PACE OCI Lunar Calibration: Initial Results

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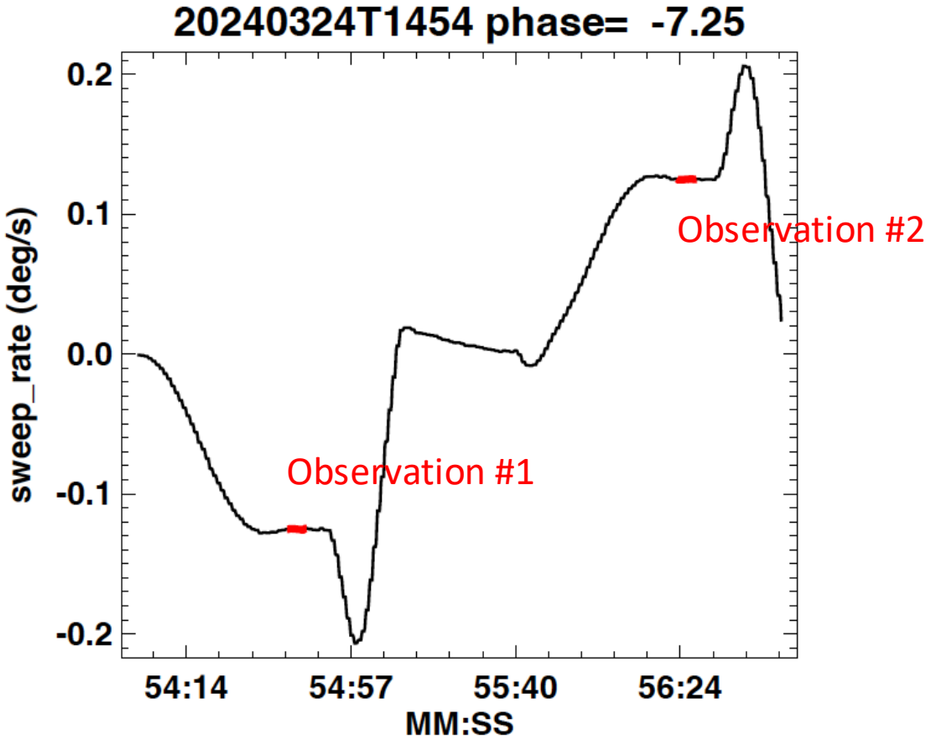
Content

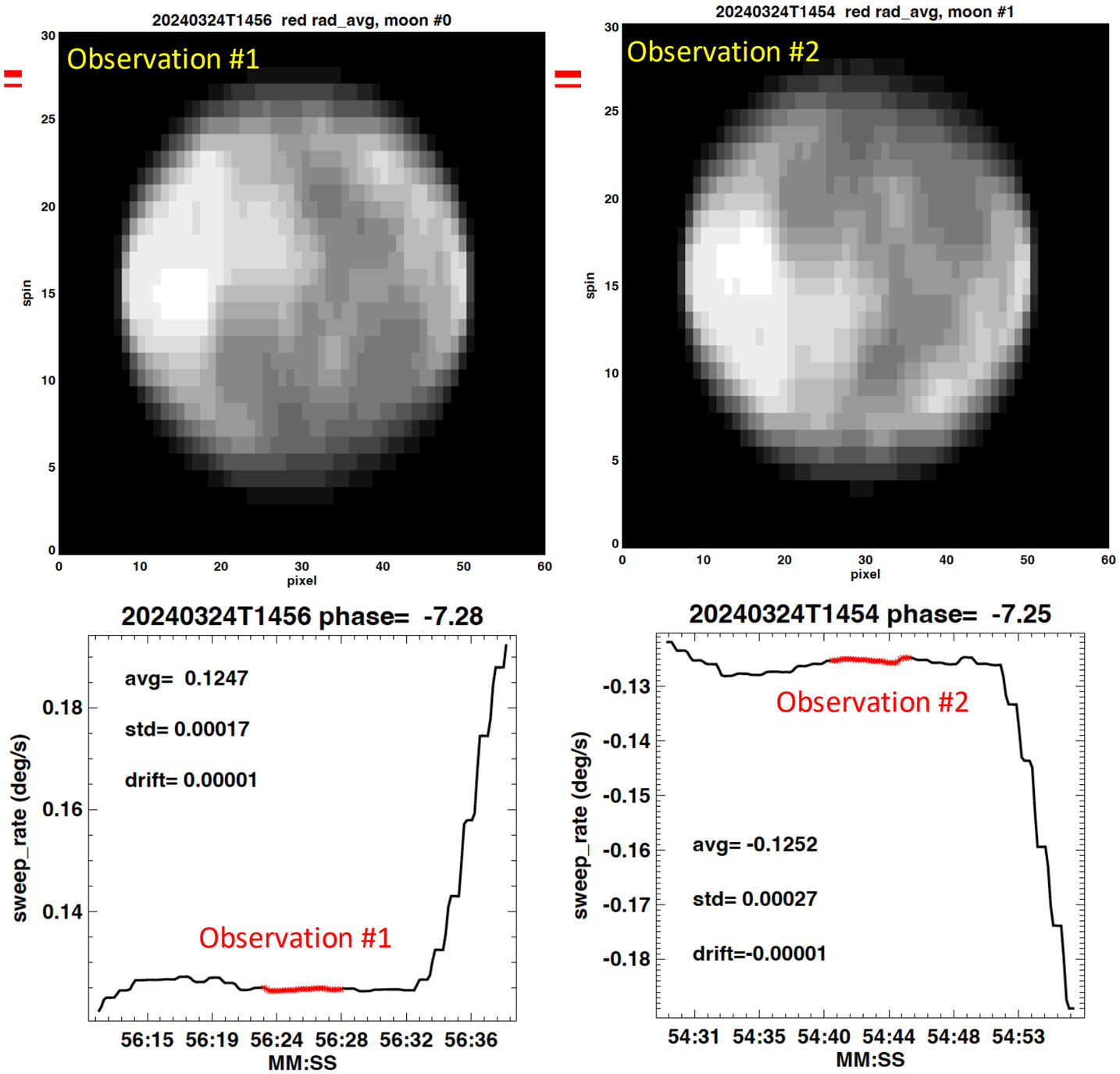
- OCI lunar observation
  - Special attention to maintain constant lunar sweep rates.
  - 2 observations per calibration event
  - +- 7 deg (primary) and other angles (secondary)
- OCI lunar calibration
  - Model: ROLO reflectance + TSIS solar irradiance.
  - OCI: calibrated pixel radiance * ground sampling distance (GSD) (in stead of IFOV)
- Early results:

