Fall 2005 ASTR 1120-001 General Astronomy: Stars & Galaxies.
Problem Set 5. Due Th 17 Nov

Your name:

Your ID:

    Except for the tutorial, for which you should submit answers on line, please write your answers on this sheet, and make sure to *show your working*. Attach extra sheets if you need them. If you mess up, you can get another copy of the problem set at `http://casa.colorado.edu/~ajsh/astr1120_05/prob.html`.

1. Tutorial on Detecting Dark Matter in Spiral Galaxies

    Go to `http://www.astronomyplace.com`, press on the Cosmic Perspective 3rd Edition icon, log in. You should already have joined our class 'cm651430', so that you can record your work and submit it for grade on line. Click on Tutorials, and do the tutorial on Detecting Dark Matter in Spiral Galaxies. You can redo the tutorial as often as you like, to improve your grade.

    Your score should be recorded automatically, but as a double check against your score disappearing into a black hole:

My score was _____ .

If you like, you can comment here on the tutorial:

2. Recession velocity of Per A

This is the observed spectrum (Kennicutt 1992) of NGC 1275, also known as Per A, the central galaxy in the Perseus cluster of galaxies. The name Per A is because it's the brightest radio source in the Perseus constellation.
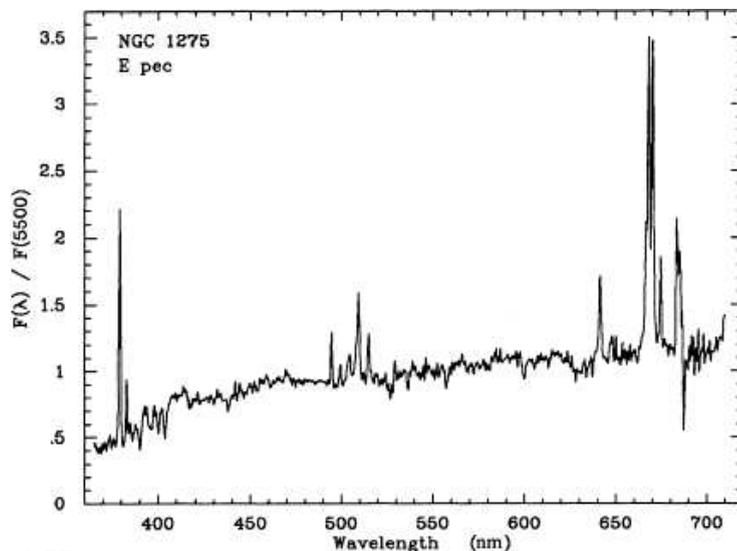
(a) Wavelength of Hα

Measure, as accurately as you can, the wavelength of the Hα line (Hα is the leftmost of the two close prominent emission lines at the right of the graph).

The observed wavelength of the Hα line in Per A is _____ nm.

(b) Redshift

Deduce the redshift z of Per A, from the redshift formula $z = (\lambda - \lambda_0)/\lambda_0$, where $\lambda_0 = 656$ nm is the laboratory wavelength of Hα.

The redshift of Per A is _____ .

(c) Recession velocity

Hence deduce the recession velocity v of Per A from the nonrelativistic Doppler formula $z = v/c$ with $c = 3 \times 10^5$ km/s the speed of light.

The recession velocity of Per A is _____ km/s.

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3. Cepheids

h & χ Persei is a pretty double open cluster of stars. The clusters contain several Cepheid variable stars which are used to calibrate Cepheid luminosities. Here is a table of their periods and luminosities:

Star	Period (days)	Luminosity ($L_\odot$)
UY Per	5.4	2600
VY Per	5.5	3660
VX Per	10.9	5450
SZ Cas	13.6	7660
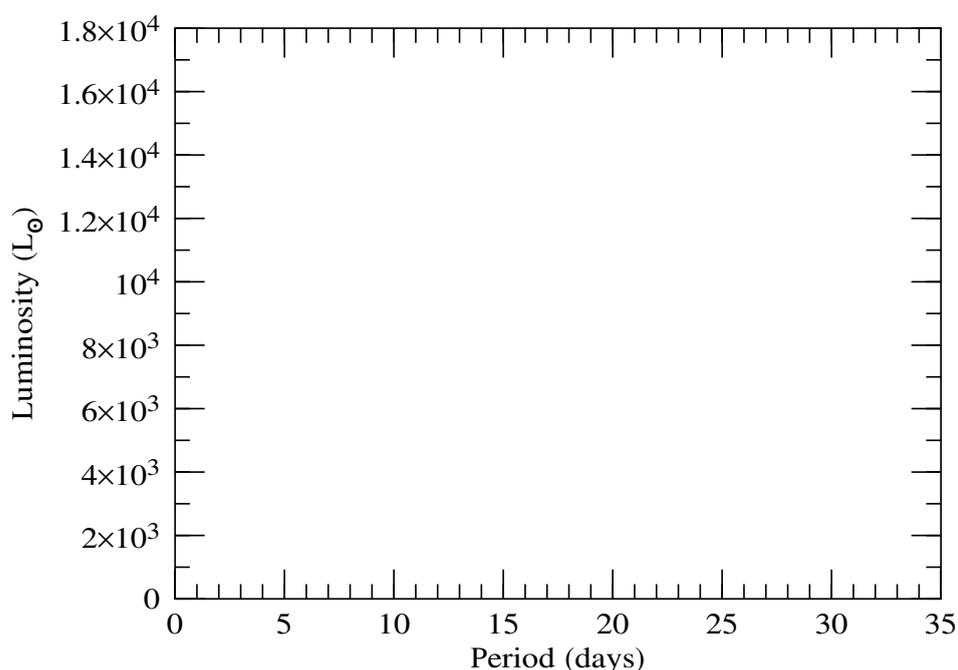
(a) Luminosity-Period

Plot these Cepheids on the above graph of Luminosity versus Period. Draw a *straight* line as fairly as you can through the the origin and through the h & χ Cepheids (the line will not pass exactly through all the points because there are observational and other errors and uncertainties in the precise positions of the points). The straight line expresses graphically the proportionality

$$L \propto P$$

discovered by Henrietta Leavitt in 1907.

(b) Hubble's Cepheid Number 1

The first Cepheid variable found by Edwin Hubble in 1923 in M31, the Andromedae galaxy, had a period of 31.4 days. Plot the expected position of Hubble's Cepheid on your diagram. Read off the plot the luminosity of Hubble's Cepheid.

The luminosity of Hubble's Cepheid Number 1 is _____ $L_\odot$.

(c) Distance to M31

The observed flux from Hubble's Cepheid is $F = 1.1 \times 10^{-15}$ W m^{-2}. Use the inverse square law of flux with distance to determine the distance to M31 in pc? [Hint: 1 L$_\odot$ = 3.9×10^{26} W; 1 pc = 3.1×10^{16} m.]

The distance to M31 is _____ pc.