

Hitchhiker's Guide to Using the Observatory Telescope

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Note: For more information or if you are having a problem, see the Contact List on the last page of this guide, the wall, or look at: <http://www.astro.uiuc.edu/~uias/observing>

Guidelines for Astronomy Club Members:

All of the members of the University of Illinois Astronomical Society may use the facilities at the Observatory once properly trained by a club officer. Trained members will be placed on a list that will be kept in the Astronomy Department office. To check out keys, show your ID to the secretaries in the office. The keys can be signed out from 8:30 a.m. to 5:00 p.m. on normal business days from 103 Astronomy Building (located at 1002 W. Green St., Urbana). The keys are given out on a first-come, first-served basis. If the keys are already checked out you are encouraged to contact the person observing that evening. In most cases the person will be happy to share his or her time with another observer. The keys must be returned to the office the following day by 11:00 a.m. Keys checked out on Friday must be returned the following Monday by 11:00 a.m. Failure to adhere to this policy may result in the loss of telescope privileges. If you wish to check out the keys on consecutive days, first return the keys and wait until 3:00 p.m. before attempting to sign them out again.

SOLAR OBSERVING is only permitted for club members who have been specifically trained to observe the Sun using the Observatory Telescope. Sorry, there's just too much that can go wrong unless you know what you're doing.

All classes, tours, and Astronomy Department activities take priority over club use. You must wait until the observing session is over before you can use the telescope. The Department holds regular class observing sessions on clear nights in September, October, April, and May. Only club officers are allowed access to the equipment in the Department's closet. If you are interested in using any of the Department equipment (for example, other telescopes), talk to an officer. *Club* equipment can be borrowed, but only with permission from an officer. The use of club equipment and the facilities at the Observatory are a special privilege given to the Astronomical Society. Use them to the fullest, but don't abuse them; it could result in the revoking of your and others' privileges.

Balcony, Observing Ladder, Light, and Guest Policies:

The balcony – especially the railing – are not considered safe enough to be on, so not advisable to do more than poking your head out the door or windows.

Be careful when using the top two steps of the observing ladder. Also be careful when moving the ladder around so that you don't break light bulbs off the wall or hit the telescope. The light outside the entrance can be turned off using the timer switch on the inside next to the entrance, and the red lights in the dome can be dimmed by turning the knob next to the door. A few guests are always welcome at the Observatory, but you are responsible for their conduct. Therefore it is recommended that you do not bring large groups.

If lights inside of Smith Memorial Hall are bothering you, simply go over and ask politely of students/employees in the respective rooms if they will close their blinds.

Procedures for Use:

The following sections provide a step by step method for setting up, using, and putting away the telescope. If at any time you are unsure of yourself, stop and call someone! A list of club officers and their phone numbers is located on the bulletin board next to the closet with the eyepieces, as well as on the last page of this guide. Do not, for any reason, extrapolate any of these procedures into something that you think may be correct.

Opening

There are two keys on the key chain. The key with the round head will open the north outside door of the Observatory and the key with the jagged head will open the Equatorial Room and the closets in this room. The first thing to remember is to always keep the keys in your pocket. This way they will not get locked in a closet, which is a good thing! Once inside the building, make sure that the front door locks shut.

1. The first thing that you need to do is **SIGN IN THE LOGBOOK!** Make entries for any deficiencies left by the previous user (i.e. power on, dome slit open, clocks not accurate, etc.). Be polite and brief with your remarks.
2. **OPEN THE NORTH BALCONY DOOR AND THE DOME SLIT.** This will allow the dome to reach temperature equilibrium with the outside and improve the seeing. The slit is opened with a hook-pole located in 201 (the closet next to the desk). Unfasten the ring from the retaining slot on the left side of the slit, 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. Another important note: never open or close the dome slit with the lens cap off. This way no debris will fall on the lens and damage it. Never open the dome slit if the wind is greater than around 35 mph. If you have any doubts as to whether it is too windy, don't open it.
3. **KEEP THE INSIDE DOOR** (from the dome to the staircase) **CLOSED** when you're not going through it. It lets warm air rise into the dome and through the dome slit, which will ruin the seeing (turbulence).
4. **TURN ON THE POWER FOR THE TELESCOPE AND DOME.** The power box is located on the lower west side of the telescope pier. Open the hatch and flip up the handle on the right. The dome will operate once this main power switch inside the pier is on.

