**Astro 7B Worksheet – week 7**

1. **Virial theorem for elliptical galaxies** Suppose you take a spectrum of an elliptical galaxy...

   (a) Do you expect to see mostly absorption lines or emission lines?

   (b) You look at a Magnesium spectral feature at $\lambda = 5176$ Angstroms and fit it with a Gaussian. The resulting Gaussian has a standard deviation of 6 Angstroms. Estimate the velocity dispersion of the galaxy. Assume that the entire width of the line is due to Doppler broadening.

   (c) Suppose the galaxy has angular size (half-light radius) of 5 arcseconds and is at a distance of 100 Mpc. What is the half-light radius of the galaxy, in kpc?

   (d) Estimate the mass of the galaxy, to order-of-magnitude. Note: $G = 4.3 \times 10^{-6}$ kpc $M_\odot^{-1}$ (km/s)^2.
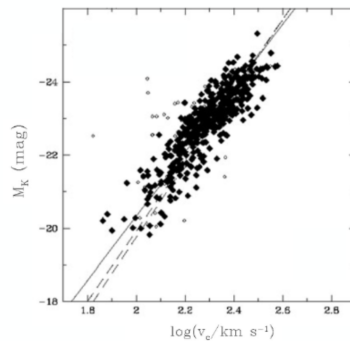
2. **Rotation nation** You observe a galaxy with a spectrometer (you might recognize this galaxy from class...). Like in class, the major axis is 3 times longer than the minor axis. The extracted "spatial" spectrum[1] is found in the second panel.
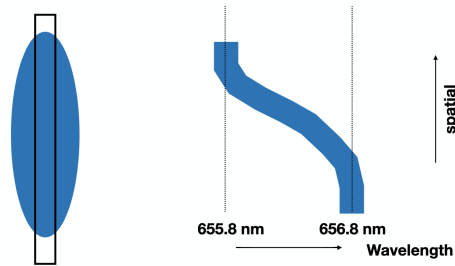
   (a) In the space below, draw a rough expected "1D" spectrum. Why does it look this way?
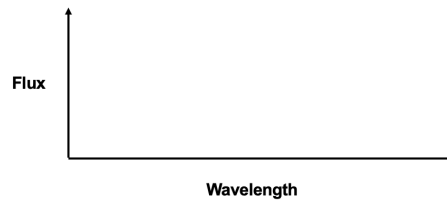
   (b) What is $v_{\max}$ for this galaxy?

   (c) The galaxy has a total integrated observed K-band magnitude of 10.2. Calculate the distance to this galaxy.

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[1] We call this a 2D spectrum