OCI Lunar Calibration Maneuver



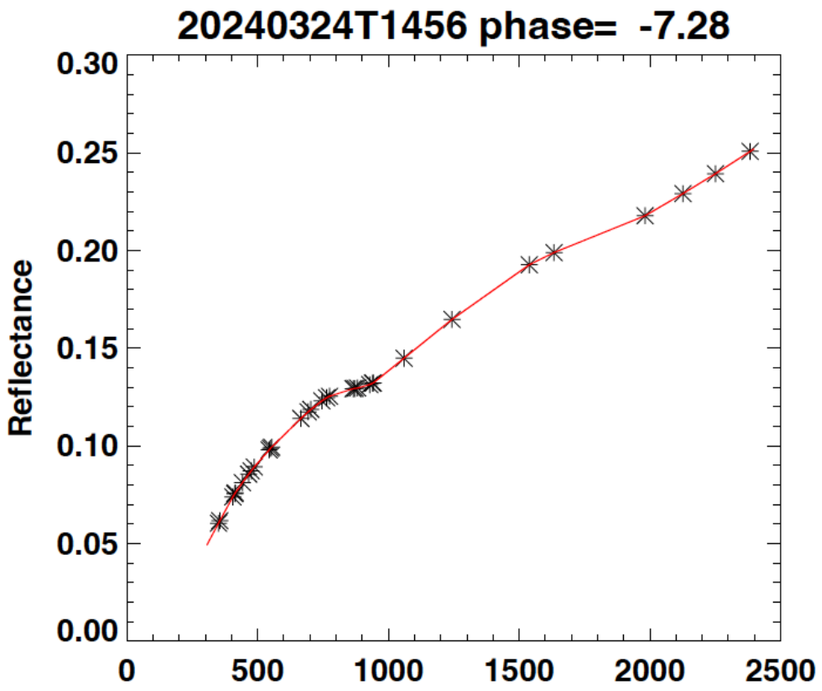
- Left: OCI Lunar observation makes 2 passes to view the moon in the forward and backward directions through a series of spacecraft maneuvers.
- Right: The OCI sweep rate during lunar observation is carefully controlled. The 2 lunar observations are high lighted in red

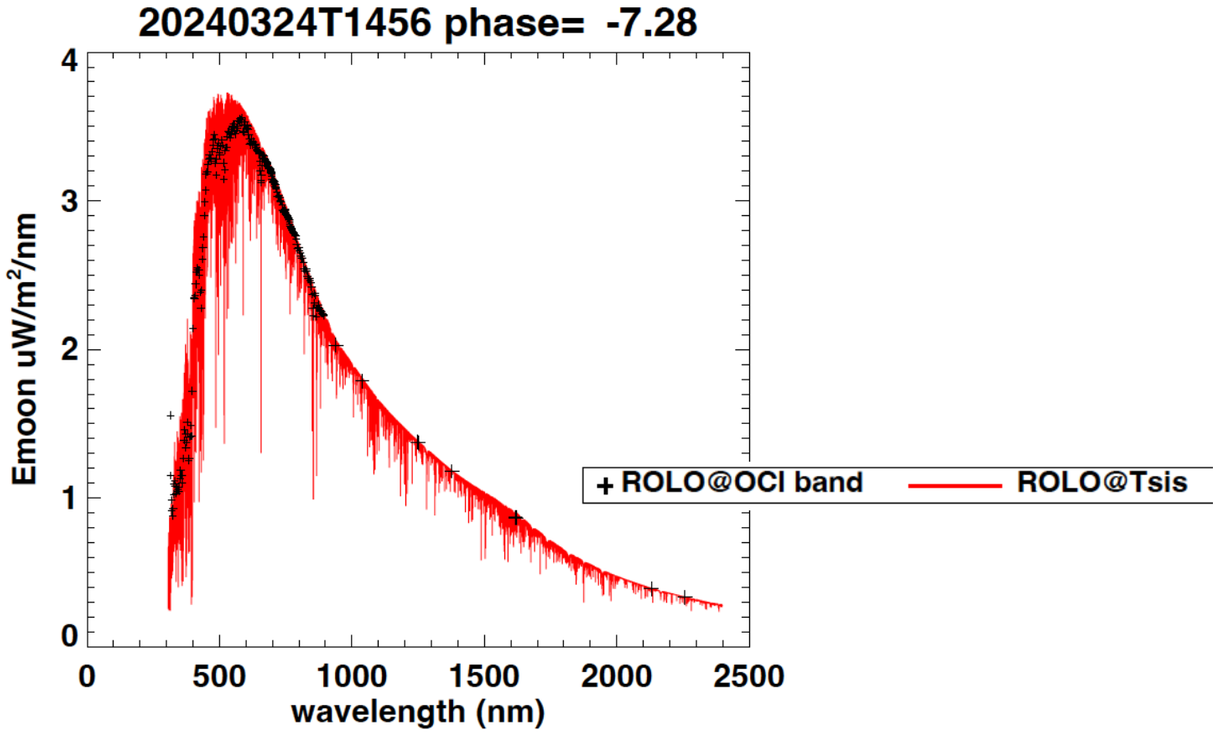
OCI Lunar Observations



- Left: forward observation
- Right: backward observation
- The forward/backward images were mirrored along y-axis (spin).
- Sweep rate: Forward vs. backward observation
- ~0.4 % difference
- std <~0.2%.
- Sweep rate of ~0.125 equals 4x oversampling
- ~5 sec to scan the moon

