

UNIVERSITY COLLEGE LONDON

University of London Observatory

PHAS1130 Practical Astronomy 1112.1

Use of the Fry Telescope

The Fry Telescope is an 8-inch $f/15.75$ achromatic refractor (focal length 3200 mm) originally built in 1862 and restored by Mr. Ron Holder at ULO. After restoration it was remounted in the new dome building at ULO in September 2000. It is set on a German equatorial mounting and its clock drive is powered by a slowly falling weight. For further information about the Fry and the restoration programme, see the Observatory's web page¹.

For PHAS1130 training, the sections to be covered in depth are §§1, 3, and 4. The dome control (§2) will only be described or demonstrated; dome operation is also practised by students during the Celestron training. Each student will be assessed, and up to 10 marks awarded, to check their understanding and practical operation of the Fry telescope, according to the checklist given in §7.

1 Safety and General Precautions

When operating the Fry telescope, one is often required to use a step-ladder to access the eyepiece, lens cap, setting circles, *etc.* It is therefore highly important that attention is given to working safely with the telescope to avoid damage either to yourself, another student, or the instrument. Do not take a risk (“I could probably reach it if I just leaned a little further . . . oops!”); always ask for assistance if required.

When operating the Fry telescope:

1. Be careful when you move the telescope — ladders and people can get in the way and the telescope or others could get damaged.
2. Never leave the telescope unclamped — even if you're away from it just for a second.
3. Never unclamp the telescope in both RA and DEC at the same time; unclamp and move only in one axis at a time.
4. Never *ever* leave the drive on when you leave the dome.
5. Please treat the eyepieces with the same respect as the telescope:
 - only *one* eyepiece should be out of its case at any one time;
 - take special care not to touch or breathe on the eyepiece lenses.
6. If there is a problem, seek the assistance of a demonstrator or technician.
7. Make a note of everything you do in the logbook (right-hand pages!).

¹<http://www.ulo.ucl.ac.uk/telescopes/>



2 Dome Control

For dome operations, there are two sets of controls — one for opening the shutter and one for dome rotation. It is important that one has regard for the safety of individuals and equipment when operating the domes. Again, always take special care when using ladders or steps.

1. Whenever the dome shutter is opened or closed, the telescope must be covered or moved to a position where dislodged grit and dirt cannot fall onto the telescope objective lens. At the beginning of the night, leave the telescope covers on until the dome is fully open. At the end of the night, cover the telescope first before the dome is closed.
2. The ‘park’ position for the dome is with the shutter to the N, so that the shutter motor control is S of the telescope pier and accessible from a ladder.
3. On first entering the dome, and with the dome in the ‘park’ position, the shutter power-lead should be uncoiled from the stow-hooks (a ladder is required — take care!) and plugged into the power supply on the South wall. The shutter can then be opened using the controls (‘FOR’ward). The person operating the controls should stand next to the controls while the shutter is in motion, ready to turn it off if a problem occurs. When the shutter is fully open, the power automatically cuts out, and the controls should be switched to the OFF (central) position.

N.B. The power lead must then be disconnected and safely stowed on the hooks before anything else is done.

4. The dome can be rotated using the handset attached to the pillar or on the South wall.
5. At the end of the night, the dome should be moved to the ‘park’ position and the shutter power-lead uncoiled and plugged in. The shutter is closed by selecting ‘REV’(erse), and again, the operator should stand ready by the controls until the dome is closed. The controls should then be moved to the ‘OFF’ (central) position, and the power lead disconnected and safely stowed on the hooks.
6. Note that when opening the shutter, the lower section gets picked up by default, but obscures the zenith when fully open. If you wish to observe near the zenith, the pick-up section can be left down (obscuring objects at lower altitudes) if one person releases the catches by pulling on the chain (ladder required!) while another operates the shutter. The catches engage automatically when the shutter is next closed.

The whole process of closing, dropping or picking up the lower section, and re-opening takes about 3–4 minutes, so it is not horribly inconvenient to change over; but note that —

- (a) the dome must always be rotated to the ‘park’ position first, to enable power to the shutter to be supplied;
- (b) as noted above, the telescope must be moved to protect it from dislodged particles of dirt;
- (c) efficient observing requires students to think ahead (!) about where their targets are placed to avoid having repeatedly to lower or raise the pick-up section.

3 Telescope Operation

(You may want to refer to Figure 1, which shows all the parts of the telescope labelled.)

On entering the dome, one normally finds the Fry telescope in its ‘park’ position on the west side of the pier. The following sections describe the main telescope controls.

3.1 Clamps

The telescope moves about two axes (see diagram). In order to move the telescope, it needs to be unclamped in one or other axis so that the telescope can be moved about this axis, and then reclamped in position.

