

PROCEDURES FOR USING THE HISTORIC BRASHEAR 12" INCH REFRACTOR

Welcome to the historic Observatory at the University of Illinois and the Brashear 12- inch refractor.
Please follow these procedures when operating this irreplaceable instrument.



There are six cardinal rules that must be observed whenever you use the telescope:

- ① When opening or closing the dome slit cover, **BOTH** lens caps **MUST BE ON**
- ② Use **ONLY** the **RED** knobs to move the telescope.
Do NOT push or pull on ANY OTHER PART OF THE TELESCOPE!
- ③ **NEVER LET THE COUNTERWEIGHTS GET ABOVE TELESCOPE TUBE.**
- ④ When turning on the clock drive motor **VISUALLY** confirm that the motor is running.
NOTE PLACARD REGARDING MOTOR FAILURE TO START ON NORTH SIDE OF PIER.
CONTINUE TO MONITOR MOTOR OPERATION.
- ⑤ **Never** leave the telescope unattended with the clock drive motor running.
- ⑥ Before leaving the dome for the night **reconfirm** that each item on the closing checklist has been completed.

See the appendix 2 for the reasons for these rules

Opening and Preparing to observe

Depending on how your card is marked, you will check out one of two key sets from the Astronomy Office.

The **CLUB** key set has three keys. The key marked with OS opens the north outside door of the Observatory; the key marked AAAA3 unlocks the dome; the third key unlocks the Club Room, (Rm 28).

The **TA** key set has two keys. The key marked with OS opens the north outside door of the Observatory; the key marked (AAAA1A) unlocks the dome, 124, 128, and the south outside door.

It is good practice to keep the keys on you, such as in your pocket.

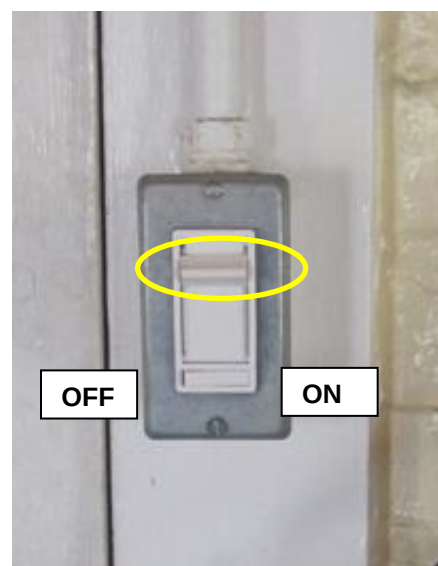
Once inside the building, make sure that the exterior doors are locked shut unless you are expecting or want visitors. **NOTE:** When you come in the north door it will either be unlocked (no key needed) or locked (key needed.) **YOU CANNOT** actually lock or unlock the door. A night watchman does that around 5:00 pm M - F. The OS key only allows you to enter but does not change the status of the lock itself.

The following items are listed in an efficient sequence. It is recommended that you use this order until you become more familiar with the equipment.

1. Upon entering the dome, check around dome for current condition. Use to diagram in Appendix 1 to complete this initial inspection. If you find anything out of order please note it in your logbook entry.

NOTE: Check the **MESSAGE BOARD** for amendments to this document or temporary conditions

NOTE: The dome lights are operated by the dimmer switch next to the entry door. To turn the lights ON, press the right side of the toggle switch at the bottom; control the brightness with the slider. (Yellow oval in picture at right.)

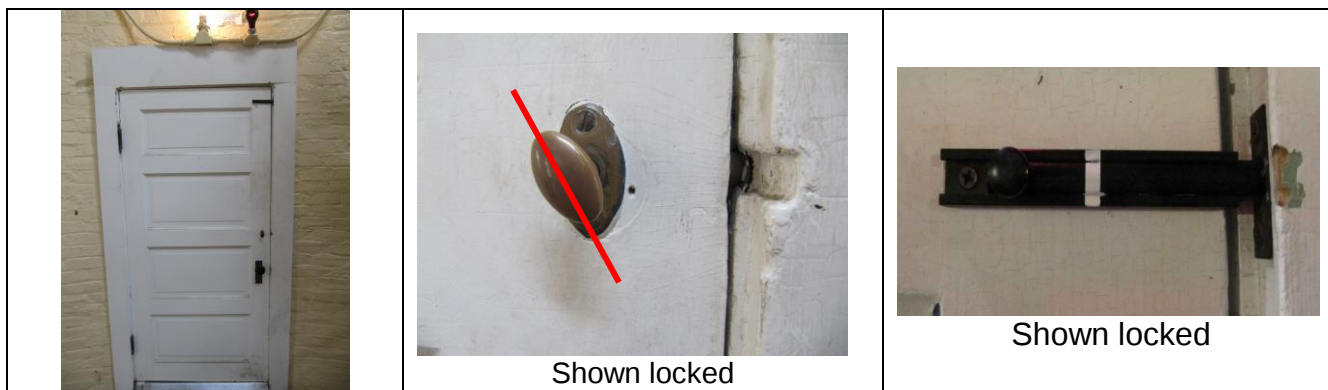


2. SIGN IN and begin the LOGBOOK entry!

At minimum, please enter **your name**, the **time you arrive** and the **time you depart**, and **any issues** noted from your inspection in item # 1. . Any other items (what you viewed, seeing conditions, friends' names, etc. are up to you.) Also glance at a few prior logbook entries to see if there are any issues that might affect your operation of the telescope.

