

Observer's Guide to LDT Startup Procedures

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Because the LDT is a complex modern facility, startup at the beginning of the night can take a while. The purpose of this page is to provide a guide for the observer about what steps occur at the start of the night, and at what point different observer tasks may be done.

<Maybe add a reminder to observers that before they do anything that impacts the site they must be in touch with the staff on site.>

LDT Facility Start Up

- **TO responsibilities**
 - The TO(s) will start up the facility starting 1 to 1.5 hours before sunset. The standard intent is to be ready to operate a little before sunset. If your observing program needs to ready earlier, please communicate this to the TO (ldtoperator at lowell dot edu) and arrange a revised schedule.
 - Start up includes verifying that all LDT systems are in safe and proper working order and then starting up the telescope, active optics, dome, and environmental monitoring systems. During the start up process, the TO may not be immediately available as they have to walk through the site to do the check out.
 - During start up, the TO will make any instrument setup changes that are needed. This includes filter and grating changes.
 - The TO will communicate to the observer when the facility is ready to operate, and will also apprise the observer of any facility or weather concerns that may limit the observer's science time.
- **Observer responsibilities**
 - Observers are generally responsible for starting up the instrument(s) they expect to use during the night. The observer should communicate with the TO about when they can start up the instrument. **<E.g. If an LMI filter change is needed, LMI should not be started up before that is done to avoid the chance of the observer trying to move the filter wheels while the change is being done. TO policy disables the wheels, but just in case.>**

- Once the TO confirms that the facility is operational, the observers can begin taking calibrations. If you need to start calibrations early, please arrange a time with the TO. Some instruments can do calibrations entirely internally (*i.e.*, they do not need to interact with the telescope or facility). In those cases, the observer can start earlier, but MUST still advise the TO about their plans.
- The observer will communicate with the TO about any special setup needs and the general plan for the observing session. This is especially important if the observer has any time-critical observations or quickly setting targets that require getting on-sky promptly.
- Note that any special or unusual setup needs should be communicated at least a day ahead of time to ensure that the staff can fulfill them.

Calibrations

- **Internal Instrument Calibrations (Done by the observer)**
 - Instrument calibration frames that do not require the telescope may be done just about anytime. For instance, CCD biases or NIHTS biases and darks may be done in the afternoon before the TO has completed setting up the telescope for the night's observations.
 - Be sure to contact the TO before starting internal calibrations to ensure their startup tasks do not interfere with your data taking, and that you are not interfering with another observer.
 - Visitor / PI instruments may have internal calibration procedures that are completely separate from the telescope operation and may be done at any time (e.g., EXPRES BON calibrations, which are internal to the EXPRES BEM). **<While EXPRES cals are internal, they still pipe light up into the cube and back down. It shouldn't impact anything else, but it might and they should notify others if they plan to do so.>**
- **Flats / Dome Darks (Coordination between the observer and the TO is required)**
 - Flat field calibrations require the telescope / instrument system to be fully online. Please communicate your flat field needs to the TO early so they may prepare the facility properly.
 - Dome flats (and dome darks for NIR instruments) may be completed in the afternoon well before sunset. The TO will point the telescope at the flat field screen and turn on the appropriate lamps (see your instrument manual for the proper settings).
 - Sky flats require the dome to be open and pointing away from the sun. The TO can point at the Chromey Spot (uniform sky illumination). Sky flats for narrow-band and/or very blue filters may be done before sunset / after sunrise if the dome is properly blocking the telescope from the sun.
- **Facility Calibrations (Done by the TO)**
 - Telescope Pointing Check – The LDT's mount and control system is designed to maintain pointing accuracy within a few arcseconds. The nightly Pointing Check is used to monitor the present performance of the current pointing model and to correct for any small offsets. This task can be done as soon as stars are visible – dark skies are not required for this task. If weather or technical issues have delayed the start of the observing session, the pointing check may be bypassed. In general, the pointing check should take about 5-10 minutes.
 - Wavefront Correction – The LDT's active optics system (AOS) is equipped with a forward-predictive model (WOLM) to maintain mirror figure and optical alignment as a function of mount elevation angle and temperature. The nightly wavefront solution (WFS) provides additive correction atop the WOLM, and may remove up to several tenths of an arcsecond of aberration, in quadrature, from the initial image quality FWHM. Because these aberrations are removed in quadrature, if the seeing is fair to poor (generally FWHM greater than 1.5" - 2.0") the image quality gains provided by performing a WFS may not be noticeable. In general, the wavefront solution should take about 15-20 minutes, depending on sky conditions.

Observing

- **Guiding**
 - The pointing of the LDT is good to several arcseconds, and the tracking drift is typically less than 0.1 arcseconds per minute. The telescope can track unguided within the seeing margin for 5-10 minutes, depending on telescope elevation. If longer exposures are required, the observer may request closed-loop guiding be initiated.
 - Guiding may be initiated either before or after starting an exposure, and generally takes 30-60 seconds for the TO to select and lock onto a guide star. **<Suggest that guiding be initiated before the start of an exposure to avoid any jog in the pointing during the guide locking.>**
 - If you are using a [dither pattern](#), guiding may be used during the entire sequence, but requires additional consideration. Discuss your pattern with the TO so they may select an appropriate guide star in the annulus that will remain visible at all dither positions.