The upper of the three wooden rods attached to the telescope tube (with the telescope on the west of the pier), is the clamp for declination (E). (This rod has a brass spot on the end, so you can always tell — or feel — which of the three is the clamp, whatever the telescope orientation.) The RA clamp is the one on the flexible connector (B), attached to the telescope mount near the worm gear.

To unclamp the telescope in either axis, take hold of the clamp and twist it about half a turn (or more) anticlockwise. The telescope is now free to move. It is best to move the telescope by holding only that part of the breech end which is covered in perspex (to avoid long-term corrosion of the brass parts by repeated handling). Movement in either axis can also be achieved by holding the handles on the wheel (R) at the end of the declination axis.

Clamp the telescope by turning clockwise until the clamp is hand tight. *Do not over-tighten the clamps.*

3.2 Slow motion controls

The other two rods (H,I) of the three attached to the telescope tube operate the telescope slow motions: in RA (the middle one, H) and declination (lower, I). (So remember, the outer pair are declinations controls — clamp and slow motion — and RA is in the middle.)

When one first enters the dome to start observing, you should check that the slow-motions are approximately centred (*i.e.*, check that the tangent-arm nut [W,X] is in the centre of the screw). Each nut should also be approximately re-centred after a night’s observing, ready for the next observing session.

When using the slow-motion controls, take care not to screw them to the very end of their travel; forcing them up to their limits will damage the tangent screws. If you run out of travel for the slow-motion control, wind it back to re-centre the tangent-arm nut, unclamp the axis and move the telescope slightly to find your object again; then clamp and use the slow-motion control to centre the object.

3.3 The telescope drive

The telescope drive is started by releasing the brake (J); the governor should begin to rotate freely as the weights fall. Make sure that the telescope is not in a position where it may drive into the pier! (See §4.2 below.)

Rewind the drive (K) about every 20 minutes. Rewind the pulley to about 10 cm below the drive support-bracket; *no higher*. The handle may be removed or repositioned to avoid collisions with the telescope.

Do not adjust the controls on top of the drive; these set the drive rate and must not be interfered with.

4 Observing procedures

In order to observe with the Fry, the dome must first be opened, of course, and the telescope uncapped. Then the telescope can be set on the target, using the finder to help locate it. If precise setting of the telescope position is required (for faint targets, say), the setting circles need to be used.

4.1 Uncapping the telescope

1. To uncap the telescope, unclamp it in declination, then carefully move the telescope to an almost horizontal position, avoiding collisions with ladders and any parts of the drive.
2. Climb a stepladder, and remove the 8-inch lens cap (A); it is quite heavy so take care not to drop it. The fit is snug, so some twisting or gentle rocking as you pull may help.
3. The finder lens cap (C) should also be removed (unless solar observing is being carried out, in which case you won't touch the telescope until it has been set up by a technician for safe observing).
4. Store the lens caps on a table out of the way.
5. Move the stepladder out of the way, and move the telescope back to its original position.

4.2 Which side of the pier should the telescope be?

Before even attempting to move to a chosen target, you must check that the telescope is on the correct side of the pier for observing: when on the west side of the pier, the telescope cannot move much further west than the meridian before either the telescope fouls the pier, or the RA clamp fouls the worm gear. Therefore, the telescope can only conveniently be used to observe objects close to or east of the meridian (so one is 'looking over the top' of the pier). The opposite is true when the telescope is on the *east* side of the pier. From that position, it is only convenient to observe objects *west* of the meridian.

The process of moving the telescope from one side of the pier to the other is called *reversing the telescope*, and students need to know when and why it needs to be done, and how to do it safely.

Bear in mind that objects will move from east to west during the course of the night, so it is unwise to begin an observation with the telescope west of the pier if the object is close to the meridian. Reverse the telescope first.

4.2.1 Reversing the telescope

When reversing the telescope, always watch carefully to avoid collision with ladders or other parts of the telescope. Using ladders or steps carefully, as required, to reverse the telescope:

1. Move in declination until the telescope tube is parallel to the polar axis (*i.e.*, declination is about $+90^\circ$). Clamp the telescope in position.
2. Unclamp in RA, and traverse the telescope through 12 hours moving *over* the polar axis. Move in hour angle only by pushing/pulling on the wheel (R), not on the end of the tube.
3. Clamp in RA, then unclamp in declination and bring the telescope back to point nearer the celestial equator again.

(Note that with the telescope on the east side of the pier, the RA clamp is high up, so a ladder is needed to reach it.)