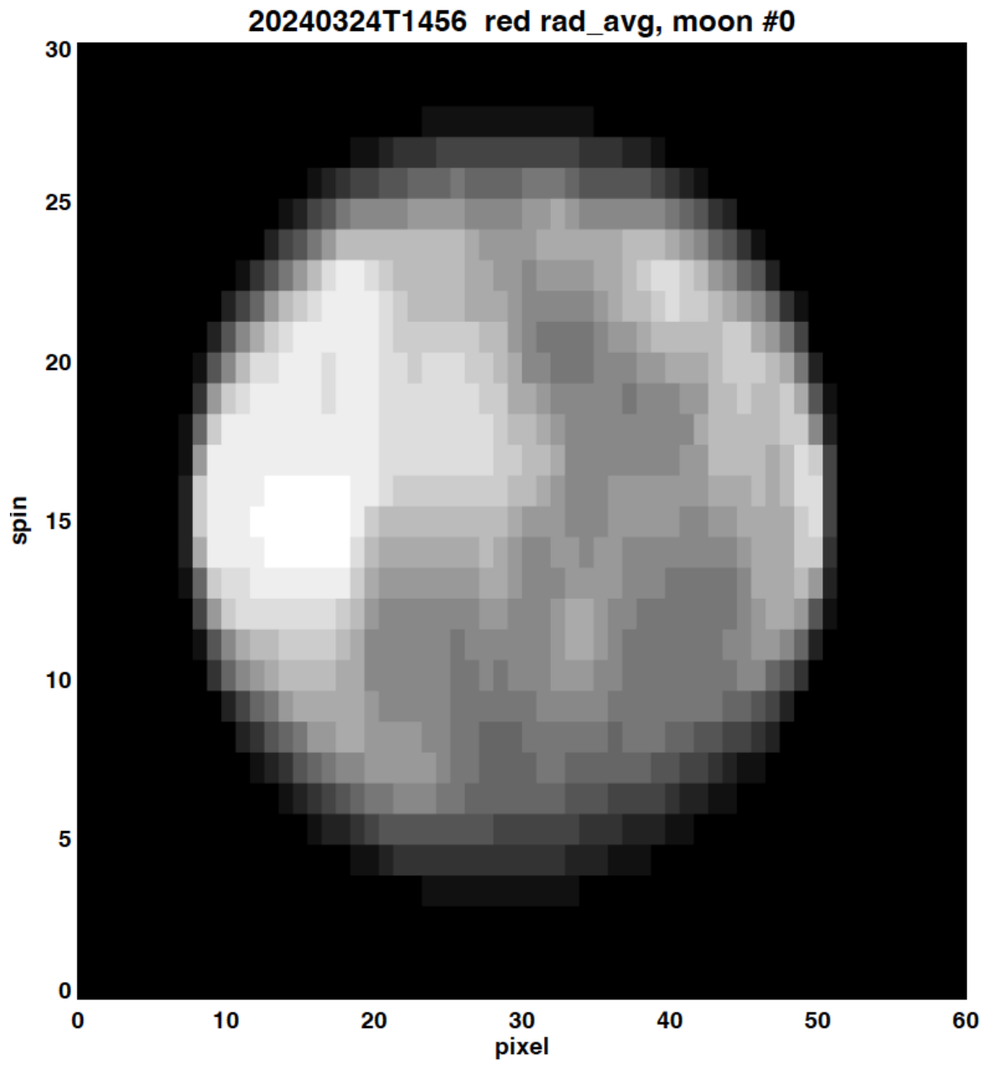
Lunar Irradiance: Model





- Left: ROLO model output reflectance (symbols) and interpolated values (red curve).
- Right: modeled lunar irradiance (Emoon). Interpolated ROLO lunar reflectance*Tsis Esun (red). Estimated Lunar irradiance at each OCI band band (black symbols).
- $E_{moon}(\lambda) = Ref_{rolo}(\lambda) * E_{sun}(\lambda)$
- $E_{moon\_oci}(b) = \int E_{moon}(\lambda) * RSR_{oci}(b,\lambda) / \int RSR_{oci}(b,\lambda)$, b = oci band

