

MARYLAND SPACE GRANT OBSERVATORY - OBSERVATORY PROCEDURES

I. STARTUP

1. If you haven't already, head back downstairs and prop open the door. This is necessary for ventilation and gaining temperature equilibrium.
2. Turn on outside and inside red lights. The outside lights let people (and security) know that the observatory is in use.
3. Plug in the dome slit cord, decide where you will be observing (near zenith or near horizon), and open the dome slit accordingly. If you will be observing near zenith, pull the chain located on the right side of the slit and flip the switch to open. Hang onto the chain until the upper portion of the slit has cleared the hooks, then you can let it go. When the slit is all the way open, it will automatically stop.
4. When the dome slit is open, switch the controller off, unplug the box-like connection above the controller switch (leave the cord plugged from the wall), and put the end of the cord all the way up on the metal ledge of the slit opening. **DO NOT FORGET TO UNPLUG THE CORD.**
5. Begin log entries.
6. Turn on the PC monitor on the right and adjust the contrast and brightness to a comfortable level. The computer should be ON; if it's not, see the TROUBLESHOOTING section – How to Reboot the Computer.
7. Check the telescope coordinates – HA (hour angle) should be 0h0m0s. DEC (declination) should be 39°17'18" (Baltimore's latitude), and the telescope should be pointing at zenith.
8. Check the blue front panel's switches: MAIN POWER should be always ON, red HALT MOTORS button depressed, and all other switches off (down=off).
9. Turn on MTR DRIVER CHASSIS.
10. Release HALT MOTORS (push it so that it's not depressed).
11. Turn on DRIVES.
12. Use the handpaddle to move the telescope over to the south (S) and west (W) and remove the yellow cover from the main telescope and the black lid from the finderscope. Put them on the lower tray of the metal cart to keep them from getting dusty.
13. Turn on TRACK. You can also turn on the AUX TRACK at this point.
14. Turn on DOME TRACK.
15. Turn on AUTO DOME, if desired. You can also control the dome manually.
16. Observe and have fun! (Check Section II for further details).

Note that there is one switch left off: EXTERNAL COMPUTER; the main computer is not connected to any external computer.

II. OPERATION PROCEDURES AND USEFUL INFORMATION

1. Operating the Computer Control System

- i. The first thing to do is to get into the MOVEMENT MENU, as indicated in the box in the lower right side of the screen. Typically, the computer will already be in this menu. If it is not, click the ESC button repeatedly, until reaching the MAIN MENU. This menu has the following four choices:

1. Initialization Menu
2. Movement Menu
3. Rates Menu
4. Miscellaneous Menu

Select the Movement Menu (option 2).

- ii. In the Movement Menu, you are given the following choices:

1. **Set slew position** – this option will prompt you for the coordinates of the object. Type in the right ascension (RA), declination (DEC), and EPOCH (of the equinox for the coordinate system you are using). This can be a little tricky, as the computer demands a particular format. For example, if you want to enter 9h 22.5m in RA, 30° 45.2' in DEC, and 2000 in EPOCH, you need to first convert the 22.5m into 22m and 30s, and the 45.2' into 45' and 12", then enter the following sequence:

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09 [space] 22 [space] 30 [enter] 30 [space] 45 [space] 12 [enter] 2000
[enter]
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If you make a mistake, continue to the end; you will have an opportunity to correct after the final [enter] – an “Any changes?” prompt will appear; answer “yes” or “no,” as appropriate. If you answer “yes,” you will be returned to the data entry process, hitting [enter] will take you to the next item, leaving the previous one unchanged. If you answer “no,” you will be returned to the Movement Menu.

If your target is within range (i.e., far enough above the horizon for safe telescope operation,) a highlighted box saying “SLEW ENABLED” will appear on the screen. You can now make the telescope slew by selecting option 7, Start Slew. If not, a highlighted box saying “TARGET OUT OF RANGE” will appear. You can then try a different target or check your coordinates.

Finally, ALWAYS CHECK THAT THE AREA AROUND THE TELESCOPE IS CLEAR OF PEOPLE AND OBSTRUCTIONS BEFORE SLEWING.

