Using the Hubble Redshift Program

Welcome to the observatory! We will simulate an evening's observation during which we will collect data and draw conclusions on the rate of expansion of the universe. We will gain a proficiency in using the telescope to collect data by working together on the first object. Collecting data for the other four objects will be left to you to complete the evening's observing session. Then you will analyze the data, draw your conclusions, and use the information to predict the age of the universe.

Let's begin.

1. Open the Hubble Redshift program. Select **File…Log in** from the menu bar, and enter your names (or don't enter them – see if I care!). Click **OK** when ready. The title screen appears.

2. Select **File…Run** from the menu bar to begin the exercise. The screen shows the control panel and view window as found in the "warm room" at the observatory.

The **Hubble Redshift Distance Relation** program simulates the operation of a computer-controlled spectrometer attached to a telescope at a large mountain-top observatory. It is realistic in appearance, and is designed to give you a "hands-on" approach of how astronomers collect and analyze data for research.

Notice that the **dome** is closed and **tracking status** is off. Before you can access the telescope controls, a message appears notifying you that you have control of the telescope. Click **OK** to continue.

3. To begin our evening's work, first open the dome by clicking on the **dome** button. The dome opens and the view we see is from the finder scope. The finder scope is mounted on the side of the main telescope and points in the same direction. Because the field of view of the finder scope is much larger than the field of view of the main instrument, it is used to *locate* the objects we want to measure. The field of view is displayed on-screen by a CCD camera attached on the finder scope. (Note that it is not necessary for astronomers to view objects through an eyepiece.) Locate the **Change View** button on the control panel and note its status, i.e. finder scope. Also note that the stars are drifting in the view window. This is due to the rotation of the earth and is very noticeable under high magnification of the finder telescope. It is even more noticeable in the main instrument which has even a higher magnification. In order to have the telescope keep an object centered in the spectrometer opening (slit) to collect data, we need to turn on the drive control motors on the telescope.

4. We do this by clicking on the **tracking** button. The telescope will now track in sync with the stars. However, before we can collect data we need to do the following:

(a) Select a field of view (one is currently selected).

(b) Select an object to study (one from each field of view).

5. To review the fields of study for tonight's observing session, select **Field…** from the menu bar at the top of the control panel. The items you see listed are the fields that contain the objects we have selected to study tonight. An astronomer would have selected these fields in advance of going to the telescope by: selecting objects that will be well placed for observing during the time we will be at the telescope. This list in the **select star field dialog box** contains 5 fields for study tonight. You will need to select one galaxy from **each** field of view and collect data with the spectrometer (a total of 5 galaxies).

To see how the telescope works, change the field of view to Ursa Major II at RA 11 hour 0 minutes and Dec. 56 degrees 48 min. Press **OK** to move the telescope to the correct position.

Notice the telescope "slews" (moves rapidly) to the RA and DEC coordinates we have selected. The view window will show a portion of the sky that was electronically captured by the charge coupled device (CCD) camera attached to the telescope.