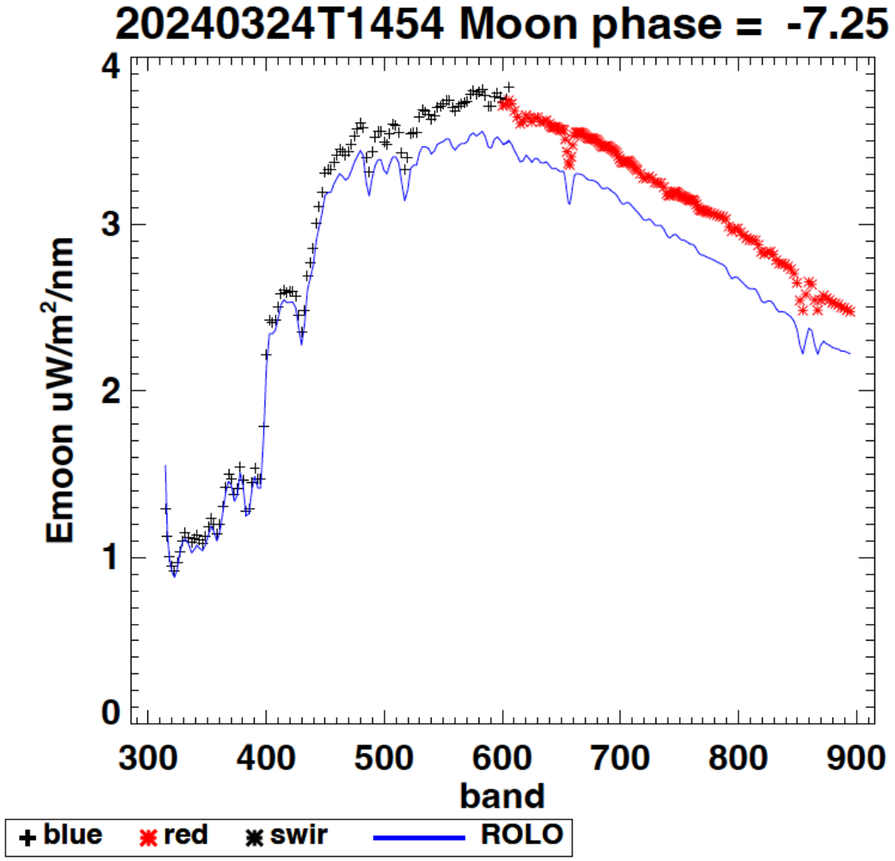
Lunar irradiance: OCI

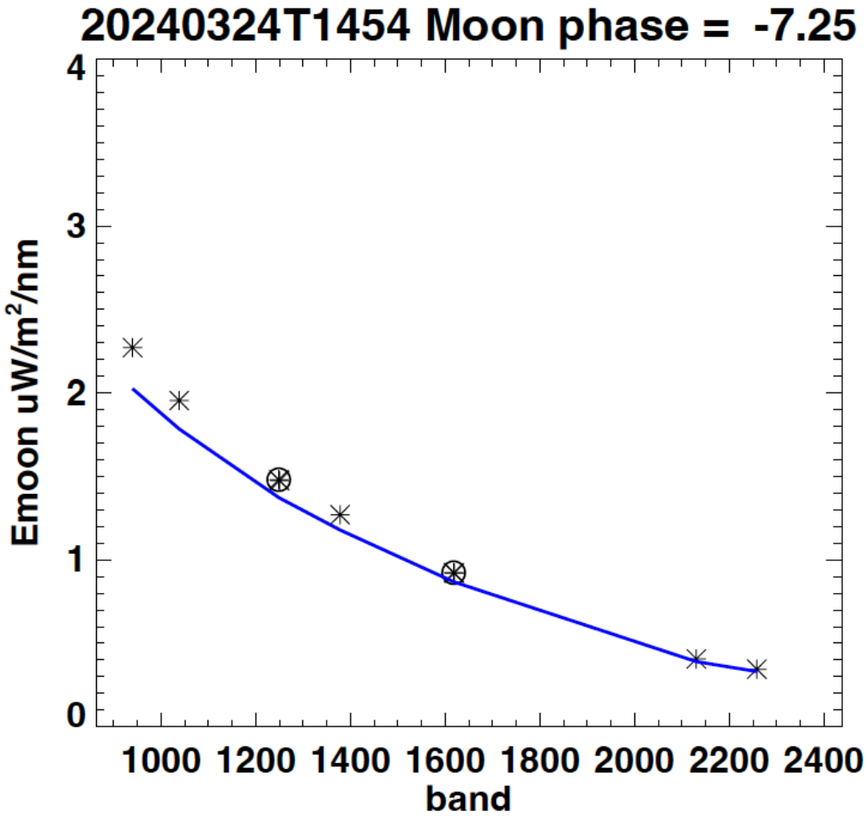


- OCI lunar irradiance = lunar pixel radiance * sampled area (A) defined by Ground Sampling Distant (GSD)

- $E_{oci}(b) = \sum_{i=0}^{n} L_i(b) * A(b)$
  - L_i = calibrated pixel radiance
  - b = OCI band
  - A = pixel sampled area = GSDx*GSDy
  - GSDx: scan direction, prelaunch value
  - GSDy: track direction, spacecraft sweep rate
- GSDy: Knowledge of sweep rate is key to minimize uncertainty