These last steps are the standard conclusion to all options 1 through 5.

2. **Set offset** – this option allows you to move the telescope a specific number of arcseconds away from the current position. This is useful in finding objects whose coordinates are often referred to a prominent object. For example, supernovas are often located relative to the nucleus of a galaxy: “Move off the nucleus by 2 arcsec west and 10 arcsec south to find the supernova.”
3. **Select library object** – this option enables you to access the built-in library of interesting objects. A list of this library is in the navy blue binder on the desk. Objects are listed in order of increasing right ascension. Entering “3” will give you an “OBJECT” prompt, then type the number of the object from the list. Note that objects 1-100 are simply the corresponding Messier number. Again, you will be asked “Any changes?” before the computer flips you back up to the Movement Menu.

4. **Select table entry** – this option accesses the customizable table of objects. Forty objects can be entered into volatile memory. To make a table, go back to the MAIN MENU, select “4”, Miscellaneous Menu, then option “3”, Set Table Entries. Enter the data as shown. Note that you can enter the current telescope position by entering all zeroes for the coordinates.
 5. **Set zenith position** – this option is used to return the telescope to its rest or shut down position, which is when it is pointing to the zenith. This label is something of a misnomer; it should say: “point telescope to zenith.” The only unusual thing encountered here is that the control window/box will tell you to turn off TRACK before slewing. This instruction is just to ensure that the telescope does not immediately track off the zenith.
 6. **Start trail** – this option is a different type of movement from slew. The telescope has the built-in capability to trail in an arbitrary direction. This is a holdover from the days of spectroscopy observations on photographic plates, which were often trailed along the slit to get better signal-to-noise. In modern times, this feature might be used to automatically follow a moving target, such as a nearby comet. Before using this option, you must set the trail rate, which can be done by going back to the MAIN MENU, selecting “3”, Rates Menu, then “3” again, Set Trail Rates, and putting in the appropriate numbers. Now go back to the MOVEMENT MENU and choose option “6”.
 7. **Start slew** – this option sends the telescope over to your chosen object. Note that this option is only effective when the highlighted “SLEW ENABLED” box appeared on the screen. Instead of typing “7”, you can also use the big green “GO” button on the desk’s front panel (some people get thrills from this). Finally, make sure that the area around the telescope is clear before slewing it.
 8. **Stop** – this option will quit any procedure the computer is currently executing. For example, if you have chosen a target and the “SLEW ENABLED” box has appeared on the screen and then you decide to go to another object, you need to use option “8”, Stop, to quit the procedure before entering the next object’s coordinates. The big red “STOP” button on the desk’s front panel performs the same function as option “8”.
- iii. Some of the other menus and menu items are discussed elsewhere, particularly in the TROUBLESHOOTING section.
 - iv. The [ESC] button on the keyboard will quit any procedure of the computer control program and, in general, get you out of situations you don’t want to be in.

2. The Handpaddle

- i. There are 2 of these guys – one hooked to the telescope and the other sitting on the metal cart. Either can be used. If you simply want to bypass the computer guidance, you can point the telescope manually with these.
- ii. Telescope motion is one of three speeds: guide, set, and slew. For guide speed, simply press the corresponding N, S, E, or W buttons. For set or slew speeds, hold down the SET or SLEW button and simultaneously press the N, S, E, or W buttons.
- iii. Focus with the top two buttons. A high speed focus can be achieved by using these buttons in conjunction with the SET button.

3. Available Eyepieces

- i. There are 5 eyepieces that can be used on the 20” telescope – the 55mm (diameter 2”), 32mm (2”), 25mm (1.25”), 15mm (1.25”), and 8mm (2”). The 55mm is normally the piece on the telescope; the 32mm is the finderscope’s eyepiece, and the others reside in

the black plastic box on the desk. There is also an adapter for the 1.25" eyepieces to fit the 20" telescope. (Oddly enough, while the 32mm will fit the slot on the 20" telescope, the 55mm will NOT fit in the finderscope).

