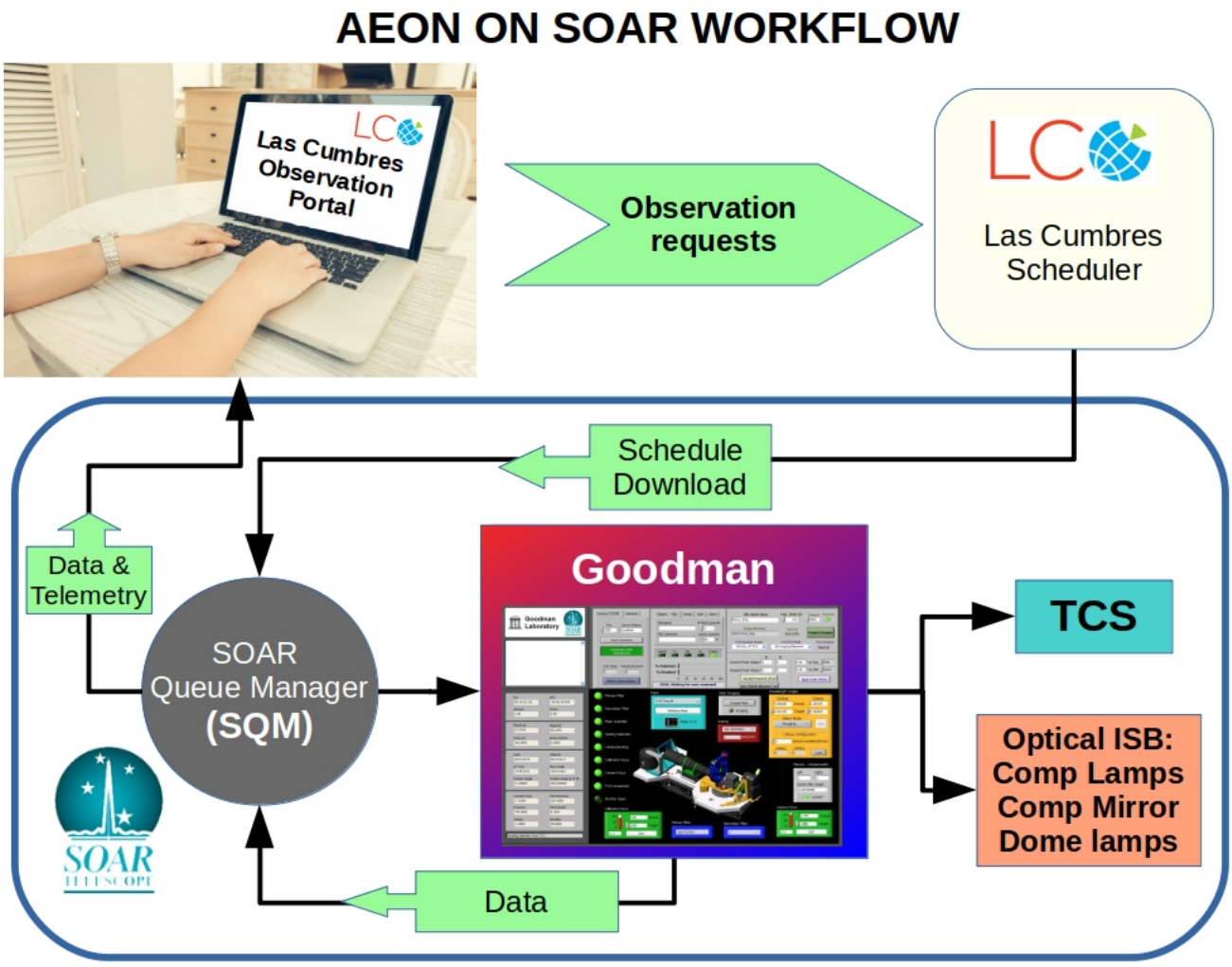
The cameras will be scheduled according to demand. Because up to 4 gratings are possible for the red camera, on any given night only 3 of the 4 will be available. Again, the choice will be based on demand, but we expect that the 400 l/mm grating will always be present.

Scheduling

For both 2019B and 2020A, all proposals included in the queue are given equal priority, but must be above the TAC cut-off for classical observing. The queue is filled at 100%, i.e., if the the approved proposals comprise N hours of observing time, the queue nights during the semester add up to N hours also. We will assess our experience prior to 2020A (and request user feedback!), in particular whether it would be advantageous to have a lower queue fill factor (thus ensuring higher completion rates but fewer programs).

Cadence

For the 2019B semester, we were able to schedule 3-4 nights/month, which meant we could support a cadence of roughly an observation every two weeks. We were also able to support programs requiring observations over a period of a few nights, but no longer. We anticipate being able to support similar cadences in 2020A, but it is unlikely we can support nightly cadences for more than a few days in a row.



[6]

Observing with AEON on SOAR

Astronomers can request observations either through the Las Cumbres Observation Portal [7], or via standardized, *programmable* interfaces, using established APIs, supported by the Target Observation Manager (TOM) Toolkit [8].
The scheduler software runs continuously, and will respond to new observation requests within 15min. This means that the sequence of observations for a given night can be dynamic and evolve over time.

Users can manage all aspects of their observing programs, including observation requests, by creating an account [9] with the Observation Portal [10].

Once time is awarded, users will find that their active proposals are listed under the 'Manage Proposals' tab and they will be able to request observations. The time needed to execute an observation is debited automatically from the relevant proposal, but only once each observation is completed. If a request cannot be scheduled, no time is debited.