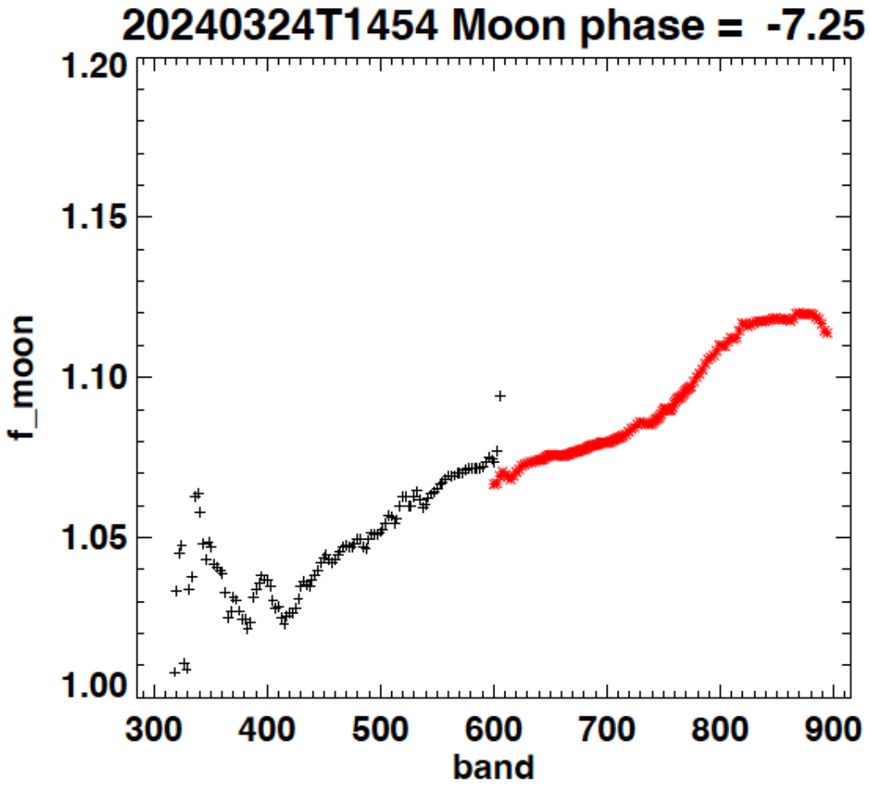
Lunar irradiance: measured vs. modeled

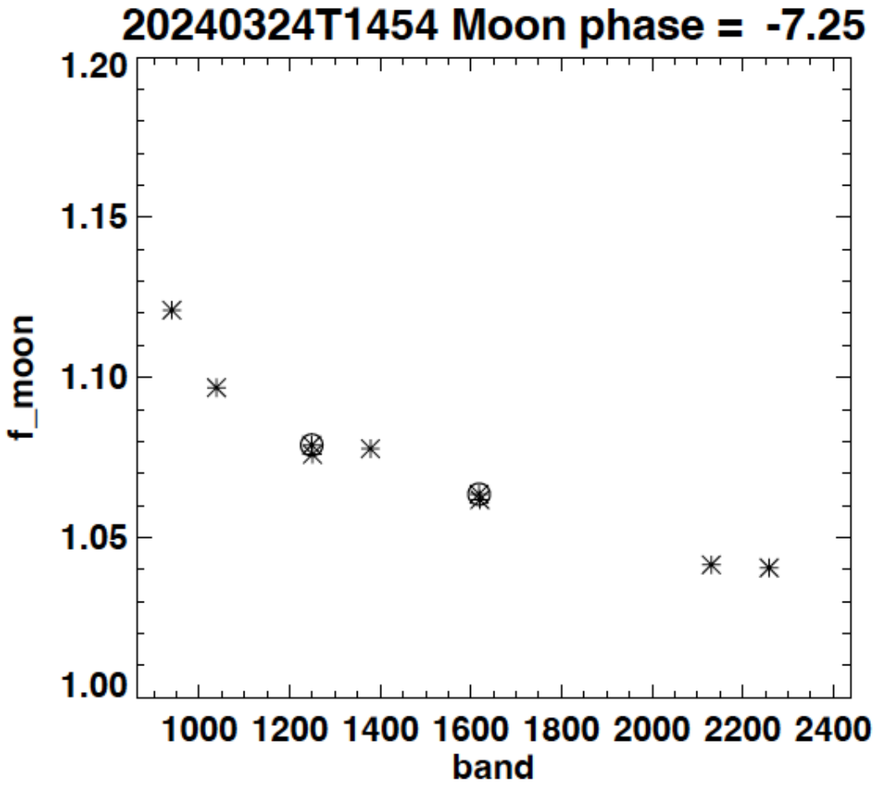




- OCI measured (black) vs. model predicted (blue) lunar irradiance (Emoon).
  - Left: blue and red FPA hyperspectral bands; Right: SWIR bands (high gain bands circled).
- Overall OCI measured lunar irradiances are higher than model predicts