- ii. These eyepieces are held in place by a screw on the mount. Take great care to firmly (but not excessively, as the threads would be stripped) tighten the screw when changing the eyepieces. Also, handle the pieces with caution. They are expensive.
- iii. These eyepieces all have different focal points. On the monitor, there is a number labeled FOCUS the appropriate settings are as follows:

55mm	655 ± 10	(The focus will vary around the central value
32mm	735 ± 10	depending on atmospheric conditions, angle
25mm	920 ± 10	above horizon, temperature, and object type)
15mm	1000 ± 10	

The focal length of the telescope is 4064mm; this value divided by the eyepiece's focal length gives the magnification.

4. Available Filters

- i. There are 5 filters: deep sky, lunar, and 3 color filters. The deep sky is 2" in diameter and thus can be used with all of the eyepieces (the adapter for the 1.25" eyepieces has threads so the filter can be screwed on). All the other are 1.25" and thus must be used with the 25mm and the 15mm eyepieces.
- ii. The deep sky filter blocks the most common light pollution wavelengths: Hydrogen-b (486nm) 96%, Oxygen III (501nm) 93%, Hydrogen-a (656nm) 95%, premium (496nm) 93%. This makes the sky background look much darker. Supposedly, nebulae are much easier to see, but we haven't yet noticed any big improvements; however, marked improvements have been seen when looking at open and globular clusters.
- iii. The lunar filter uniformly reduces transmission of light across the spectrum by 87%. Lunar features are easier to discern, as they are not longer lost in the glare.
- iv. Color Filters
 1. The 80#A Blue (30% transmission) enhances the boundaries between Jupiter's reddish belts adjacent bright zones and details of the Great Red Spot; brings out detail in Saturn's belts and polar phenomena; useful in studying Mars' surface features and caps; and enhances lunar details under dark sky conditions.
 2. The 21# Orange (46% transmission) reduces or blocks transmission of blue-green wavelengths; on Jupiter and Saturn, it enhances detail in the belts and polar regions; sharpens boundaries between yellow-orange areas and blue-green regions on Mars; and enhances lunar features.
 3. The 23#A Red (25% transmission) does approximately the same functions as the 21#, but with stronger contrast and enhancements or marginally defined blue-green surface detail; useful primarily on Jupiter, Saturn, and Mars.

5. Other Equipment. There is a CCD camera installed inside the telescope for astrophotography. However, the use of this equipment requires additional training and/or the presence and cooperation of the Observatory Technician.

6. Additional Computer at the Observatory. This computer can be used to search for information on the Web, among other things. The username and password to gain access to this computer is located on the first page of the logbook. There are a couple of links with useful information related to astronomy in the bookmarks menu.

III. SHUTTING DOWN

1. Turn DOME TRACK to home (down). If you have not been using AUTODOME, you will need to turn that switch on; otherwise the dome will not automatically return to its home position (south). You can manually return the dome home.
2. When the dome has returned to home position, turn AUTODOME off.
3. Use the handpaddle to move the telescope south and west again. Replace the telescopes' covers.
4. Turn TRACK off (and AUX TRACK if on).
5. In the Movement Menu, select #5, *Set Zenith Position*, then #7, *Start Slew*, (or press the green GO button).
6. Once the telescope is "homed" to zenith, turn DRIVES off.
7. Depress HALT MOTORS.
8. Turn MTR DRIVER CHASSIS off.
9. Plug together slit cord and close the dome's slit.
10. When the dome slit is closed, turn the controller switch off and unplug the cord from the box-like connection above the controller switch, and from the wall.
11. If any other switches are still on (except the MAIN POWER), turn them off.
12. Turn off the PC monitor.
13. Complete logbook entries.
14. Tidy up: make sure that you remove any eyepieces from the main telescope and secure them in the black plastic case. Make sure that the 32mm eyepiece is back on the finderscope. Also, tidy up the reference books on the desk.
15. (Downstairs) turn off all lights.
16. Un-prop the door and pull it closed (jiggle a bit to be certain lock has caught).

IV. TROUBLESHOOTING

DON'T PANIC. It is almost impossible to damage the telescope permanently by accident.

