ROLO Facility

Hardware

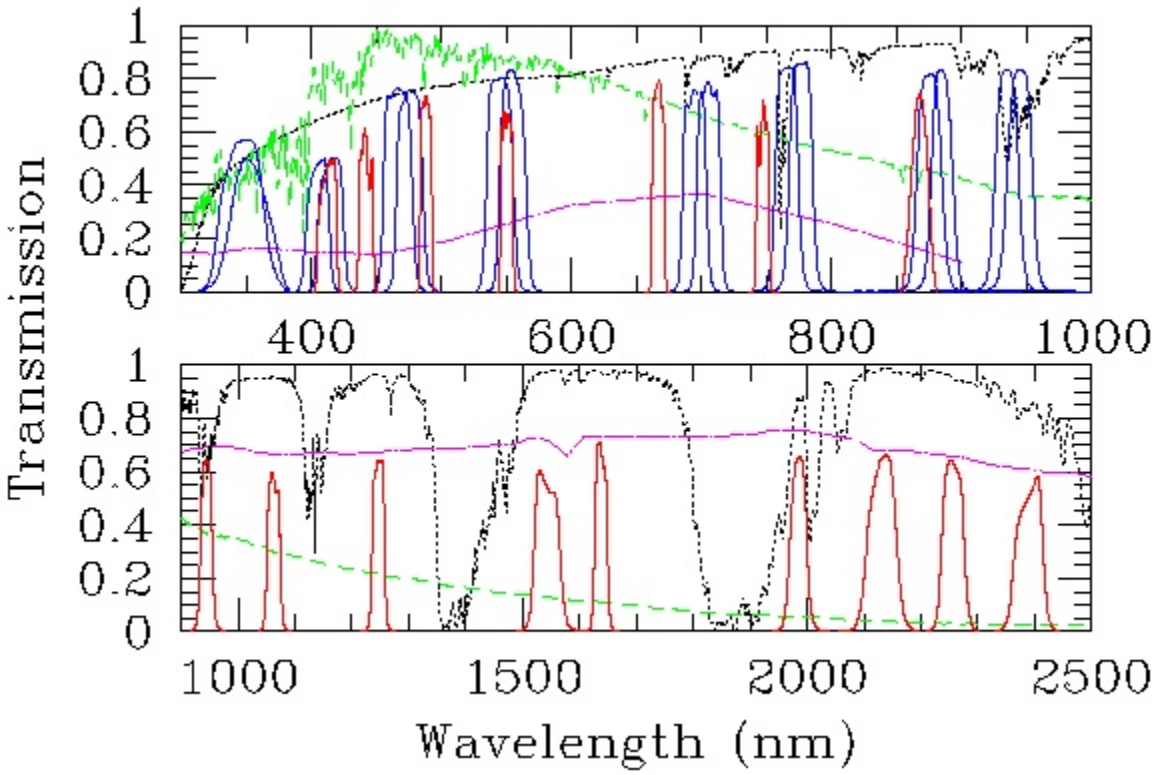
The ROLO facility is located on the campus of the USGS field center in Flagstaff, AZ.

- longitude 111 deg 38’ 5.0” W
- latitude 35 deg 12’ 52.9” N
- altitude 2148 m

The observatory has a roll-off roof, allowing clear access to the entire night sky.

Two nearly identical telescopes are coaligned on a common mount. The telescopes are Ritchey-Chretien optical design with 20 cm diameter primary mirrors; effective focal length is ~1m for both. The VNIR camera is a 512x512 Thomsen TH7895 CCD array. Dual filter wheels hold 23 passband filters spanning 350 to 950 nm, with typical bandwidths 15 to 20 nm. The SWIR camera is a 256x256 HgCdTe array (Rockwell) similar to the NICMOS camera on the Hubble Space Telescope. The SWIR filter wheel has 9 filters spanning 950 to 2350 nm, and a blocked hole for acquiring dark frames.

The ROLO passbands are shown in the figure below. Several wavelengths coincide with typical remote sensing applications, but also included are stellar photometry bands in spectrally adjacent pairs to resolve stellar color trends. For imaging the Moon, a 2.0 optical density neutral density filter is inserted in the optical path by means of a pneumatic actuator. A fused silica glass compensator is in place for star imaging.



Passbands for the two ROLO telescopes. Common remote sensing bands are shown in red; stellar color pairs are blue. Also shown are the detector quantim efficiencies (purple), nominal atmospheric transmission (black), and a normalized solar spectrum (green).

Realtime Systems Control

The data acquisition system is virtually fully automated. A master computer controls two separate computers for the cameras and a third for the telescope mount. At the start of each observing night, the master computer queries an ephemeris program (MICA) and generates an observing sequence for the entire night, including telescope pointing and tracking for each object, the ND filter position, and camera exposure settings for each filter. Wind speed and ambient temperature are recorded from a mini weather station; these are later merged with the image data. The detector readouts are stored on the camera computers until the night's end, when all image data and ancillary pointing and ephemeris information are transferred to a separate archive computer. A paper describing the ROLO realtime system in greater detail is listed in the references.

Operations

For more than 6 years, ROLO operated every clear night from First Quarter through Full Moon to Last Quarter lunar phase. Routine observations of the Moon and stars extended to 30 degrees above the horizon (this zenith angle restriction may limit the ultimate accuracy achievable for extinction correction with the ROLO dataset). Stellar observations accounted for about 70% of observing time when the Moon was accessible, 100% otherwise.

Dark current measurements were acquired at the start and end of each observing night. For detector flatfielding, a spectralon plaque is mounted inside the observatory dome and illuminated with a 1000 Watt FEL lamp (the FEL lamp is calibrated, but this apparatus is no longer used for calibrating the ROLO telescopes). Flatfield observations were acquired 2-3 times during each lunation, or observing “bright run.” Periodic special observations were taken for instrument characterization, such as monitoring the ND filter attenuation, and measuring the thermal background contribution to SWIR images.

Regular observations ceased in September, 2003, at the end of the original NASA contract. The observatory is currently maintained in operable condition for periodic calibration and instrument characterization work.