# Observing Instructions

## Origin & Evolution of Storms, Clouds, and Hazes on Uranus and Neptune
## [Lick/ShARCS-NGS program 2016B-S002]

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**Website:** http://mtham.ucolick.org/deKleer-NeptuneUranus2016/

**Science Objective**
Determine the frequency, time evolution, and vertical location of storm systems on Uranus and Neptune by obtaining frequent, brief images of these planets.
**Recent Press Releases:**
Neptune's dark vortex (2016)
Uranus' extreme storm system (2014)

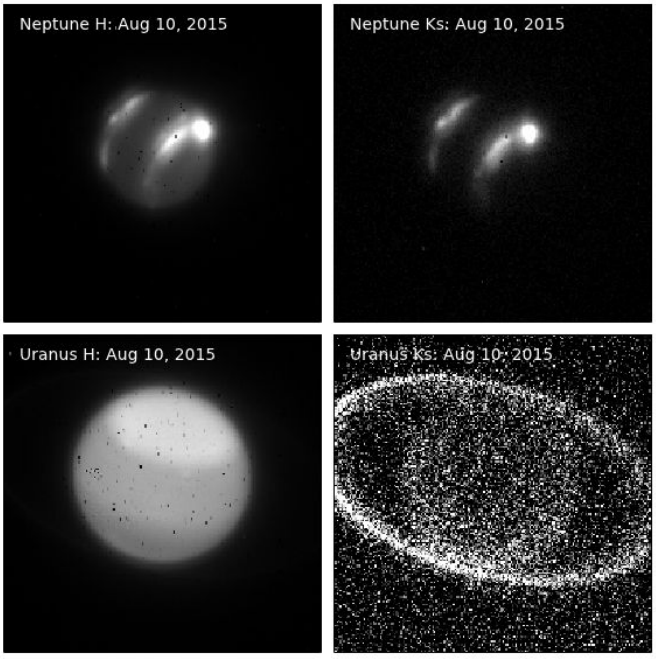



*Figure: Example Lick/ShARCS-NGS observations of the targets*

**"Voluntary ToO" Scheduling**
We invite 2016B AO observers to run our program on a "voluntary ToO" basis. The program images Uranus and Neptune with AO (NGS) in H and Ks bands, and takes 1 hour to run including overhead. These targets are bright, and our program is well-suited for times such as twilight or marginal weather that may not be suitable for the science objectives of other observers. Details on the observations and co-author invitation are below.

**Co-authorship invitation**
Modeled after the UCO policy for ToO programs, our co-authorship invitation is as follows:
**Single activation in 2016B:** Observers on duty + program PI
**Multiple activations in 2016B:** Full program team
**Engineering time:** Staff observers on duty

## Targets

### Uranus

RA: 01:30:50, DEC: +08:50:00 (non-sidereal target; coordinates as of 2016-Aug-01)
Apparent magnitude: 5.7
Angular diameter: 3.7"

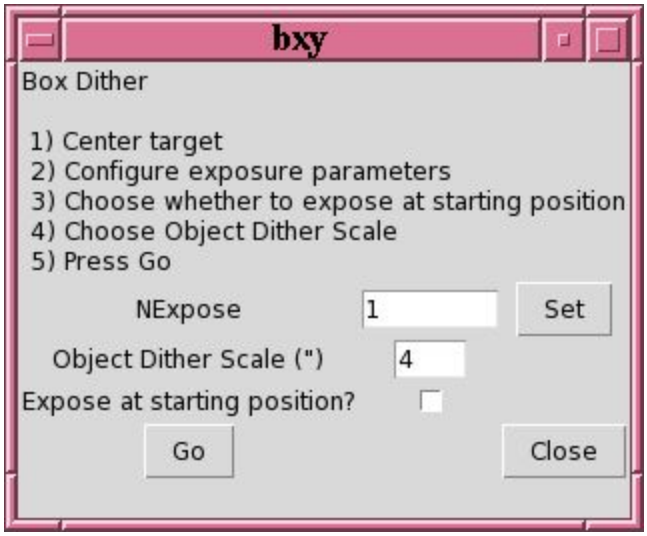
### Neptune

RA: 22:52:04, DEC: -08:09:21 (non-sidereal target; coordinates as of 2016-Aug-01)
Apparent magnitude: 7.9
Angular diameter: 2.3"

Ephemerides are available on program website:
http://mtham.ucolick.org/deKleer-NeptuneUranus2016/

## Observing Instructions

1. Before sunset, take flat field frames in H and Ks. Ideally, count levels should be between 10,000 and 20,000 DN. If weather prevents taking sky flats, do dome flats instead (refer to http://mtham.ucolick.org/techdocs/instruments/sharcs/tips/#flats for dome flat procedures).
2. Make sure AO operator has ShaneAO in NGS mode and wavefront sensor is on-axis.
3. Acquire **Uranus** [10min]
4. Have the AO operator lock AO on Uranus in NGS mode (the AO operator will set proper parameters for the ShaneAO system).
5. Put in H filter.
6. Take a 120 sec exposure. Check to be sure there are no saturated or non-linear spots on Uranus (count levels greater than 25,000 DN). If bright spots, take another test exposure of 60 sec and 2 coadds and use that for the rest of H-band imaging.
7. Open the bxy script GUI and make sure it is set as shown:



8. Press the "Go" button in the bxy GUI. This will take 4 more 120 sec (or 60 sec x 2 coadds) in a 4"x4" dither pattern. [10min]
9. Change filter to Ks.
10. Take a 120 sec exposure. Check to be sure there are no saturated or non-linear spots on Uranus with count levels greater than 25,000 DN. If there are very bright storms, take another exposure of 60 sec and 2 coadds and use that for the rest of the Ks-band imaging.
11. Press the "Go" button in the bxy GUI. This will take 4 more 120 sec (or 60 sec x 2 coadds) in a 4"x4" dither pattern. [10min]
12. Acquire **Neptune** [10min]
13. Lock AO on Neptune in NGS mode (the AO operator will set proper parameters for the ShaneAO system).
14. Put in H filter.
15. Take a 120 sec exposure. Check to be sure there are no hot spots on Neptune (count levels greater than 25,000 DN). If bright spots, take another test exposure of 60 sec and 2 coadds and use that for the rest of H-band imaging.
16. Press the "Go" button in the bxy GUI. This will take 4 more 120 sec (or 60 sec x 2 coadds) in a 4"x4" dither pattern. [10min]
17. Change filter to Ks.
18. Take a 120 sec exposure. Check to be sure there are no hot spots on Uranus with count levels greater than 25,000 DN. If there are very bright storms, take another exposure of 60 sec and 2 coadds and use that exposure time for the rest of the Ks-band imaging.
19. Press the "Go" button in the bxy GUI. This will take 4 more 120 sec (or 60 sec x 2 coadds) in a 4"x4" dither pattern. [10min]
20. At end of night, take Darks with the exposure times used for Uranus and Neptune imaging, as well as the H and Ks flat field frames.
21. Copy data to gouda (computer at Lick Observatory) by doing the following commands from a Lick Observatory computer:
    - ssh gouda
    - cd /workspace/S002/
    - Make a directory with the current date in YYYY-MM-DD format, e.g. mkdir 2016-08-17
    - cd 2016-08-17 (or whatever the current date is)
    - cp /data/sharcs/s01*.fits (choose whatever the actual files are to copy)
22. E-mail PI de Kleer at kdekleer@berkeley.edu indicating that data were taken. Please include a summary of the Uranus, Neptune, flat field, and dark frames numbers, weather conditions, seeing estimate, and observer names in the e-mail, or in a text file saved to the directory with the data.

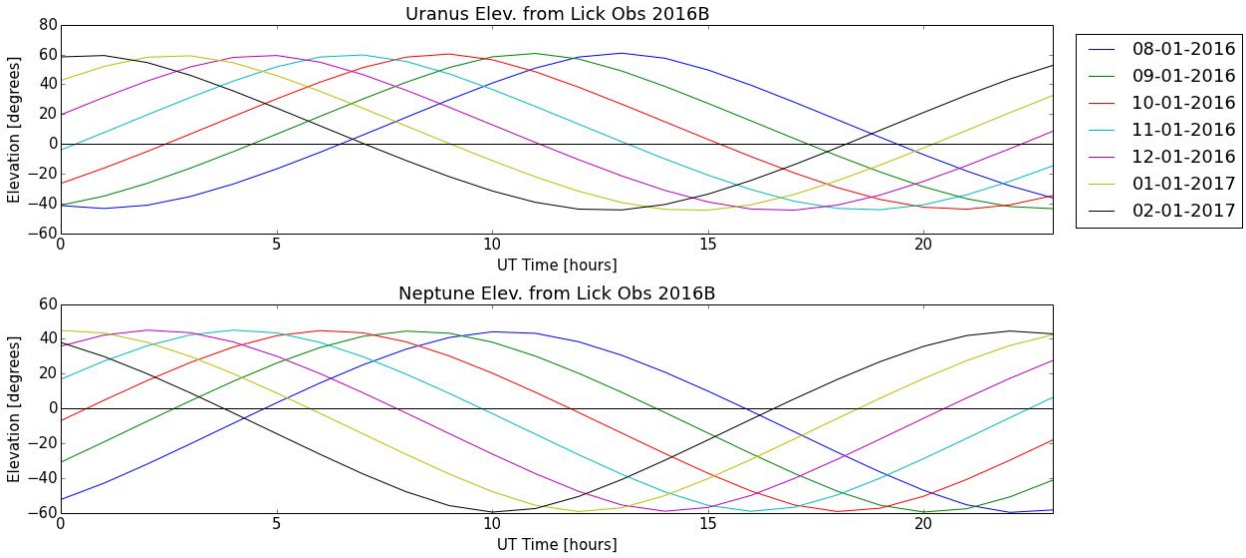
[60 min total]

**Notes:**

(1) standard star and sky observations are not needed, as absolute photometry is not required, and a sky frame can be constructed from a median-average of the dithered image.

(2) Program may be run on consecutive nights, or twice within the same night separated by at least 6 hours, which will give coverage of different hemispheres (rotation period for both planets is ~16 hours)

## Summary of Target Visibility in 2016B




Approx time intervals when targets are above 2 airmasses

**Uranus**
8/1/16: 9UT - sunrise
9/1/16: 7UT - sunrise
10/1/16: 5UT - 12:45UT (twilight)
11/1/16: 3UT - 10:30UT
12/1/16: sunset - 8:30UT
1/1/17: sunset - 6:30UT
2/1/17: sunset - 4:30UT

**Neptune**
8/1/16: 7:30UT - sunrise
9/1/16: 5:30UT - 11UT
10/1/16: 3:30UT - 9UT
11/1/16: 1:30UT (twilight) - 7UT
12/1/16: sunset - 5UT
1/1/17: sunset - 3UT
2/1/17: -