1. *Observing Near the Motion Limits of the Telescope*

- i. The telescope cannot reach objects below DEC of -35° on the meridian.
- ii. If you enter a coordinate that is out of range, a highlighted box will appear on the monitor telling you so. If you are approaching the limits, a highlighted box will appear on the monitor telling you that too.
- iii. When slewing with the handpaddle and approaching limits, the slew rate will drastically slow to only a bit faster than the set rate. This is your warning.
- iv. If the telescope is down near the horizon (and the screen tells you "APPROACHING LIMITS"), and you select another object on the computer, tell the telescope to slew, and the telescope does NOT move, use the handpaddle to move the telescope up, until it is once again slewing at the normal rate. Now, you can reenter the object into the computer, tell the telescope to slew, and watch it obediently move to the new coordinates.
- v. If, despite all warnings and indications, you manage to get the telescope low enough that it is stuck (i.e., not responding to the computer commands, handpaddle, etc.), your observing run for the night is over! Follow the shutting down procedures in section III (except, of course, for sending the telescope back to the zenith). Contact the Observatory Technician as soon as possible and report the problem. Fixing this requires bringing the experts.

2. *Telescope Not Aligned*

i. Method #1

1. Turn off AUTO DOME so it won't annoy you.
2. Using the planisphere, pick a bright star that is currently visible in your sky, which you can easily identify (e.g., Vega, Deneb, or Altair in the summer; Sirius, Rigel, or Betelgeuse in the winter).
3. Point the telescope (with the handpaddle) to the selected star. You may first want to find the star using the finderscope, and then use the main telescope to center the star.
4. After you have centered the selected star in the main telescope, use the Catalog of Objects (navy blue binder on the desk) to find the coordinates of this star (you may want to find the right ascension of the star in the planisphere and then find it in the catalog).
5. In the main computer, escape to the MAIN MENU, select #1 Initialization Menu, then #2, Set Telescope Position.
6. Turn TRACK off. Enter the coordinates of the chosen star (RA and DEC). Remember to enter 2000 under EPOCH if using the catalog.
7. The telescope should be aligned at this point. Select a known object from the catalog and send the telescope there to confirm the proper alignment of the telescope.

ii. Method #2

1. Turn TRACK off (you should probably also turn off AUTO DOME, so it won't annoy you).

2. Align telescope by eye (or use the bubble level located inside the black plastic box on the desk) to the zenith position.
3. In the Movement Menu, select #5, Set Zenith Position. Do NOT start slew or press the GO button.
4. Escape up to the Main Menu, select #1, Initialization Menu, then #2, Set Telescope Position. Enter all zeroes to set telescope to next object position.
5. Turn TRACK back on.
6. Go back to the Movement Menu and choose #3, Select Library Object.
 - a. Using the sidereal time (ST) as a guide, pick a 400-series ephemeris star halfway between the horizon and zenith. Example: ST is 18:34:00. The ephemeris star close to the zenith is then 418. Halfway to the horizon is 3 hours away, so either 421 or 415 will work.
 - b. Alternate strategy: considering Baltimore's usual haziness and overall sky-brightness, we work with the options available. In the summer, you can typically identify with certainty Vega (library #284), Deneb (#421), and Altair (#508) [the summer triangle], and Mizar (#250) [the middle star in the handle of the Big Dipper]. In the winter, Sirius (#228), Rigel (#214), and Betelgeuse (#507) in Orion can be easily found. If you are good at constellations and have one of those extremely rare, remarkable clear nights, your choices naturally expand. Type in the library number of an appropriate star.
7. Select #7, Start Slew, or press the GO button. The telescope will move to what it believes is the star's position – this may be way off.
8. Center the star in the finderscope using the handpaddle. This can take quite a while, so be patient.
9. Move the reticle eyepiece in the Guide-Acquire Module to center position – the drawer fully in, and the white mark as 7.9 cm for left/right position. If you can't see the crosshairs, turn up the brightness of the lines (follow the wires up to a box with two knobs on it; fiddle the knobs until the lines glow red (clockwise = on, counterclockwise = off). This eyepiece focuses at about 1080.
10. Center the star, again, using the handpaddle.
11. Go to Initialization Menu and choose #2, Set Telescope Position. Enter all zeroes to set the telescope to object position.
12. Double check now. While the reticle is still in position, you probably want to go to a few more obvious objects (e.g., distinct double stars) to ensure that the telescope is properly aligned. Also, turn back on AUTODOME to see if the dome is aligned with the telescope; if not aligned, correct as described in the next section.
13. Dim the reticle lines all the way, and slide the eyepiece back over to the left side.
14. The telescope should now be aligned with the sky. If not, repeat steps, making sure that you have acquired the correct star.