4.3 Finding a target

The telescope can be pointed at the target by alternately moving the telescope in RA (or hour angle) and declination, slowly converging on the object.

Locate the object in the finder (D) first. You probably should use the lowest magnifying eyepiece on the telescope itself to find your object. After you can see the object in the field of view, you can use the RA and Dec slow-motion controls [(H) and (I)] to centre the object.

4.4 Eyepieces

Eyepieces are expensive and have delicate optical surfaces, so handling them correctly is important. Hold them firmly in both hands, horizontally, so that your breath cannot touch the glass. The magnification is given by $M = f_{\text{telescope}}/f_{\text{eyepiece}}$ where f is the focal length. Longer focal length eyepieces give wider fields of view. Most eyepieces have a diameter of 1.25-in. It is also possible to change over to a 2-in diameter eyepiece. The focus knob G is on the side of the main eyepiece tube. Always focus gently; never force the knob.

In some positions of the telescope, use of a star diagonal may be convenient. When using the diagonal, the secondary brass tube that holds the eyepiece must be pushed in to bring objects into focus. This tube fits tightly, so it may be necessary to help it by using a twisting motion. Whenever pushing or pulling this tube, it is essential to hold the primary brass tube G that it fits into, to prevent it moving. Grip firmly. If it is carelessly pulled out, the precision focus rack and pinion gear will be damaged.

5 Using the Setting Circles

For more precise work and for finding objects which are not visible with the finder, the setting circles are used to set the object's right ascension (O) and declination (V).

The right ascension and declination setting circles have silvered scales. Both scales have small eyepieces [(P) and (U)] attached to enable you to read the scales. *Never touch the metal surfaces of the scales or verniers; treat the eyepieces with care.*

5.1 The declination circle

Set the declination first. First, check that the telescope will not collide with anything if it is moved in declination.

To set the declination:

1. Unclamp the telescope in declination (E), and rotate the telescope with the thing that looks like the wheel of a ship (R) until the declination scale (V) reads close to the correct declination at the pointer arrow.
2. The declination scale is divided into degrees which are further subdivided into 6 smaller units (each is 10 arcminutes). The figures on the declination scale are in mirror writing, since prism eyepieces will eventually be used to read them (introducing a reflection).
3. Rotate the telescope and set the arrow to the nearest 10-arcminute division. When you are close, ask your partner to clamp the telescope, and you can then use the upper declination slow-motion control to set the scale to the nearest arcminute.

5.2 The right ascension (hour) circle

When setting the RA of the object, one has to allow for the fact that the *hour angle* of the object is constantly changing. To account for this, the RA (hour) circle has two vernier scales attached — one for setting the object RA and one for setting the sidereal time. So the telescope works like an analogue computer, setting the correct hour angle for you! The vernier visible below the ruled circle is clamped into alignment with the local meridian; the other one above (actually, there are two of these, marked A and B, 12 hours apart) moves with the telescope. When both are correctly set, the object should appear in the telescope field of view.

1. To set the RA, carry out the following steps:
 - (a) First, switch off the telescope drive.
 - (b) Then disengage the ruled hour-circle worm gear with the knob and cam provided (M).
 - (c) **N.B. Avoid touching the silvered scales with your fingers!** Using finger pressure underneath the circle, rotate it until the desired RA is nearly aligned with the *lower* fixed vernier arrow. Lock the worm gear (M) and use the fine-adjustment knob (N) to get the RA as exact as you can; using the vernier, it should be possible for you to read to ± 2 seconds. (Read the scales using the magnifier provided).
2. Next, to set the local sidereal time (LST), do the following:
 - (a) By moving the telescope (unclamp the RA!), set the *upper* vernier to approximately the value of LST for observing to commence. Use the LST clock and estimate about 3 minutes ahead. This part is tricky because you cannot move the telescope while looking at the scale — it helps to have two people!
 - (b) Clamp the telescope in RA, and read the exact LST set on the vernier.
 - (c) About 15 seconds before the LST clock agrees with the LST set on the circle, start the drive. This allows time for the drive to accelerate to the correct rate.
3. If you have done everything correctly, the object should be centred in the field of view. (This method can be used to find stars in the daytime.)

6 Closing Down

When closing down, please remember to do the following:

1. Turn off the drive.
2. Return the telescope to the W side of the pier.
3. Remove and store the eyepiece.
4. Replace the lens caps (*before* closing the dome).
5. Close the dome, and park with the shutter to the N.
6. Park the telescope on the W side of the pier at a small positive declination close to the meridian.
7. Clamp the telescope in both axes.
8. Check the positions of the slow-motion screws and re-centre if necessary.
9. Sign the logbook.
10. Final check that the drive is off.
11. Final check that the telescope is clamped in both axes.