3. OPEN the NORTH BALCONY DOOR, THE DOME SLIT, WINDOWS, adjust SHADES.

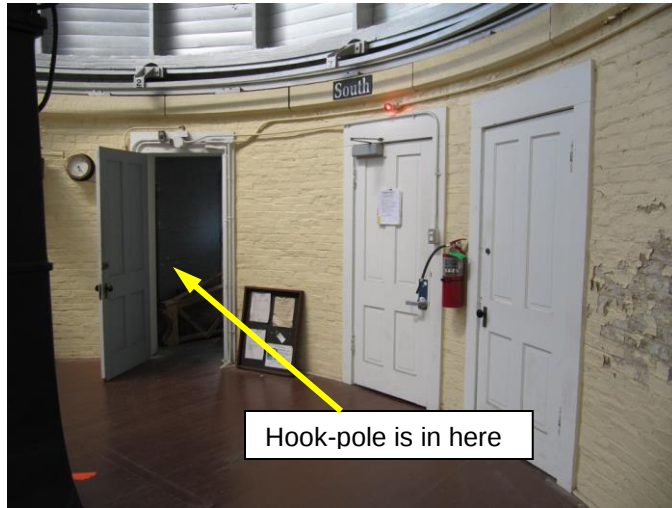
This allows the dome interior to come to equilibrium with the outside.



North Balcony Door. There are two deadbolt type locks on this door. When locked, the old one (near the door knob) should be in the approximate 5:00 / 11:00 o'clock position (see RED line) Both the old one and the new one (near the top of the door) are shown locked here. Both should be locked when you arrive and relocked when you leave.

The Dome Slit Cover. Open slit with a hook-pole located in 201 (the closet shown with the door open in the picture below.) Unfasten the ring from the retaining slot on the left side of the slit by pulling down and slightly out. Then pull down on the ring on the right side. If this is difficult, leave a note in the logbook so that it can be fixed. Please hang the pole in the closet after EACH use. Do NOT leave it hanging on the ring or just standing against the wall somewhere.

Maximum wind (including gusts) to open slit: 35 mph



Hook-pole is in here



Dome Slit cover shown CLOSED, but NOT latched (on left)



OPEN (on right)

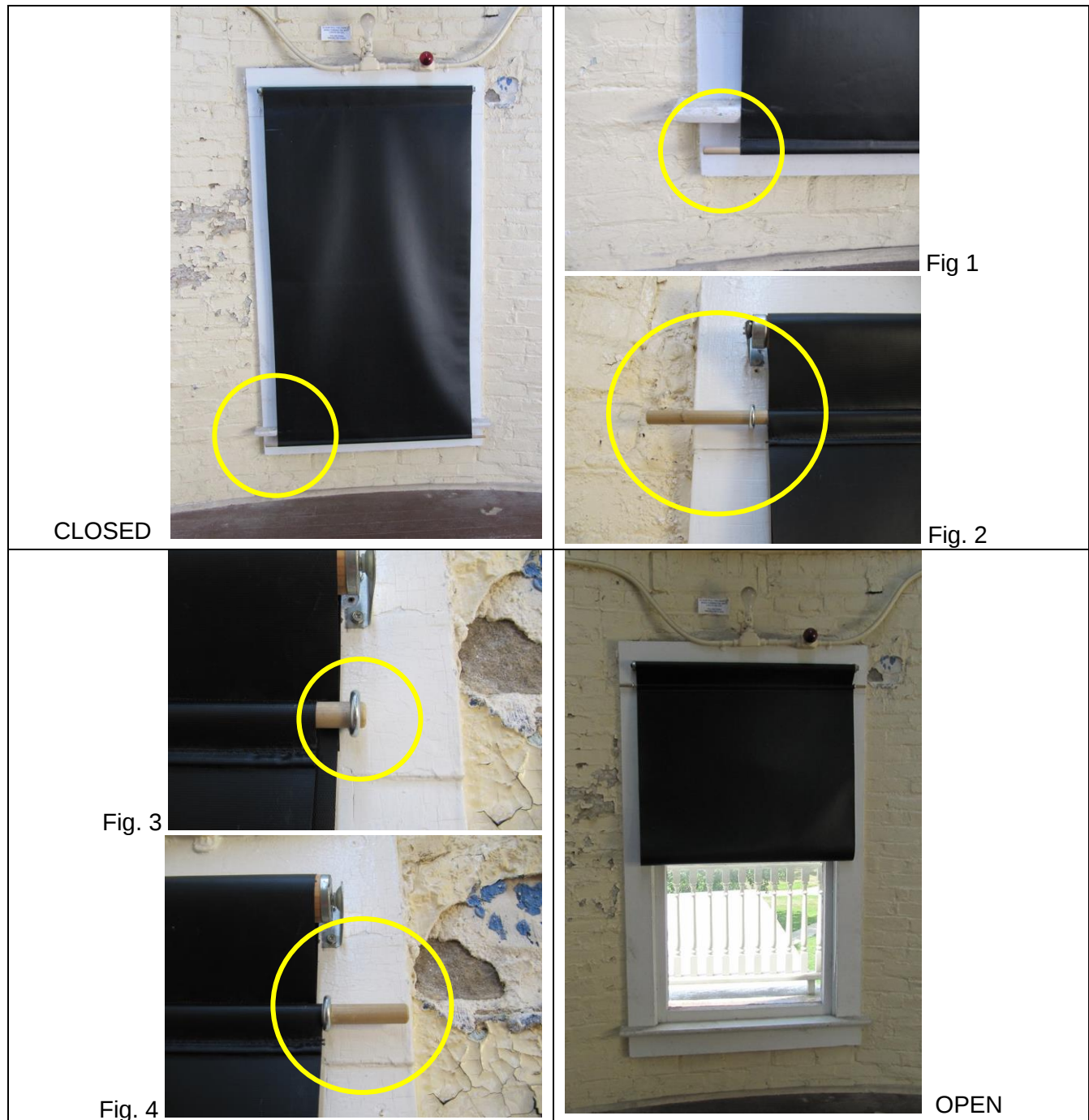
The Windows. Open windows as desired. If it is breezy, you may choose not to open all the windows.