5. **TURN ON THE DRIVE MOTOR (LEFT SWITCH) AND SETTING CIRCLE LIGHTS (RIGHT SWITCH).** The two switches are located on the north side of the pier. **Never leave the telescope unattended with the drive motor running.** The telescope could be driven into the pier.
6. **REMOVE THE FINDER SCOPE CAP.** Do **NOT** jump to reach it; use a chair if necessary.
7. **REMOVING THE PRIMARY LENS CAP WILL REQUIRE EXTRA EFFORT.** Unlock the telescope, and check to see that the counterweights are properly balanced (both visually and by cautiously checking to see that the scope more or less does not move freely after an applied force). If the telescope does not seem properly balanced, make note of this in the logbook and notify the Observatory Chairperson(s). Once this is complete, move the telescope in declination until it is at 0. You can see the declination by looking at the large setting circle. Lock the declination (the small knob) but leave the right ascension (large knob) unlocked. Using the right ascension motion wheel (the ship's wheel on the north side of the pier), rotate the telescope clockwise (westward) until the lens cap is within reach. If at any time there is resistance while attempting to move the telescope, stop. Something has gone wrong. From this point start over. Make sure that the declination wheel is locked and the right ascension is unlocked. If there is still a problem call an officer. Remove the lens cap by gripping both sides firmly and pulling evenly.
8. **PLACE BOTH LENS CAPS** felt-side down on the desk or back of the observing chair, so that dust will not collect on the surface that faces the lens. Reverse the procedure to bring the telescope back to its original position. You are now ready to observe! (Clap your hands and do a dance of joy.)

Using the Telescope to Observe

The eyepieces are stored in plastic cases in the basement Club Room (room 28), in the gray standing cabinet. The cases contain a wide variety of eyepieces. There are both 1.25- and 2-inch eyepieces, and there is an adapter on one of the shelves that will allow the 2-inch eyepieces to fit on the telescope. Filters and Barlow lenses are also available. Be careful with the eyepieces, especially when changing them. Some of the eyepieces do not fit very tightly so make sure that you hold onto them or remove them when moving the telescope or when observing nearly straight up. Do not leave eyepieces on the observing ladder where they are at risk of falling. **NEVER** touch the optical surfaces of any lens or eyepiece. Most of them have special coatings that are susceptible to damage from the alkaline and acid present in skin oils. **NEVER** try to clean any eyepiece or lens, **ESPECIALLY THE 12 INCH OBJECTIVE.** If something is really dirty, leave a note in the logbook or talk to one of the officers.

Moving the telescope is really very easy. It is important to remember to unlock the telescope before moving it and lock it again once the object has been located. Turn the knobs until they stop, but not so far that you can't undo them. If the telescope resists

movement, stop and check that it is unlocked. Never let go of the telescope if it is unlocked, it could move by itself and hit the pier. Only move the telescope using the knobs, not the finder scope or the brass rods on the side. Don't move the telescope at high velocities; you may injure yourself, other people, or even worse, the telescope.

The telescope is finely balanced so do not move the weights. If the telescope is out of balance, again, leave a note in the logbook or tell an officer. When the telescope is out of balance, it will move by itself when unlocked. Normal movements will be more difficult and the telescope will resist motion in some directions and accelerate in others.

To view objects in the western sky, the telescope must be on the east side of the pier. To view objects in the eastern sky, the telescope must be moved to the west side. To move the telescope to the other side is called a “roll-over” and is the most difficult procedure when using the telescope. The main idea is that you don't want the counterweights on the declination axis to rise above the telescope barrel and you also don't want the telescope to get close to the pier where it could hit and be damaged. Follow the steps below and everything will turn out fine.

