Avg. per Channel: The number of photons averaged from the total number of the channels of the spectrometer.

Signal-to-noise Ratio: A measurement of the quality of the data taken to distinguish the H and K lines of calcium from the noise. Try to get a signal-to-noise ratio of 10 to 1. For faint galaxies, this may take some time.

Information that appears in the top portion of the window

Wavelength (angstroms): Wavelength as read by the cursor in the measurement mode

Intensity: Relative intensity of light from the galaxy at the position marked by the cursor in the measurement mode

9. Click **start/resume count** from the menu bar in the Spectrometer Reading Window. Continue to collect photons until a *clear* spectrum of the H & K lines of calcium is displayed. These lines are approximately 40 ≈ apart. They should stand out from the noise. If not, continue to count photons. If you are not sure about the data, check with a lab instructor to help you interpret the data.

10. Record the object, photon count, apparent magnitude, and the measured wavelength of the H & K lines of calcium on the data sheet located at the end of this exercise. The H & K lines measured should be red shifted from the laboratory values depending on the galaxyís motion. Apparent magnitude is just another way of describing the apparent brightness of an object. Weíll use it later in figuring out the distance to the galaxy.

11. To collect data for additional galaxies, press **Return**. Move the telescope to a new field of view, then follow steps 6 through 10. Repeat until you have measurements of one galaxy in each of five different fields of view.

Calculating the Hubble Parameter

Now that we see how to use our instrument to collect data, we can use this information to determine the distance and velocity of each galaxy.

To find the distance, we would normally use the inverse-square law, $b = L / (4\pi d^2)$. Astronomers often write this relationship in a different way, using *apparent magnitudes* and *absolute magnitudes*. Apparent magnitude, which is usually called *m*, is just a different way of talking about apparent brightness, and absolute magnitude, *M*, is just another way of talking about luminosity. Both apparent and absolute magnitudes run backwards (that is, higher values of magnitude correspond to fainter objects). Theyíre also both *logarithmic* scales, meaning that *adding* a certain value to the magnitude is equivalent to *multiplying* the brightness by a certain value. All you really need to know about magnitudes is that the inverse-square law can be expressed in terms of magnitudes like this:

(A) **M = m + 5 ñ 5 * log D**

or

log D = <u>m ñ M + 5</u>
5

or

$$D = 10^{(m-M+5)/5}$$