Shown locked; note lock "hood" over arc.

It is suggested that you KEEP THE INSIDE ACCESS DOOR CLOSED to prevent drafts and turbulence in the dome.

The Shades. If the window is closed, you may leave the shade down. If you open a window, however, you need to raise that shade so that it does not blow in the wind. Simply lift the shade and insert one end of the dowel into one of the eyelets and then slide the other end into the other eyelet. Try not to wrinkle the shade material.



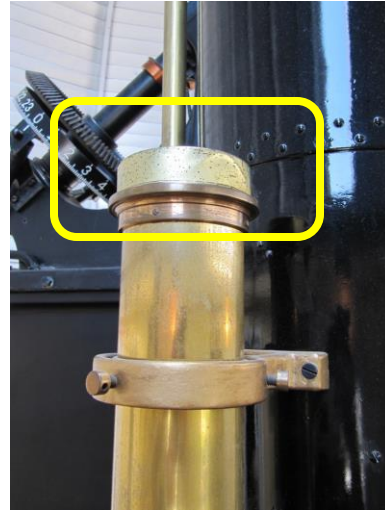
**Now is a good time to collect the eyepieces if you haven't already got them.
The dome can be coming to equilibrium while you are gone.**

4. REMOVE THE FINDER SCOPE CAP.

Do **NOT** jump to reach it; use a chair or stool if necessary.

Grasp both sides and gently twist and lift.

When reinstalling the finder scope cap make sure it is pressed down level so that it sits squarely on the scope as shown.



5. SECURE THE SILVER DRAWTUBE.



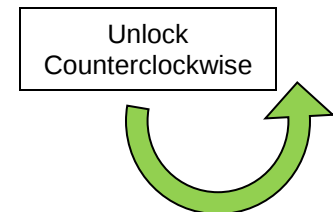
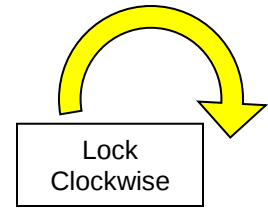
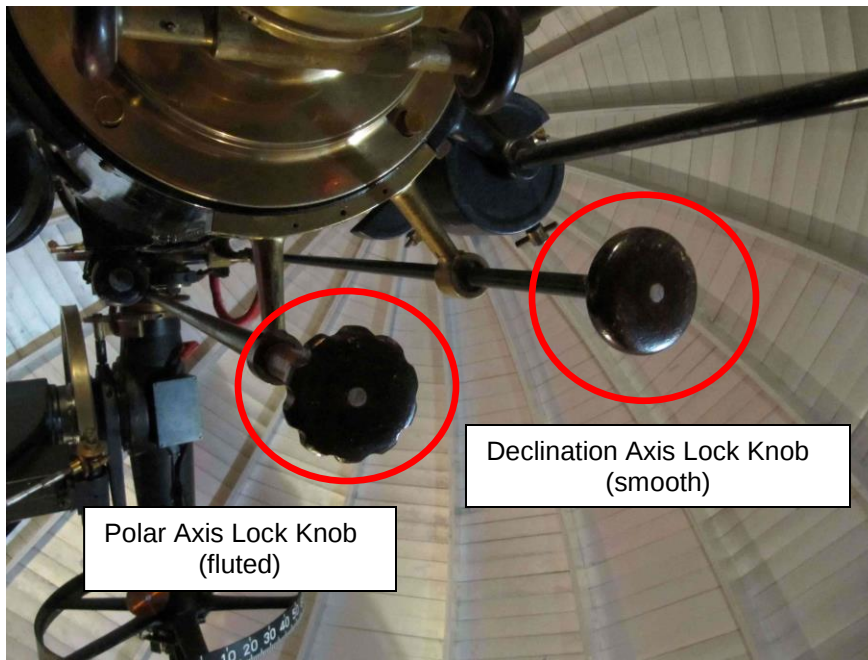
In the image on the left, the focusing draw tube is in its resting position: fully extended with the thumb screw (circled in red in image) loose. This is the state to which the focusing assembly must be returned after observing.

Before proceeding, this focuser assembly must be secured. Push the draw tube all the way up to its stop and engage the thumb screw to tighten the friction lock. **Do not overtighten the thumb screw. Tighten it just until the draw tube does not slip**

6. Check the balance of the telescope:

A) Unlock the telescope by turning the two locking knobs COUNTER CLOCKWISE as viewed from the eyepiece end of the telescope. (See pictures next page.) For the (smooth) Declination axis lock, turn the knob ONLY until you feel it release; turn the (fluted) Polar axis lock turn the knob ALL THE WAY to its stop.

