TELESCOPIC OBSERVING

I. Properties And Use Of An Astronomical Telescope

The purpose of this experiment is to familiarize one with the use of an **equatorially mounted** telescope to locate celestial objects. The telescope is the tube and the optics contained within it. The telescope is mechanically attached to a set of perpendicular axels, each of which can be rotated independently. One of these axels is aligned with the axis of rotation of the Earth. Hence it points to the north celestial pole in the sky; for this reason it is called the **polar axel**. The other is called the **declination axel**. Motion of the instrument around the polar axis is done to change the right ascension or hour angle of the telescope. Motion of the telescope around the declination axis, changes the declination at which it is aimed. See the diagram on the next page.

Once the telescope is aimed at the object to be observed, it is necessary to compensate for the rotation of the Earth. This requires continuous motion of the telescope around the polar axis at the **sidereal rate**, which is accomplished by means of what is known as **a clock drive**. The clock drive is essentially an electric motor which, through a train of gears, provides a strong torque to turn the telescope around the polar axis at the sidereal rate. In addition, the telescope usually has manual or electrical **slow-motion controls** that enable the observer to make fine adjustments in the position of the telescope, in order to center a celestial object in the field of view.

Once an observer knows the approximate location of an object in one's horizon system, a small telescope such as the one you are using can be moved to point approximately in this direction. This is called **slewing** and if it is done by the observer, it is called **manual slewing**.

A small telescope is mounted on the tube of the larger telescope as a sight for quickly locating a target object. This auxiliary telescope is called the **finder telescope**. The finder telescope has a large field of view and low magnification. It is mounted in such a way that when the target is centered in the finder, the target should be nearly centered in the larger telescope.

On each axel of the main telescope is mounted a graduated circle or wheel called a **setting circle.** These are used for setting the telescope in right ascension and declination. As the telescope is turned around one of the axes, the coordinate at which the telescope is aimed can be read from a setting circle by an index or indicator. The declination circle is graduated in degrees and is always ready to be read. The right ascension circle, which is mounted on the polar axel near the clock drive housing, is larger and its smallest graduations may be a few minutes of time. The hours of right ascension (**RA**) are marked but usually that is all. However, each hour is divided in half and each half into quarters of an hour. On some telescopes divisions are every 10 minutes. You will have to determine the units for the smallest graduations by visual inspection.

Before the RA setting circle can be used, it must be turned and set to agree with the current sidereal time. There is usually a fiducial mark on the clock drive housing that indicates zero hour angle, and hence, the plane of the local celestial meridian (**LCM**). When the RA circle is turned so that this indicator lines up with the RA that is the same as the sidereal time, the circle is set to correctly read the RA at which the telescope is aimed. Once the circle is so set, it does not have be set again if the clock drive is running. This is because the clock drive also turns the RA circle at the sidereal rate. Hence, one needs a clock that keeps sidereal time in order to set a telescope. Such a clock is in the observatory, but it may not be correctly set. Hence, one needs to find the current sidereal time in some other way and check the clock. Once the clock is set for the day's observations, it will keep track of the sidereal time so that the observer can set his telescope to the RA of any object.

II. Observational Procedures

Get a list of planetary positions for today's date. One source is the program "Ephemeris" available in the Skylab2 software. You can also get the local sidereal time from the program for the

animation of the diurnal motion of the Sun under Skylab2's program "Celestial Sphere." In the latter program, change the date to the current one and the ZT to an exact hour value before the beginning of the observing session. When you go to set the sidereal clock in the observatory or the RA circle on the telescope to the correct LST, allow for the ZT that elapsed since you obtained the correct value of the LST.

Now turn the RA circle on your telescope until the current value of the LST is set to the LCM indicator. It is important to remember that:

The LST is the hour circle of RA currently aligned along the upper LCM.

The telescope is now ready to be slewed to the RA and DEC of the object you wish to observe. When you slew the telescope, make sure that the RA circle does not rotate and that it always reads the current LST.

Another way to set the RA circle is first to locate visually a bright star of known RA. Manually slew the telescope to acquire the star in the center of the field of view of the eyepiece, using the finder. Clamp the declination axel of the telescope and then turn the RA circle until the fiducial mark of the telescope is pointed to the RA of that star. The RA circle should now be set to the correct LST and an object of any RA may now be located.

Once you have acquired and centered the object you wish to observed in the field of view of the telescope, either manually or by means of the slow motion controls, tighten the RA and DEC clamps. The clock drive may not engage unless the RA clamp is sufficiently tight.