1. **PLACE THE TELESCOPE IN STANDARD POSITION** (hour angle=0, declination=40).
2. **MOVE THE TELESCOPE TO +90 DECLINATION** or as close as you can reach. This brings the bottom of the telescope to the south.
3. Unlock the right ascension, lock the declination, and **ROTATE THE TELESCOPE OVER THE PIER** using the captain's wheel. Move the telescope slowly and watch what you're doing.
4. Once the telescope is on the other side of the pier (make sure that the weights are not above the telescope barrel) **UNLOCK THE DECLINATION AND MOVE THE TELESCOPE TO A COMFORTABLE POSITION**. Don't hesitate to use a chair in reaching the telescope. **MOVE THE TELESCOPE AWAY FROM 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. Always return the telescope to the east side at the end of your observing. As you may have noted, every action is always reversed to return to the initial state. This is because the telescope mount houses many control wires which can become twisted if the actions are not reversed.

Closing

When you are finished, it is very important to close properly. Make sure that the steps on this sheet are all completed. This list is also posted on the dome room door.

1. Return all equipment to its proper place (eyepieces, books, Moon globe, etc.)

2. Leave the telescope vertical on the East side of the pier and lock the knobs. (Hour angle=0, declination=40)
3. Turn the clock drive and setting circle lights off
4. Replace the primary lens cap. Be sure to line up the dots on the sides correctly.
5. Put the finder scope lens cap back on.
6. Move the dome so that the slit faces east, close the slit, secure the chain in the slot, and put the hook back in the closet.
7. Turn off the main power.
8. Close and lock the north balcony door, close and lock the windows, and lower the window shades if they were up. **TAKE CARE** that the **NORTH BALCONY DOOR IS LATCHED AND BOLTED** – it can look closed, but if not firmly bolted, it can & has blown open in stiff winds. Once it let in a squirrel who ate five years of observatory logs and gnawed the dome slit.
9. Complete the logbook entry. Write what you observed as well as any problems with the telescope or equipment. **REPORT MAJOR EQUIPMENT PROBLEMS** to one of the officers (see the contact list at the end of this guide). Any comments other than that are up to you... some people keep it short, others are known for their painstakingly detailed observing accounts... :) it's up to you.
10. Lock the closets (they lock as soon as you close them).
11. Turn off the lights in the dome.
12. Close and lock the dome door (this doesn't auto-lock – use the key).
13. Be sure the outside door is locked.
14. Turn the keys into the Astronomy Department by 11:00 a.m. the following business day.

Finding Objects:

For beginners, deciding what to observe can be difficult, especially if they don't know the sky very well. Initially, try to stick to bright objects such as the moon, planets, or objects close to bright stars. Then try finding fainter objects such as the Orion Nebula, Ring Nebula, or the Andromeda Galaxy. There are star charts located in the closet (201) that will show where these are. Start by using less complicated charts. Sky & Telescope and Astronomy are monthly magazines which are also very useful for deciding what to look for. They have a star chart for each month, positions of planets, moons, and comets, and dates for eclipses and other celestial events. You might want to look at a copy before you observe.

To find which eyepieces work best, try using them. After a while you will become familiar with how things look through the various eyepieces and which are most useful. In general it is best to start with a low power eyepiece, e.g. 32 or 40 millimeter focal length – long-focus eyepieces show wider fields of view. Then once you've located the object, move to a higher power, for example 17mm or 20mm, to see more detail. There will be a limit to usable magnification: magnifying too much will just make things fuzzier, not clearer. The limit depends on how steady the seeing is (influenced both by local turbulence (warm air rising through the dome slit), and by turbulence high in the

atmosphere), and on how high in the sky the object is (there's much more air in the path to a low-altitude object).

There are two ways to find objects. One way is to hop from bright stars to the object that you're looking for. Sight along the telescope tube in the direction of the object and use the finder scope to find and center the object. When trying to find faint objects it is usually easier to use coordinates, especially if you have never found the object before.