B) Check to see that the telescope is properly balanced by using the red knobs to firmly push the telescope (away from the pier) and allowing it to react. It SHOULD COME TO REST on its own. If it does not, you may have to lock one of the axes while rotating around the other axis. Most of the time you should not have to relock axes until you are ready to track an object for viewing. [Reference Rule 2]



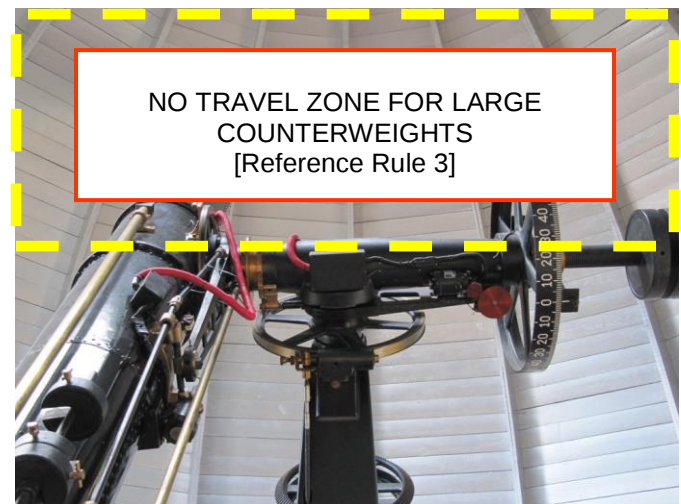
7. REMOVING THE PRIMARY LENS CAP.

Move the telescope to approximately 0 declination. If the telescope is UNBALANCED, lock the Declination knob.

Using the ship's wheel on the north side of the pier, rotate the telescope clockwise (westward) until the lens cap is within reach. You can bring the objective end as low as you need, so long as the counterweights do not go above the telescope. [Reference Rule 3] Remove the lens cap by gripping both sides firmly and pulling evenly



Set pointer at 0 degrees.



[Reference Rule 3]



Turn wheel clockwise



Grasp opposite edges, wiggle and pull

STORE BOTH LENS CAPS INTERIOR SIDE DOWN.

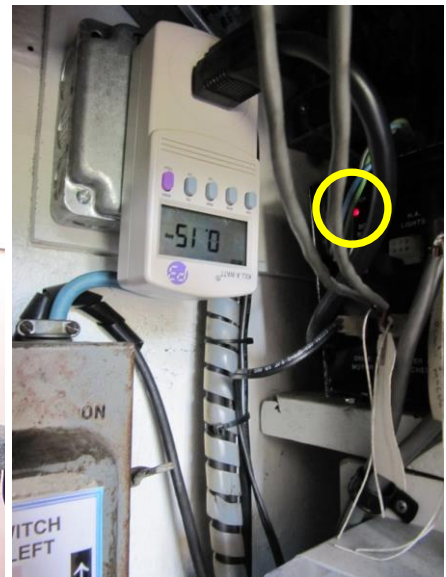
8. TURN ON THE POWER FOR THE TELESCOPE AND DOME. Find the door on the lower west side of pier. Open the hatch and locate the **RED** rocker switch on the power strip just inside the opening on the **RIGHT**. Turn this switch on. The switch and two other **RED** LEDs will illuminate. Also a small **RED** LED in the upper left corner of the pier will illuminate when the power is **ON**.



The red rocker switch



Three red lights



LED in corner

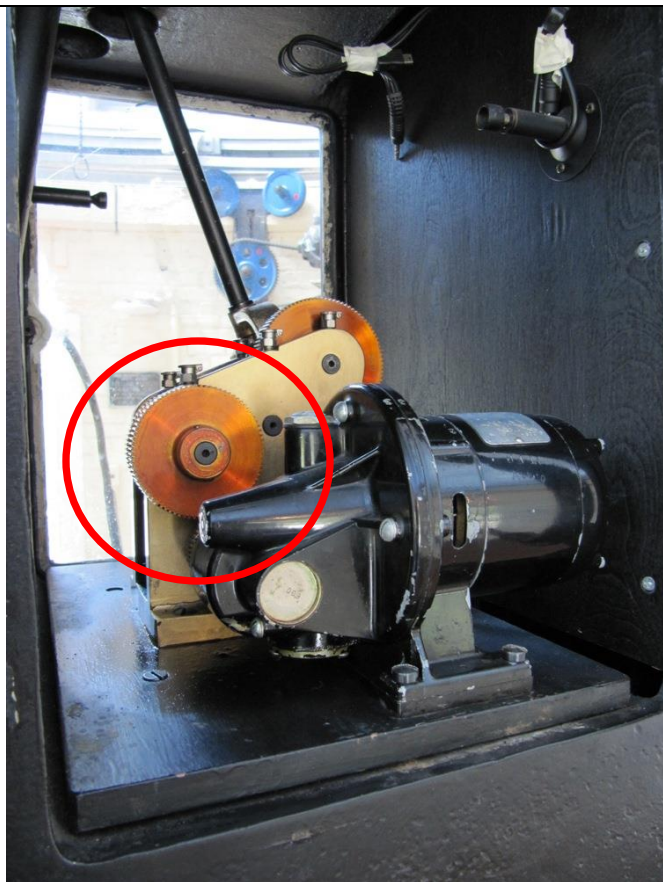
Make sure you count a total of four red lights before proceeding.
The rocker switch counts as a light.