7 Training Check List

On completion of training, the student should be able to do the following:

- describe the safe and correct procedures for operating the telescope dome;
- demonstrate the proper use and handling of eyepieces;
- focus the telescope;
- move and operate the telescope safely without fouling the pier and without touching any metal parts other than the focus mechanism;
- reverse the telescope safely and explain when and why it needs to be done;
- read the sidereal clock and give a brief definition of sidereal time;
- estimate roughly where an object of given RA and DEC should be at a known sidereal time;
- operate the drive correctly.

Following training, each student will be examined individually and is expected to demonstrate basic competence in operating the telescope safely.

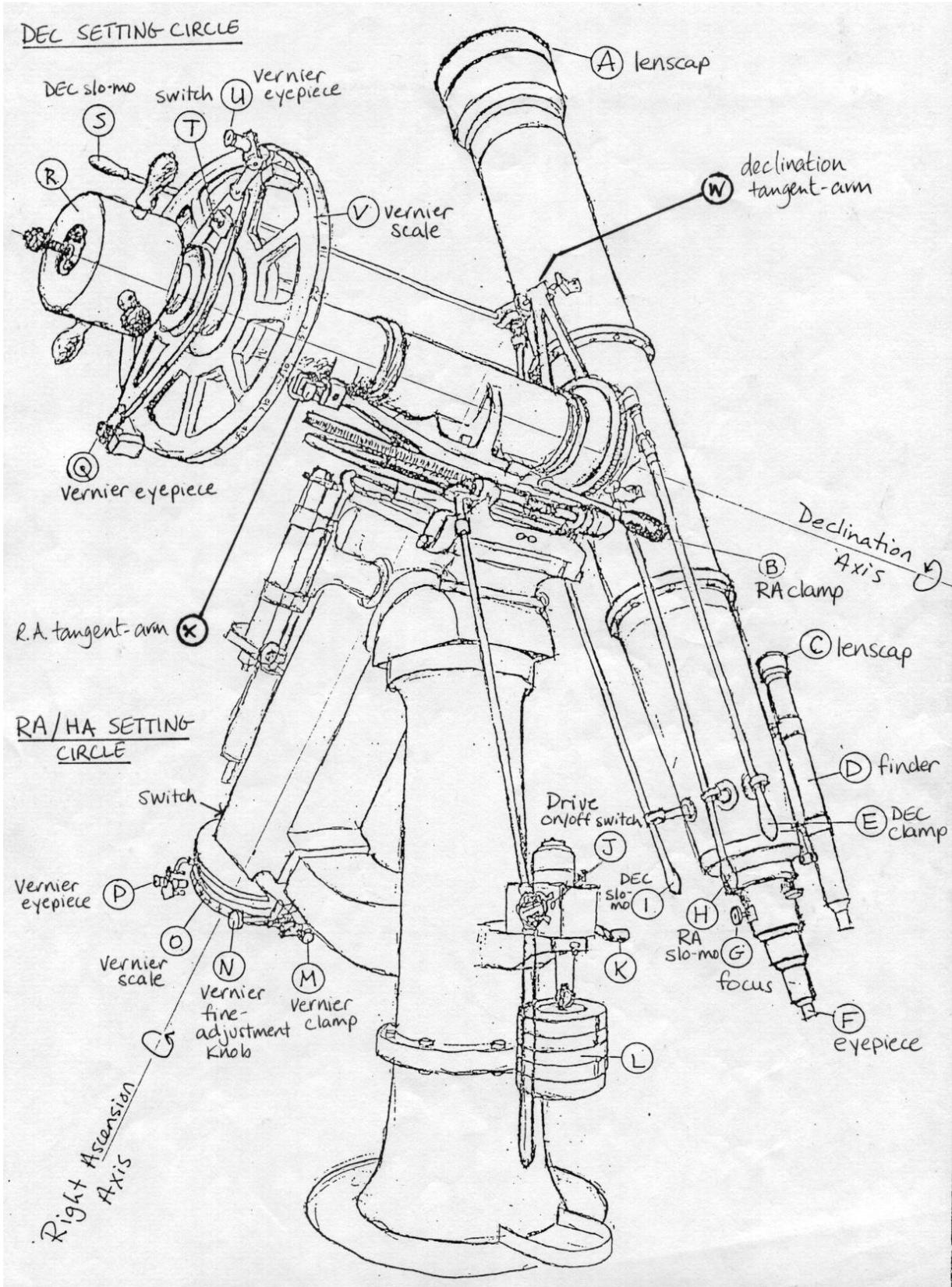


Figure 1: The Fry Telescope