Homework 11

Due **December 3 by 10:45am via Canvas upload**
Please show all work, writing solutions/explanations clearly, or no credit will be given. You are encouraged to work together, but everyone must turn in independent solutions; do not copy from others or from any other sources.

1. The Ca II H and K lines have rest wavelengths of $\lambda_0 = 3968.5$ Å and $\lambda_0 = 3933.6$ Å, respectively. In the spectrum of a galaxy in the cluster Abell 2065 (also known as the Corona Borealis Cluster), the observed wavelengths of the two lines are 4255.0 Å and 4217.6 Å.

   (a) What is the redshift z of the galaxy?

   (b) What is the distance to the galaxy?

   (c) What is the distance modulus of the galaxy?

2. A spiral galaxy, when seen face-on, appears circular; the flux you observe per square arcsecond of the galaxy (its surface brightness, Σ) is given by the relation

$$\Sigma(r) = \Sigma_0 e^{-r/r_0},$$

   where r is the distance, in arcseconds, from the center of the galaxy. Show that the total flux you observe from the spiral galaxy is $F = 2\pi\Sigma_0 r_0^2$.

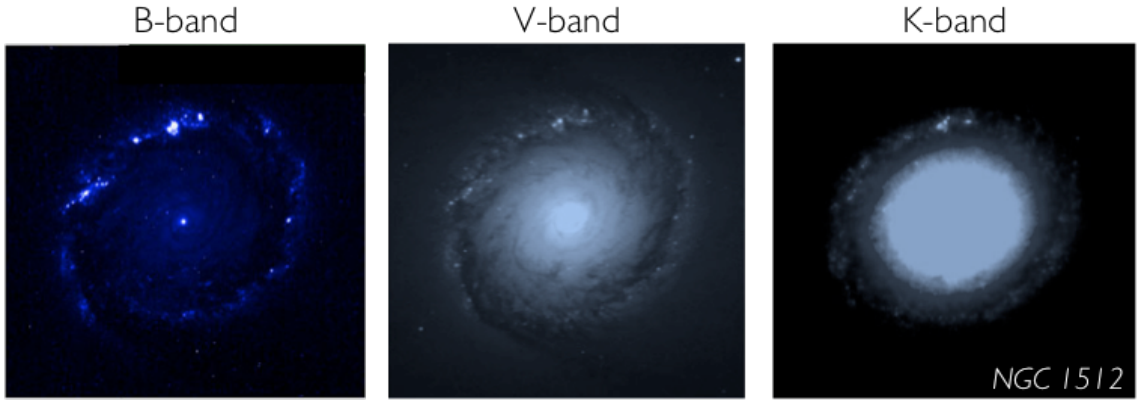

Figure 1: B-band: ∼440 nm, V-band: ∼550 nm, K-band: ∼2200 nm

Star	M_B	M_V	M_K
O5 V	-6.0	-5.7	-4.5
M5 V	+13.9	+12.3	+6.3
M5 III	+1.33	-0.3	-6.26

3. You have taken photos of the galaxy NGC 1512 (Figure 1, top of page) in three standard filters, and you want to use these images to understand the stellar populations of the galaxy. In the above table, the absolute magnitudes in these filters are given for three types of stars.

   (a) Assuming that only these three types of stars exist in the galaxy, which one is dominating the light in your B-band photo? How many of each of the other two types would be needed to equal the luminosity of a single star of the dominant type?

   (b) Repeat part a), but for the K-band photo.

   (c) Use this information and your knowledge of star formation, the ISM, and stellar evolution to explain the galaxy's different appearance in your three images.