9. TURN ON THE DRIVE MOTOR (RED SWITCH) AND SETTING CIRCLE LIGHTS (BLACK SWITCH)

The two switches are located on the north side of the pier ABOVE the blue Sidereal Time dial



You **MUST** watch the gear in the **RED** circle as you turn on the clock drive. If it does **NOT** start immediately when you turn the switch on **TURN THE SWITCH OFF. YOUR SESSION IS OVER.** Report the problem to one of the **EMERGENCY CONTACTS** at the end of this document.



[Reference Rules 4 and 5]

Using the Telescope to Observe

The CLUB eyepieces are stored in a plastic case in the basement Club Room (room 28), in the gray standing cabinet. Eyepieces for TA use are in room 124. Use care when changing them. Some of the eyepieces do not fit very tightly.

NEVER TOUCH OR CLEAN ANY OPTICAL SURFACE

- ▶ It is important to remember to **UNLOCK** the telescope before moving it and lock it again once the object has been located. Attempting to move the telescope with the axes locked can damage the clock drive gear train!!
- ▶ Always be aware of balance when releasing the telescope. If it becomes unbalanced, it could move by itself and hit the pier. Using a heavy eyepiece can, for example, cause a slight imbalance that might require locking an axis at times.
- ▶ Do not attempt to rebalance the telescope by moving any counterweights.
- ▶ **NOTE:** The telescope is nearly impossible to move near declinations +90; move it to +40 first.

See the following pictures for additional information and assistance.



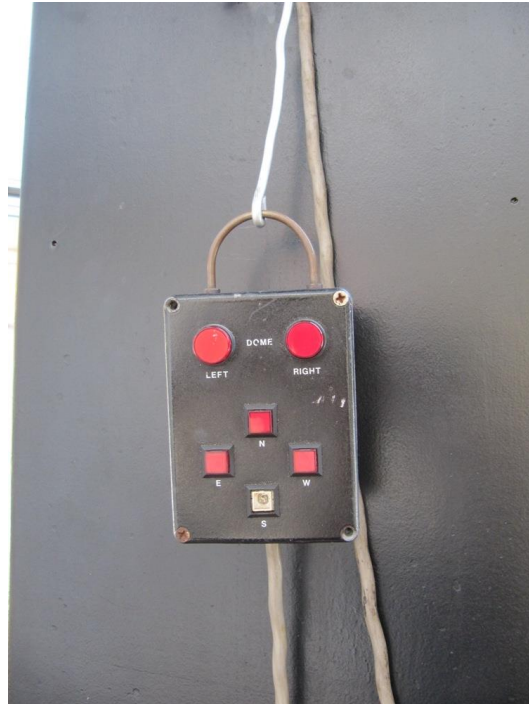
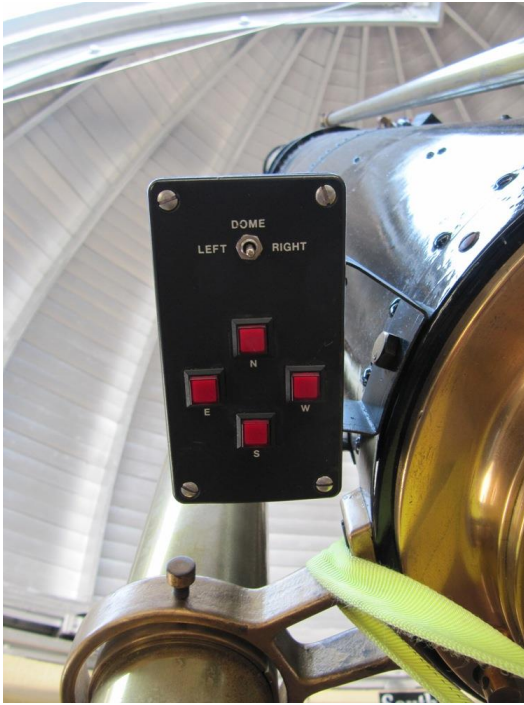
The finder scope eyepiece



The observer's "chair." To raise the chair, push the chair up. To lower the chair, while sitting on the chair pull DOWN on the rope at your LEFT side.



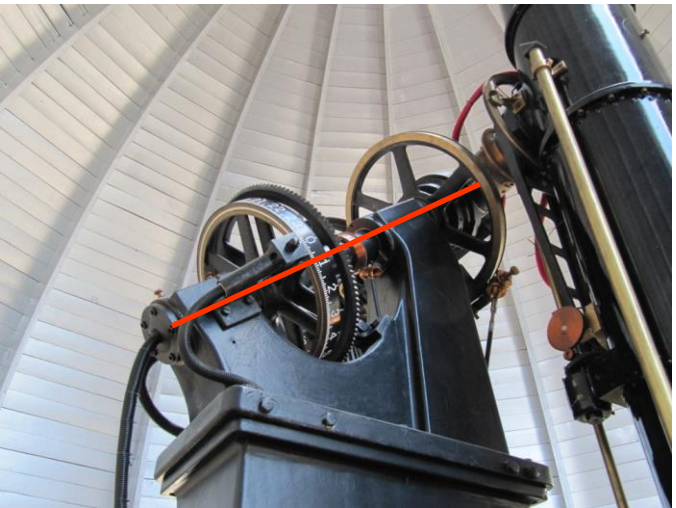
Avoid positioning the observer's chair directly under the dome drive cable rail. There are places where the chair and the rail make contact.