3. *Dome Not Aligned*

- i. Switch AUTODOME off.
- ii. Point telescope fairly low on the horizon with the handpaddle.
- iii. Align the dome with the telescope with the handpaddle.
- iv. Go to Initialization Menu, choose #3, Dome Position. Enter zero to autoselect to telescope position.
- v. The dome should now be aligned with the telescope. Check by turning AUTODOME back on.

4. *Dome Slit Not Closing*
 - i. This is a rare problem – not a big worry. This means that something is broken in either the motor or the power cord. You can't fix this – report to the Observatory Technician.
 - ii. You do, however, need to close the slit. Head downstairs, and look to your right, where the ventilation pipe is. Hanging on the wall to your right is a long pole with a hook at top. Grab it and maneuver it back upstairs.
 - iii. The motor that opens and closes the slit is at the top of the dome. Protruding from it is a loop. Fit the hook on the end of the pole through the loop.
 - iv. Crank the dome closed. The slit is **heavy**. This is quite a job.
 - v. Put the pole back downstairs.

5. *Computer System Crashes (the last and worst of the problems). READ THIS ALL THE WAY THROUGH BEFORE BEGINNING THE PROCEDURE.*
 - i. Determine if the system has indeed crashed:
 1. The telescope does not respond to handpaddle or computer commands (and this is NOT because it is way down near the horizon). A word of caution here: if the highlighted block on the monitor reads SLEW ENABLED, or the telescope is still slewing (the monitor reads SLEWING in a highlighted box, even if the telescope doesn't appear to be moving), your control is briefly forfeited. You can regain control by pressing the big red STOP button. If that fails, you have bigger problems. Continue reading.
 2. The computer does not accept input (e.g., you try to switch menus and nothing happens, or it doesn't respond to [ESC]).
 3. The computer continues to ask for input, even when you have given it input many times ([ESC] included).
 4. The HA values are no longer changing, even though TRACK is on.
 5. The above are the known and usual signs. There may be more...
 - ii. Turn off all switches (except MOTOR DRIVES CHASSIS and MAIN POWER) and depress HALT MOTORS.
 - iii. Lift up the flap beneath the row of switches on the blue front panel. This shows you where the computer is.
 - iv. Locate the reset button and the power switch. Press the reset button, or turn the computer off, wait 5 seconds, then back on.
 - v. **Wait.** The computer will boot up, until a prompt appears.
 - vi. Enter 3:TCS.
 - vii. **Wait.** The software should make the familiar screen appear. If not, then go to step iv.
 - viii. Now you must reset the date and time. Go to Initialization Menu, choose #1, Set Date and Time, and enter the year, month, day, and time. Note that the time must be universal time (UT – also known as Greenwich Mean Time, based in London, England). To convert, add 5 hours to EST or 4 hours to EDT and put it into 24-hour time. Also, if the time is late evening, it would already be the next day in London, so you may need to add one to the day's date.
 - ix. Realign the telescope as described in sub-section 2.
 - x. The dome may need to be realigned as well. Follow instructions in sub-section 3.
 - xi. Rejoice and resume observing. This procedure may take up to two hours to complete if you are unfamiliar with any of the many factors involved. If you really don't feel like doing this and no one is observing after you, you can pass the chore on to the Observatory Technician.



OTHER PROBLEMS? QUESTIONS?

Observatory Phone Number: (410) 516-6525. To call off campus, dial 9, listen for the dial tone, and dial the phone number. The observatory will not call long distance numbers.

JHU Security Phone Numbers:

Emergency extension: x67777

Information extension: x64600

Escort Services: x68700