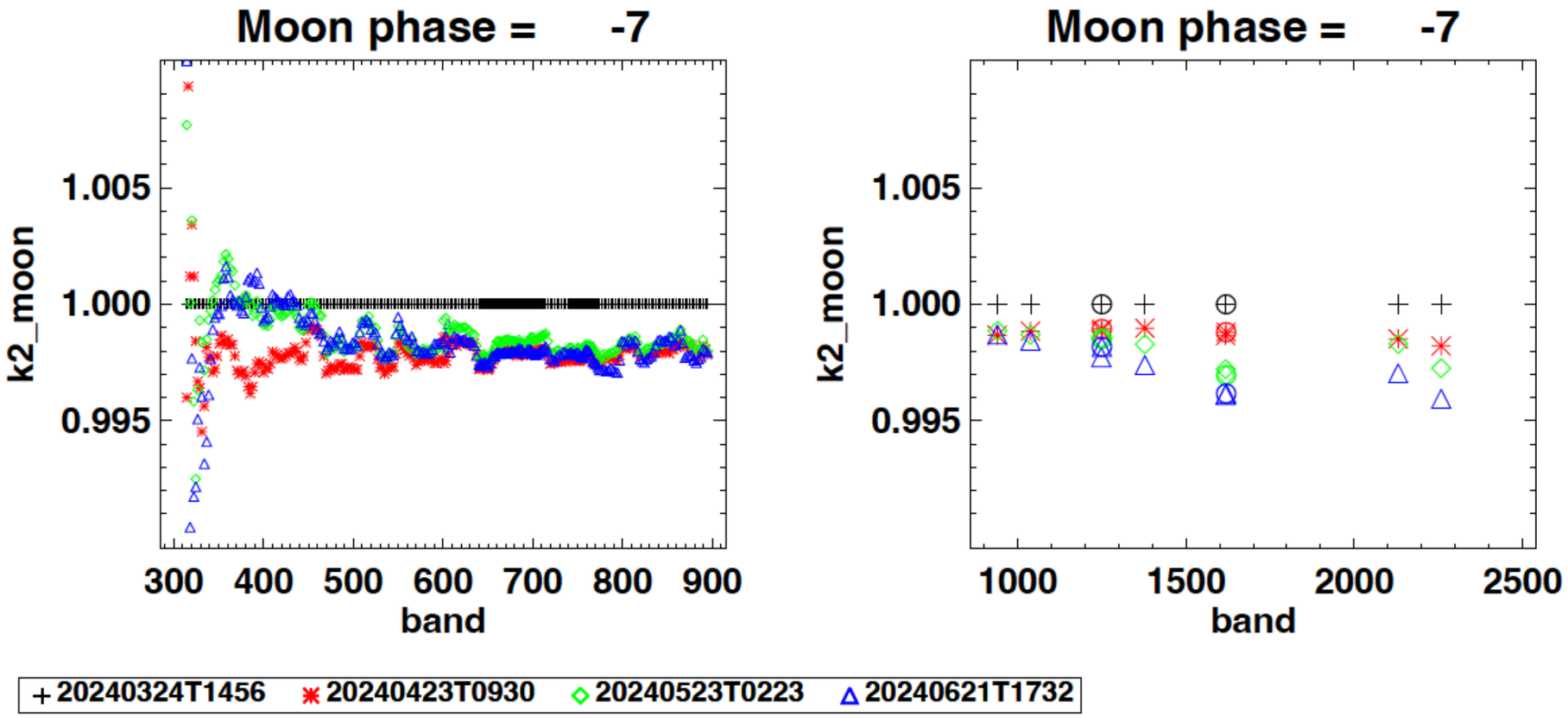
Lunar irradiance: measured vs. modeled





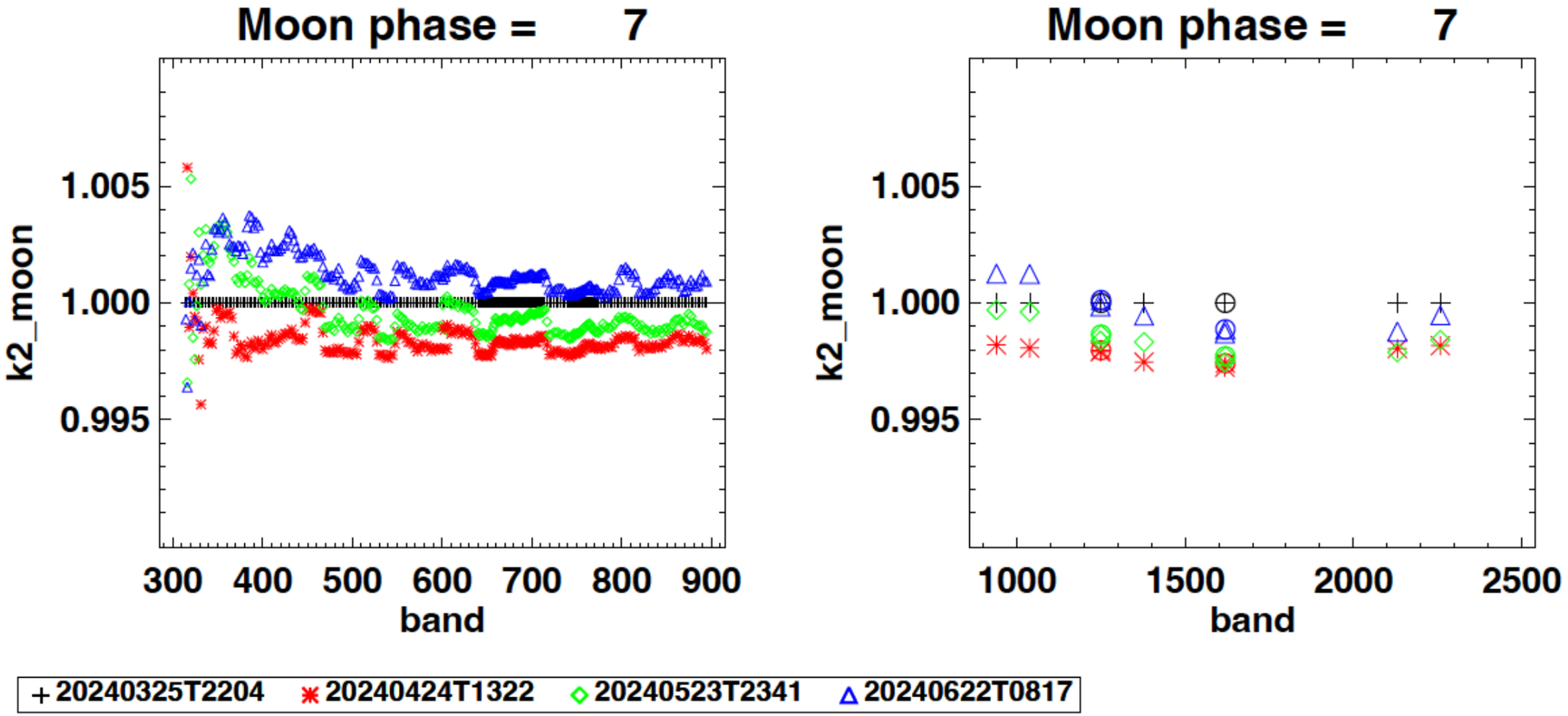
- Ratio of OCI measured vs. model predicted lunar irradiance (f_moon)
  - Left: blue and red FPA hyperspectral bands; Right: SWIR bands (high gain bands circled).
- F_moon has a spectral shape that peaked at NIR and gradually drop down to both shorter and longer wavelengths

Results: K2_moon (-7 deg)



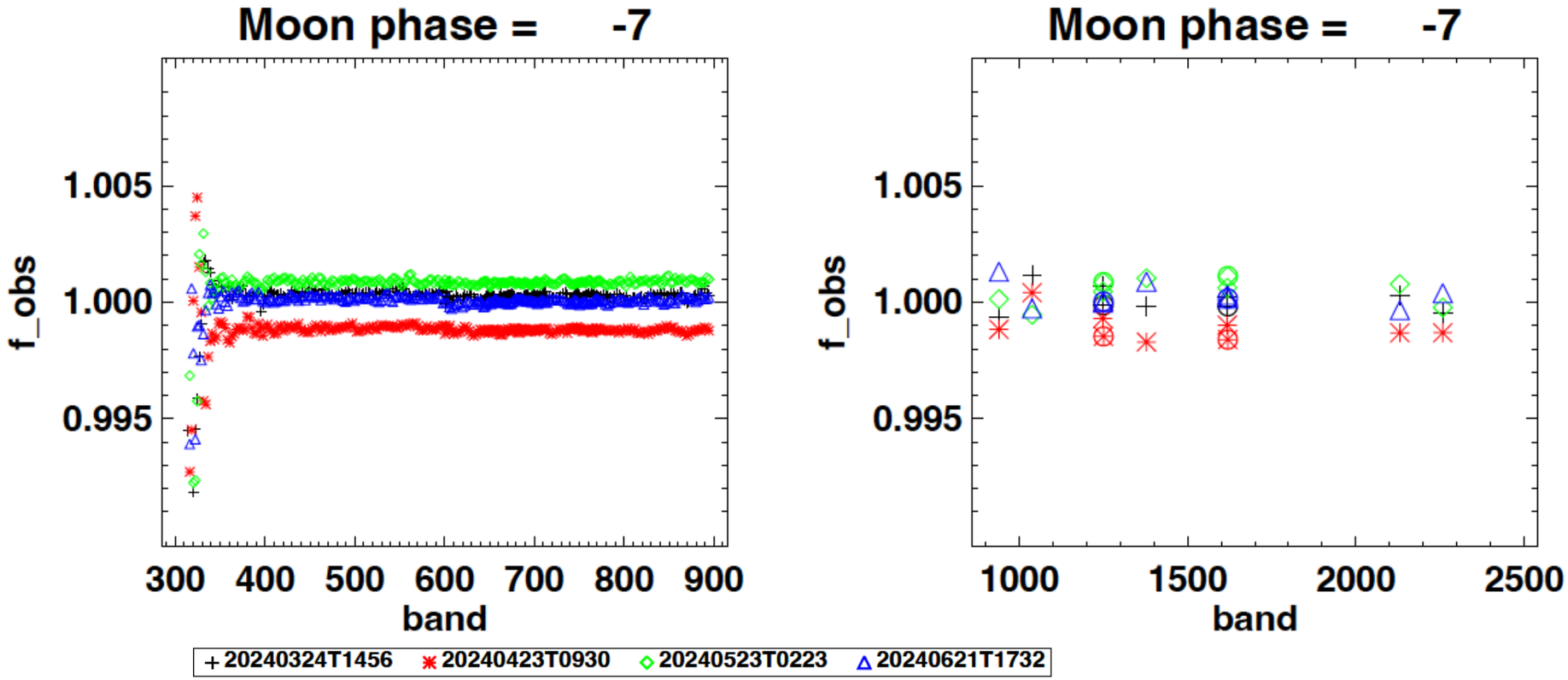
- Normalized OCI lunar gain (K2_moon): K2_moon = f_moon/f_moon(t=0)
- Hyperspectral bands: increase variation toward UV.
- SWIR bands: increase variation toward longer wavelength.
- What about +7 deg results?