Control boxes. The one on the left is near the eyepiece; the one on the right is on a long cord. Square buttons are for fine adjustment. The toggle switch and round buttons control the dome.



The Declination Axis (red line)
and Setting Circle



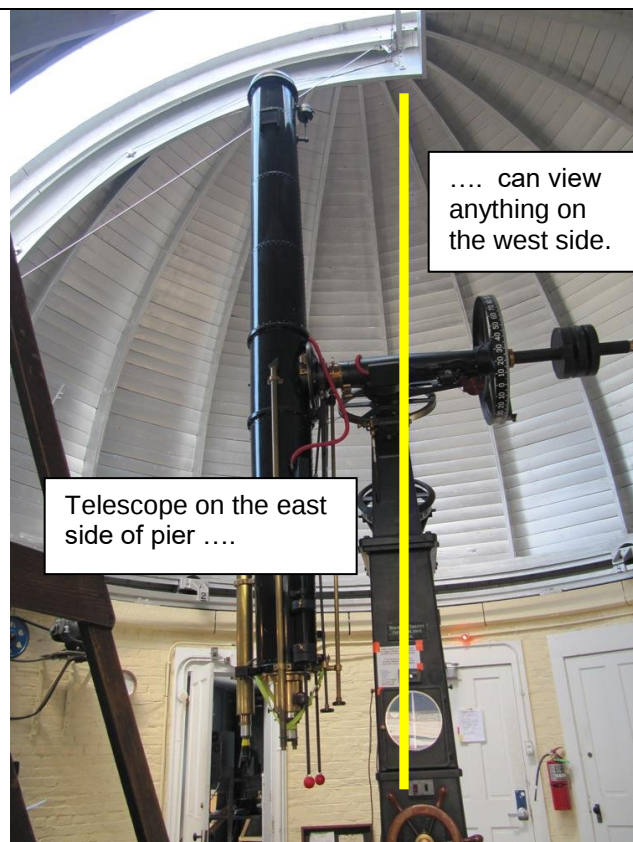
The Polar Axis (red line) and Setting Circle
(aka Hour Angle)

The “ROLL-OVER” PROCEDURE:

When is it necessary to do a “roll over”? You need to do a “roll over” when the object you want to look at is on the same side of the pier as the telescope. Put another way, the telescope must always be on the side of the pier opposite the object you are viewing.

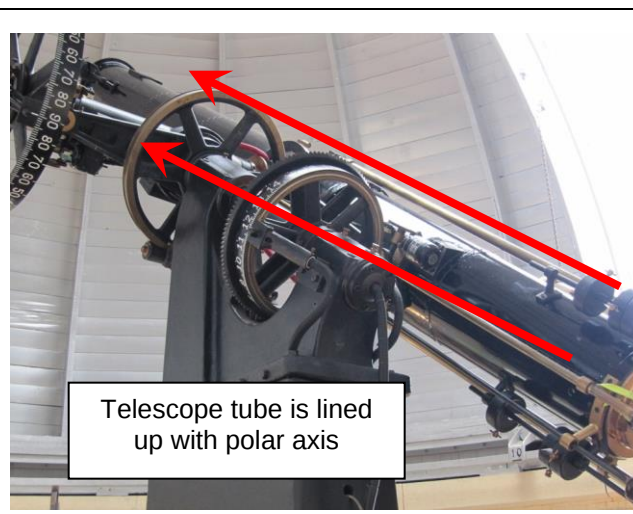
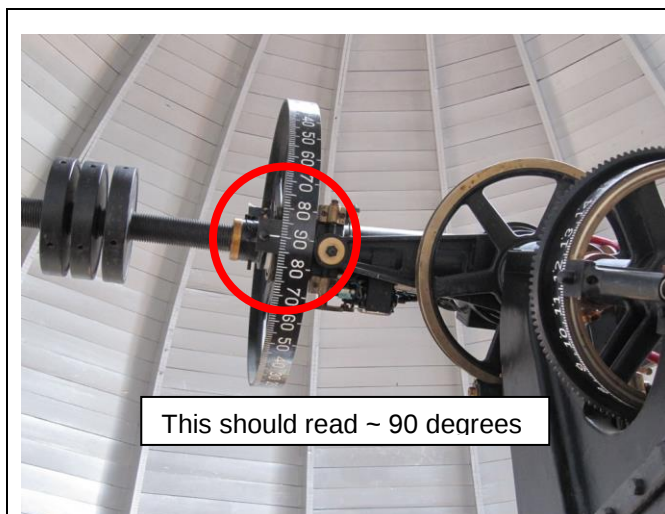
So for the telescope positioned as shown at the right, the telescope could view any object in the western (right) side of the pier.

But if you wish to view something in the east hemisphere (left of the red line,) you need to do a “roll over.”



How to do the “ROLL-OVER” PROCEDURE:

1. Begin with the telescope in the vertical position as shown in the picture, above.
2. Using the RED handles, move the eyepiece end of the telescope toward the south until the declination reads approximately 90 degrees. (See left picture below.) The telescope should now be parallel to the slanting polar axis and pointing north. (See RED arrows in right picture below.)



