ASTR 323/423 Midterm Exam Study Questions
Midterm Exam: in class, Oct 19th
Bring a (non-phone) scientific calculator!

Important: All sketches should include labeled axes and descriptions ('blue', 'red', 'bright', 'faint', etc), but do not worry about numerical values unless specifically asked. You should also mark where the Sun (for plots of stars) or the Milky Way (for plots of galaxies) lies on the plot.

Length: your written responses ought to be about 1.5-2 blue book pages long, excluding figures. Significantly shorter than that and you probably aren't giving a thorough enough explanation. Much longer than that isn't necessary, unless you are particularly wordy in your writing.....

1. Sketch the color magnitude diagrams (CMDs) you'd expect to see for stars in the following galaxies:

- A massive E0 galaxy
- A low mass E5 galaxy
- An Sb galaxy
- A dIrr galaxy

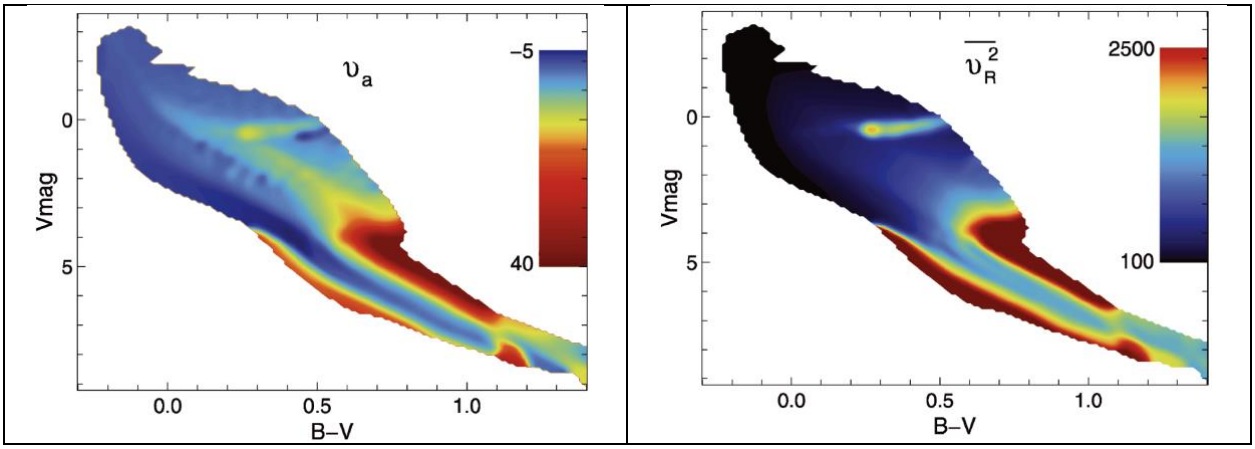
Describe the differences and similarities between the different CMDs, and explain physically what gives rise to those differences.

2. The interstellar gas in galaxies can be found in four different phases. Describe these phases, how they emit radiation, and how we detect each of them. Which phases are predominantly found in spirals, and which in ellipticals?

3. Describe and sketch the Schechter function, and explain what the parameters M* and alpha refer to. How does the Schechter function change with environment and galaxy color? How do different types of galaxies populate the Schechter function, and how does this change with environment?

4. Describe the differences between the Milky Way's thin and thick disks. Describe two different scenarios that could explain the formation of the thick disk, and explain how they account for the different properties of the thin and thick disks.

5. Explain in detail what the figures below are showing, and explain why they look the way they do. Please be thorough!



6. Define [α/Fe] and [Fe/H]. Describe how we can use plots of [α/Fe] vs [Fe/H] to learn about the star formation history of different stellar populations. Make a sketch of the plot, showing how it would differ for populations with different star formation history. On this plot, where the following populations lie?: The Milky Way's thin disk stars; the Milky Way's thick disk stars; stars from a massive elliptical galaxy. Explain your reasoning.

7. Describe how the Oort limit constrains the local density of the Milky Way's disk. The vertical velocity dispersion is different for different groups of stars; describe how and why it changes as you look at different stellar populations in the disk. If you measure the Oort limit with different populations, should you get a different answer? Explain why or why not.

8. Describe what we mean by Sersic-n, and what typical values are for disk galaxies and elliptical galaxies. Sketch the following plots for a large sample of many different types of galaxies:

- color vs absolute magnitude (for galaxies as a whole, not for their individual stars)
- color vs Sersic-n
- absolute magnitude vs Sersic-n

On these plots, indicate where different galaxy types can be found. In the color-magnitude plot, indicate the red sequence and the blue cloud, and explain why the red sequence has the shape that it does. Finally imagine a spiral galaxy falling into a big galaxy cluster. As it falls in, it experiences a burst of star formation as its interstellar medium (ISM) is shocked by the hot gas of the cluster, but then its ISM is swept away by the cluster gas and it stops forming stars altogether. Sketch how it might change position on those three plots as it evolves with time during and after this process. Describe your reasoning.

9. If I was to measure the mass function of stars in a young star cluster like the Pleiades and then measure it again just using all stars within 20 parsecs of the Sun, describe how and why these two mass functions would look different. Now define the IMF, and explain which of those two mass functions (Pleiades and Solar Neighborhood) would better describe the IMF. In a young star cluster, what type of stars make up most of the total mass of the cluster? Which type of stars contribute most of the total luminosity? Explain your answers in the context of the mass-luminosity relationship for main sequence stars.

10. Describe the cycling of baryons in galaxies via star formation and feedback, and how this impacts the chemical evolution of galaxies.

There will also be one mathematical/calculation problem on the exam, so please make sure to bring a calculator to the exam.

You will be expected to know the following equations (and the units involved):

$$m_1 - m_2 = -2.5 \log \frac{f_1}{f_2}$$

$$m - M = 5 \log d - 5$$

$$M - M_\odot = -2.5 \log \frac{L}{L_\odot}$$

$$d = 1/p$$

A list of all other necessary constants and (astronomy) equations you might need will be given to you with the exam.