Results: K2_moon (7 deg)



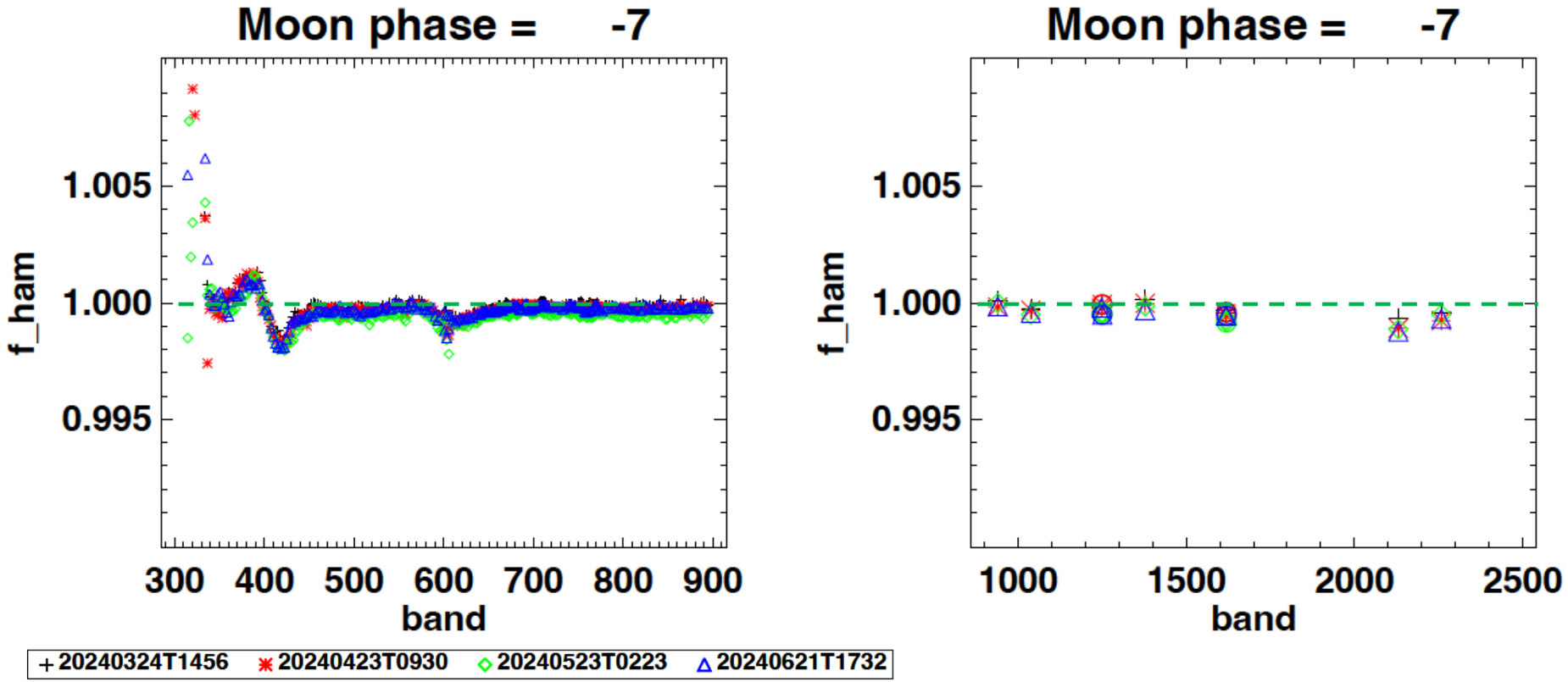
- Normalized OCI lunar gain (K2_moon): K2_moon = f_moon/f_moon(t0)
- Compare to k2_moon @-7 deg: slightly different patterns, up to few tenths of a percent differences.
- Uncertainties: Model predicts, OCI measured lunar irradiances?

Results: forward/backward observation



- OCI lunar gain ratio between forward and backward observations (f_obs) within each lunar cal event.
  - Negligible impact from model predictions, differences from measurement uncertainty
- F_obs ~0.2% deviation from 1 above 350 nm.
- Uncertainty in Lunar sweep rate knowledge is ~0.2%.
- SWIR: higher uncertainty; lower spatial resolution, impulse response correction.

Results: HAM side differences



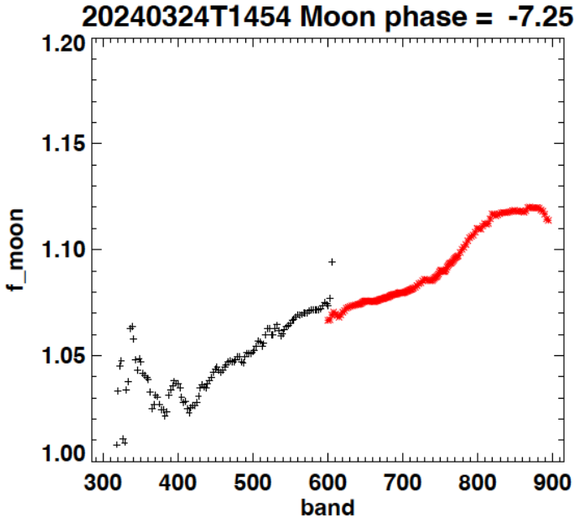
- OCI measured lunar irradiance ham side ratio (f_ham)
- Ham angle: SD@-92.5 deg, moon@30 deg.
- F_ham deviates from 1 indicates possible residual uncertainty in RVS correction.
- F_ham table over time.