3. ROTATE THE TELESCOPE OVER THE PIER by turning the captain's wheel clockwise.
[NOTE: This is the same motion as in Step 7 (Removing the Primary Lens Cap). Move the telescope slowly and watch what you're doing. As long as the telescope remains balanced you do not need to lock either axis. If it is not balanced, you will want to lock the declination (smooth knob) during this part.



Ready to roll from east to west



Rollover complete

4. Use the RED handles to move the telescope to the desired position on the west side of the pier.
5. When finished observing on the west side of the pier, **REVERSE THE PREVIOUS STEPS** to return the telescope to the other side.

Closing Procedure- BEFORE LEAVING THE DOME

1. Turn the **clock drive and setting circle lights off** (North side pier)
2. **Replace the primary lens cap.** (See #7 in the "opening" section)
3. Return the telescope to the vertical position on the **EAST** side of the pier and **LOCK** the knobs. (Hour angle = 0, declination = 40)
4. Insert eyepiece cover.
5. Put the finder scope lens cap back on.
6. Return the silver draw tube to the fully extended position and make sure the friction lock thumbscrew is loose

7. Move dome to face **east**, **close the slit**, secure the chain in the slot, and put the hook back in closet.

NOTE: When properly tensioned the **three** white chain links should be just **BELOW** the chain lock slot. You will have to pull the chain down and twist/ rotate the proper link into the slot

8. Turn off the main power. (**RED** rocker switch in side west side of pier)



9. Close the north balcony door and lock BOTH deadbolts. [See also Step 3 in “Opening” procedures] Close and lock the windows. You may leave the shades up or down but you **MUST** confirm the windows are **LOCKED**.



UNLOCKED



LOCKED

10. Complete the logbook entry. Objects observed, problems with the telescope or equipment. **REPORT MAJOR EQUIPMENT PROBLEMS** to one of the people listed in Appendix 4 “Contacts.”

11. Turn off the lights in the dome.

AFTER LEAVING THE DOME

12. Close the dome door. Make sure it latches. It locks automatically.



13. Turn off the RED stairway lights.



14. Return eyepieces all equipment to the proper places.

15. Make sure the outside door is latched if the door is locked.

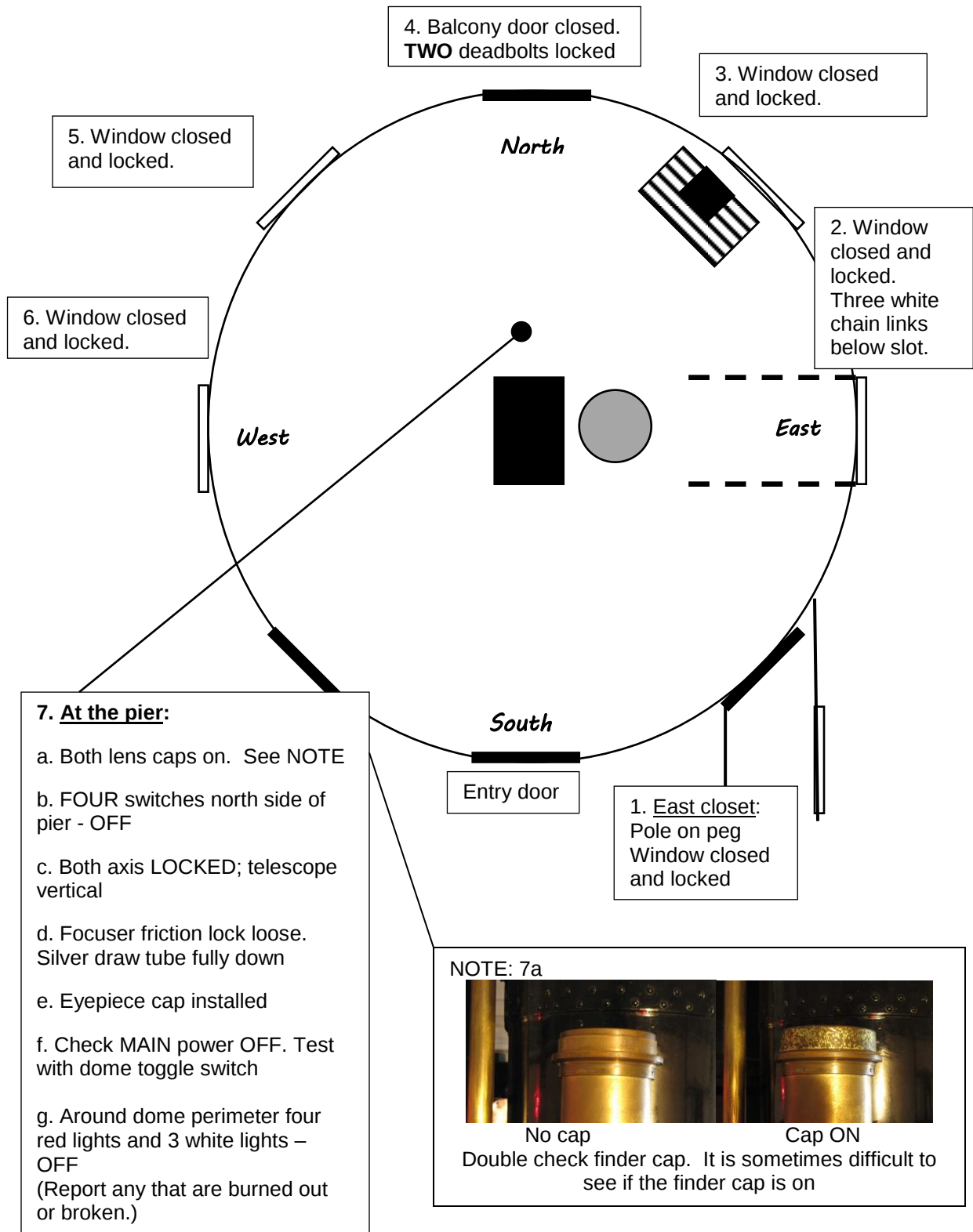
16. Turn the keys into the Astronomy Department by 11:00 a.m. the following business day.