To find objects using their coordinates, look up their position in 1) one of the reference books, such as Burnham's or the Observer's Handbook, or 2) using astronomy software on the Observatory computer. Once the coordinates of the desired object are known, the declination (sometimes represented by δ) can be locked in since it is time-independent. You can use the numbers on the declination wheel or the vernier scale (read through the two microscopes at the eye-end and accurate to 30 arc seconds). The right ascension (sometimes represented by α) is used to compute the hour angle which is used to set the telescope to the other coordinate. The hour angle is calculated using the following formula:

$$\text{HOUR ANGLE} = \text{SIDEREAL TIME} - \text{RIGHT ASCENSION}$$

A word on clocks: there are three digital clocks on the desk in the Observatory. Two of the clocks keep Solar Time, that is, the time it takes the Earth to make one rotation about its axis relative to the Sun (most every clock keeps solar time... 1 solar day equals exactly 24 hours). One of the solar clocks in the Observatory marks local time and should thus be set to Central Standard or Central Daylight time (dependent on time of year). If the local time seems off, call Time & Temperature: (9)-351-2900 to check. The other solar clock keeps Universal Time (UT, also referred to as Coordinated Universal Time, UTC, or Greenwich Mean Time, GMT, the time at Earth's meridian). Universal Time is exactly 6 hours ahead of local Standard Time, and 5 hours ahead of local Daylight Savings Time. Universal Time is useful since most calendars of celestial events (e.g. eclipses, occultations, etc.) give time in UT. The third digital clock in the Observatory keeps *sidereal* time (pronounced like the words sigh-DEAR-ee-el). Sidereal time, unlike solar time, is measured relative to the stars. The period between two successive transits (when a star crosses the celestial meridian) of a particular star (except the North Star, which does not transit) marks a sidereal day. A sidereal day, like a solar day, is divided into 24 hours, though a sidereal day is approximately 3 minutes 56 seconds shorter than a solar day (1 sidereal day = 23h56m4s solar time). This is due to the fact that the stars maintain fixed positions on the Celestial Sphere throughout the course of the year, while the Sun appears to move around the Ecliptic. It is sidereal time that we use to calculate the celestial coordinates of an object at a given moment.

The digital Sidereal clock tends to be the lowest of the three digital clocks stacked on top of one another (though it's usually pretty easy to tell which is the Sidereal clock by noting the inconsistency in the minutes slot relative to the other two clocks—so long as you're not observing on the day of an equinox!). There is also a sidereal wall clock, located

above the computer. A program which calculates sidereal time as well as instructions for accessing the program are available on the Observatory computer.

In calculating Hour Angle, remember that when you borrow from the hours side you must borrow 60 minutes. If your result is negative, add 24 hours. If the result is greater than 6 and less than 18 hours then it is not currently visible during the night.

Example: You want to observe the Andromeda Galaxy. The Sidereal time is 22:45 and the right ascension is 0 hours and 40 minutes.

Hour Angle = 22h 45m -0h 40m = 22h 05m

Move the telescope to the correct hour angle (you can look at the hour angle wheel). The telescope should now be positioned correctly. Position the object in the finder scope and then look at it through the main telescope.

Contact List:

If at any point you observe something non-trivial to be broken, malfunctioning or you break something yourself, it is *imperative* that you call one of the club officers. (If you are unsure if the item broken is of importance, call an officer). Lesser important items (e.g. lightbulbs) should warrant an email to one of the below officers or to uias@uiuc.edu

Name:	Phone:	Email:
Mike Lockwood	398-9778	melockwo@uiuc.edu
Stuart Levy	369-3485	slevy@ncsa.uiuc.edu

Final Words of Advice & Caution:

Nearly everything in the Observatory—the dome, the floors, the telescope—is **old** (the club is in the endless process of getting historical timelines, photographs, and documents up on the web—if you're interested you can help out!) The Observatory facilities have been designated a National Historic Landmark. That means the property “commemorates and illustrates the history and culture of the United States.” In other words, the U.S. Department of Interior recognizes the Observatory as a place of national historic significance. Thus, care and patience when using the facilities must be everyone's top priority.

Expect opening/closing procedures to take a good 15 minutes each or longer your first time. Carefully follow the procedures outlined in this guide! Patience is also important

for observing: you must allow enough time for temperature inside the dome to reach equilibrium with the outside and currents within the telescope tube itself to settle before “seeing” can be maximized. Sometimes air masses shifting in the atmosphere will simply be too turbulent to allow good seeing. The bottom line is to avoid frustration and take your time. If something seems to be broken or not working properly, don’t hesitate to call an officer.

Happy Stargazing!