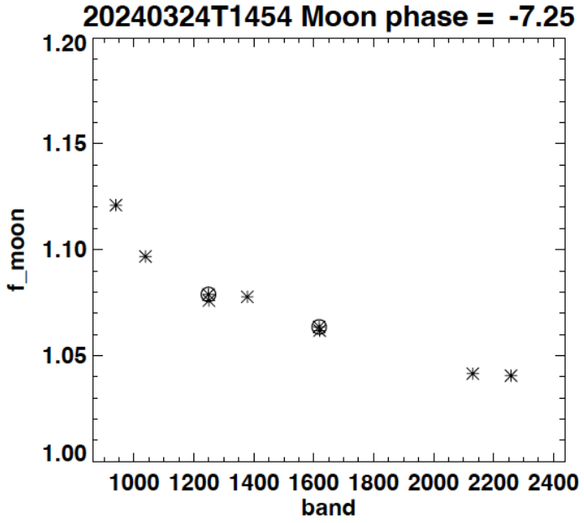
Summary

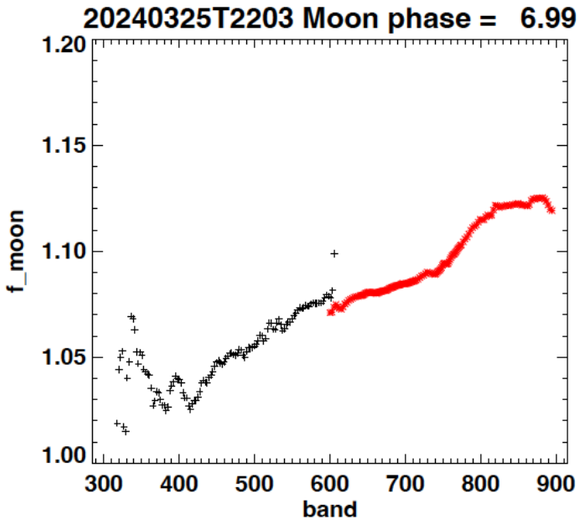
- OCI lunar observation
  - Well control lunar sweep rate.
  - 2 observations per calibration event
- OCI lunar calibration
  - Model: ROLO reflectance + TSIS solar irradiance.
  - OCI: calibrated pixel radiance * ground sampling distance (GSD)
- Early results:
  - OCI lunar irradiance overall higher than model predicts with a spectral shape.
  - OCI measurements uncertainties: ~0.2%, from sweep rate knowledge, pixel size.
  - HAM side biases indicate residual uncertainty in RVS correction.

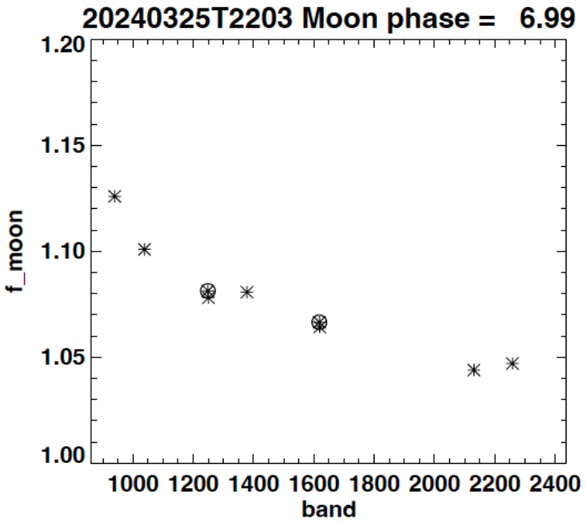
- *Continuing refine methodology and update with ever changing OCI radiometric calibration!*

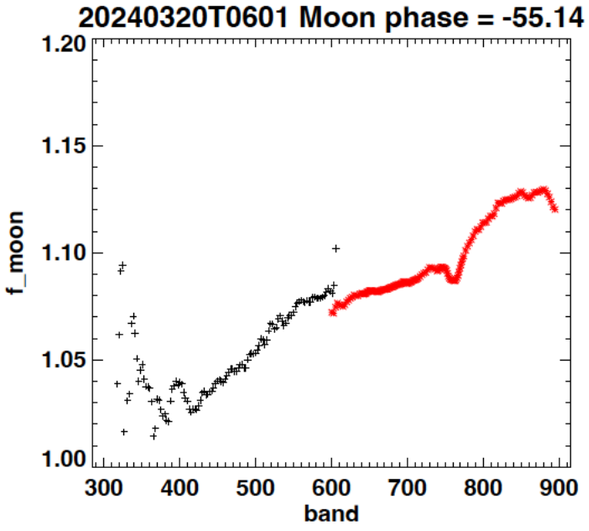
backup

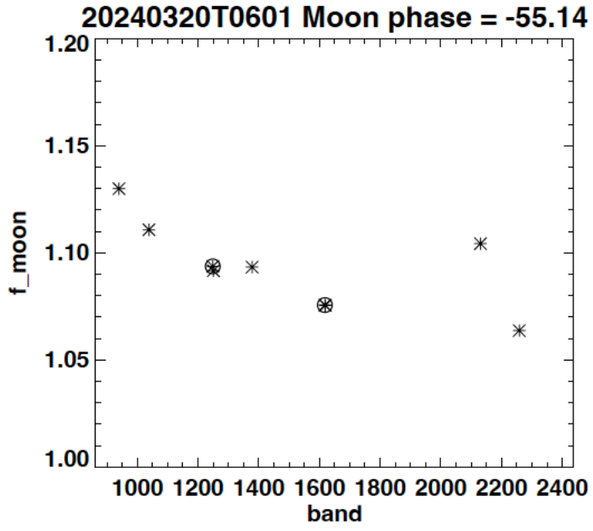

20240324T1454 Moon phase = -7.25
f_moon
band


20240324T1454 Moon phase = -7.25
f_moon
band


20240325T2203 Moon phase = 6.99
f_moon
band


20240325T2203 Moon phase = 6.99
f_moon
band


20240320T0601 Moon phase = -55.14
f_moon
band


20240320T0601 Moon phase = -55.14
f_moon
band