Observations can be requested by filling out the observation request form [11], or programmatically by submitting a request to our API. **We strongly encourage users to read the Las Cumbres**

Observatory Getting Started Guide, available from their Documentation [12] page; it describes the procedure step-by-step. Detailed information on using the APIs can be found at the Las Cumbres Observatory developer's pages [13].

Monitoring Your Observing Program

The homepage of a user's Observation Portal [10] will show a list of all of the observations they have requested. Clicking on any observation will display more information on each component of the request, including a wealth of information on its scheduling status, the target visibility, and any data obtained - all updated in real-time. The Getting Started Guide [14] describes the available information in more detail. You can also find information on the status of telescopes in the network [15].

Accessing and Reducing Your Data

When observations are completed, the raw Goodman data products are transferred automatically and made available through both the Las Cumbres Observatory Archive [16] and the NOAO Archive [17]. Both archives provide the means for users to download the data products.

The SOAR Team has developed a data reduction pipeline for Goodman data. Full details are provided on the pipeline website [18].

Where to get help

For assistance with composing observation requests, or for information on AEON-SOAR operations, users can contact Las Cumbres Observatory's Science Support team by emailing science-support@lco.global [19]. For questions about the SOAR telescope, the Goodman spectrograph and the Goodman data reduction pipeline, please contact Cesár Briceño (cbriceno@ctio.noao.edu [20]).

```
Available nights
2019-08-06 23:06:38.690652+00:00    to  2019-08-07 10:30:38.503345+00:00
2019-08-10 23:08:40.097465+00:00    to  2019-08-11 10:27:29.905463+00:00
2019-08-23 23:15:10.909551+00:00    to  2019-08-24 10:15:21.029866+00:00
2019-09-04 23:21:14.430040+00:00    to  2019-09-05 10:02:01.209422+00:00
2019-09-06 23:22:16.003326+00:00    to  2019-09-07 09:59:38.593001+00:00
2019-09-22 23:30:56.599103+00:00    to  2019-09-23 09:39:37.510664+00:00
2019-09-23 23:31:31.706613+00:00    to  2019-09-24 09:38:20.361082+00:00
2019-10-05 23:39:06.569556+00:00    to  2019-10-06 09:22:55.154176+00:00
2019-10-08 23:41:10.970627+00:00    to  2019-10-09 09:19:07.178840+00:00
2019-10-20 23:50:19.282703+00:00    to  2019-10-21 09:04:33.703162+00:00
2019-11-03 00:01:48.624925+00:00    to  2019-11-03 08:50:47.516957+00:00
2019-11-20 00:18:33.150031+00:00    to  2019-11-20 08:37:55.681869+00:00
2019-11-30 00:28:23.529062+00:00    to  2019-11-30 08:34:06.715275+00:00
2019-12-04 00:32:05.343465+00:00    to  2019-12-04 08:33:29.093155+00:00
2019-12-16 00:41:34.143108+00:00    to  2019-12-16 08:34:49.788415+00:00
2019-12-19 00:43:26.535948+00:00    to  2019-12-19 08:35:55.011550+00:00
2019-12-20 00:44:00.872538+00:00    to  2019-12-20 08:36:20.616578+00:00
2020-01-03 00:48:54.041804+00:00    to  2020-01-03 08:45:18.917362+00:00
2020-01-20 00:46:15.538793+00:00    to  2020-01-20 09:01:23.340225+00:00
2020-02-01 00:39:09.361744+00:00    to  2020-02-01 09:13:57.096247+00:00
```

[21]Calendar of SOAR AEON nights for 2019B

Start and end times at right are UT

Month	Nights
August 2019	6, 10, 23
September 2019	4, 6, 22, 23
October 2019	5, 8, 20
November 2019	2, 19, 29
December 2019	3, 15, 18, 19
January 2020	2, 19, 31

Contact details

Las Cumbres Observatory Project Scientist: Rachel Street, rstreet@lco.global [22]

NOAO Project Scientist: Stephen Ridgway, sridgway@noao.edu [23]

SOAR Project Scientist: César Briceño, cbriceno@ctio.noao.edu [20]

Gemini Project Scientist: Bryan Miller, bmiller@gemini.edu [24]

Links to AEON partner pages: LCOGT [25], NOAO [26]

AEON is a collaboration between Las Cumbres Observatory SOAR, Gemini and NOAO. The AEON Team gratefully acknowledges funding from the NSF.

Links
[1] http://lco.global/
[2] https://www.noao.edu/
[3] http://www.ctio.noao.edu/soar
[4] http://www.gemini.edu/
[5] https://www.lsst.org/
[6] http://www.ctio.noao.edu/soar/sites/default/files/images/AEON/aeon_on_soar_workflow.jpg
[7] https://observe.lco.global/
[8] https://lco.global/tomtoolkit/
[9] https://observe.lco.global/accounts/register/
[10] https://lco.global/observe/
[11] https://observe.lco.global/create/
[12] https://lco.global/documentation/
[13] https://developers.lco.global/
[14] https://lco.global/documents/55/GettingStartedontheLCONetwork.latest.pdf
[15] https://lco.global/observatory/status/
[16] https://archive.lco.global/
[17] http://archive.noao.edu/
[18] http://www.ctio.noao.edu/soar/content/goodman-data-reduction-pipeline
[19] mailto:science-support@lco.global
[20] mailto:cbriceno@ctio.noao.edu
[21] http://www.ctio.noao.edu/soar/sites/default/files/images/AEON/soar-2019b-observing-nights.png
[22] mailto:rstreet@lco.global
[23] mailto:sridgway@noao.edu
[24] mailto:bmiller@gemini.edu
[25] https://lco.global/aeon/
[26] http://ast.noao.edu/data/aeon