Appendix 1:

Opening / Closing Inspection

Use this diagram to complete the Opening Inspection upon arrival and the Final Check before leaving.

These are the conditions you should find upon entering the dome and the way you should leave them when you depart.



1. **When opening or closing the dome slit cover, BOTH lens caps MUST BE ON:**

When opening and closing the dome slit cover, there is the chance that accumulated dirt, precipitation, bird “residue,” etc. could fall into the dome. If the lens caps are not on this debris could land on the lenses and damage them. The cost of the objective lens was approximately one fourth the cost of the entire telescope!

In the event of a need for “emergency” closing of the slit cover (e.g. a sudden rain storm) tilt the telescope away from under the slit opening to minimize the chance of something falling on the lenses and close the slit. Do not attempt to put lens caps in place before closing the slit in such a situation.

2. **Use ONLY the RED knobs to move the telescope:**

The red knobs were installed in 2013 for the purpose of moving the telescope without having to push or pull on more delicate parts of the instrument. Please use them.

3. **NEVER LET THE COUNTERWEIGHTS GET ABOVE TELESCOPE TUBE:**

The three large counterweights on the declination shaft: There is no mechanical reason why these counterweights could not be above the telescope. Rather, the reason for this rule is to prevent excessive rotation of the polar shaft. There are ~45 electrical wires tightly bundled that run up through the polar shaft that operate the dome controls at the eyepiece, the fine adjust buttons, the setting circle lights, and so on. If these wires get twisted too tightly they will break and it is a serious issue to repair / replace them. (Ask Prof. Looney.)

By following the “counterweight rule” rotation around the polar shaft is limited to ≤ 180 degrees. (during a roll-over procedure)



4. **When turning on the clock drive motor VISUALLY confirm that the motor is running:**

In December, 2016 the clock drive motor failed to start. If an electric motor has energy supplied with no movement, it can burn out the coils destroying the motor. Fortunately the motor was quickly shut off before any damage occurred, but upon inspection no specific problem was found. So the motor was cleaned and lubricated. It has not failed since. But at some future time IT WILL FAIL again. By ensuring that the gears (and thus the motor) are turning immediately upon startup we can prevent damage to the motor.

5. **Never leave the telescope unattended with the clock drive motor running:**

There are certain positions of the telescope that allow the clock drive system to force the telescope against the pier. As there are no clutches or slippage devices in the system, if this were to happen the gear train would be destroyed. These gears would have to be re-cut (at significant expense) and would disable the telescope for a considerable time. If you happen to leave the dome with the telescope in a position as described, the gears could be destroyed before you return.

6. **Before leaving the dome for the night reconfirm that each item on the closing checklist has been completed:**

This is sort of self-explanatory. By performing the final check, you assure that the telescope will be in good shape for the next user. When closing “by committee” it is a good idea to designate a person to do the final check so that all the items are accounted for. That prevents the issue of “I thought *you* turned off the power, locked the balcony, etc. etc. “

Appendix 3:

In Case the Dec Axis Becomes Stiff

For a several years an issue with rotational stiffness around the declination axis developed and became increasingly problematic. An attempt to discover and solve the problem was made but the procedures were aborted with no resolution. Subsequently a “patch” was introduced by inserting a high compression strength nylon “washer” at the OTA end of the declination shaft. So far the prototype has been offering good performance.

Nevertheless, because it is a “patch” and does not address the underlying problem, the following procedure is offered here in case the stiffness issue should return.

Start with the declination axis in the horizontal position. Move the telescope back and forth (north to south and vice versa) to loosen up the movement.

Then, regardless of the target object, be it faint deep space object or the moon, **preset and lock the declination while the Declination Axis is in the horizontal position**, i. e. counterweights and telescope level. Note: The current declination can be obtained for most objects with an internet access.

Once this is done, move the telescope as required around the polar shaft. By doing this, you will be fairly accurately pointing at the target and the Dec Axle stiffness will still be mild. You can now unlock the Dec to make small adjustments before it tightens up. If the Dec Axle becomes very stiff, return the Dec Axle to the horizontal (counterweights and telescope level) and start over. Use this procedure with the telescope on either side of the pier

Appendix 4:

EMERGENCY CONTACTS

CRAIG SUTTER (PRIMARY, OBSERVATORY CURATOR)
(217) 328-2107 csutter@illinoisalumni.org

BROCK BRENDAL (ASSISTANT CURATOR)
(618) 554-0892 brendal4@illinois.edu

PROFESSOR DUNNE
(217)-766-6787 bdunne@illinois.edu

NON EMERGENCY CONTACTS

Club Officers at uias@illinois.edu