Study Guide

Midterm 1

AST 308, Fall 2009

The test will cover [CO 24.1, 24.2, 24.3 and all of chapter 25], as well as the other material I presented in the lectures (most notably: star-forming regions, chemical enrichment, and the closed-box model). [CO 24.4] "The Galactic Center" will be covered later in the course, not on this midterm. The class notes are all on the course web site (www.pa.msu.edu/courses/ast308). Review them carefully.

There will be 1 or 2 straight-forward derivations or back-of-the-envelope calculations, along the lines of the ones you have done as homework or have seen in [CO] or in my lectures.

Anywhere you write down an equation, you can invent your own notation if you don't remember what I used. But NO MATTER WHOSE NOTATION YOU USE, briefly describe in words the physical meaning of each constant, variable and term. I want you to show me that you understand what the equation is actually describing.

The other questions will be 1-2 paragraph short essays. For example, "What is the evidence for the existence of dark matter in our own Galaxy?" A bulleted outline and maybe a little sketch would be a fine way to answer, but you need to say enough to demonstrate that you know what the evidence is in some physical terms… a list of buzz words will not be adequate. And I *HAVE* to be able to actually read it, so write neatly!

In the lectures I often have briefly mentioned little details about galactic astronomy. *Examples: details of various coordinate systems, long-slit spectroscopy, etc*. I don't expect you to necessarily remember every single thing, especially if I spent almost no time on it, never used it later for anything and it is not described in [CO] either … I throw these things in because they are part of how astronomy is actually done and I think it is better for you to have at least heard of them. But the short essay questions are places where you can use such facts to help make your case, and I certainly will give you credit for knowing them.

1. *Your best bet: know everything about everything.*

2. *Failing that, know a lot about the following:*

- Overview of Cosmology: What is the general sequence of events in the evolution of the universe? What underlying effect drives this progression of events? What are the relative fractions of normal matter, dark matter and dark energy?
- I might ask you to assign a Hubble class to a galaxy or two, and to tell me the reasons you assigned that classification.
- What is the overall outline of chemical evolution in the universe?
- In broad terms, how do we measure chemical abundances in HII regions?
- Describe molecular clouds. What are they made of? Where do they form? Why are they important?
- What is the Orion Nebula? Describe its immediate neighborhood, its structure, what powers it, how it is evolving, and what sorts of objects we find within it.
- What sorts of objects (stellar types, Supernovae, etc) produce: H, He, CNO, Fe, elements heavier than Fe?
- What are Populations I and II? Where do we find them?
- What is an IMF? How does that fit together with a stellar birthrate function?

- Back in the early 1900's, what measurements seemed to indicate that the Sun is near the *center* of our Galaxy?
- What were the basic points raised in the Curtis-Shapley "debate".[1]
- *Special extra-credit question:* Who won the Rose Bowl in 1920, and what does Roman-style chariot racing have to do with the early history of the Rose Bowl?[2]
- What is the general effect of dust on our view of our own Galaxy? At what wavelengths does dust have a big effect, and at what wavelengths does it have a small effect? What *is* dust?
- What are the mathematical forms of the 3D distribution of stars in galaxy disks and halos, and of the projected surface brightness of E galaxies and bulges?
- Describe the relative masses, shapes, extents of the different components of the Milky Way. Table 24.1 will go part way towards answering this question.
- Be able to describe things in terms of the appropriate coordinate systems: $u, v, w, \Theta(R)$, l_{II}, b_{II}
- What are Oort's Constants? *Aha!* A likely source for a little problem to work.
- Taylor series expansions were used to derive both Oort's constants and the epicycles for density waves. Be able to write these down, explain what the terms mean, and explain why some terms can be set to zero.
- *Aha*^{2}*!* How about a simple derivation involving rotation curves, relating to masses? Or perhaps a simple application of the virial theorem?
- How do we measure the rotation curve of the Milky Way?
- Describe four ways that are used to measure distances within our Galaxy.
- What is the evidence (that I have described so far) for the existence of dark matter in our own and other spiral galaxies? Be able to derive the method for measuring the local space density of dark matter at some point within a spiral galaxy.
- What are the Inner and Outer Lindblad Resonances and the Co-rotation radius? Why are they important in the study of spiral structure?
- What is the evidence in favor of the existence of density waves? Why do we think they can't last forever?
- What is the Tully-Fisher relation? *Aha*^{3}*!* Do something similar to the semi-derivation of this relation given by [CO]?
- What are the true shapes of E galaxies? How do we know?
- Be able to sketch some possible orbits of stars in E galaxies, and also in Bars.
- What is the Faber-Jackson Relation?
- What is the fundamental plane?
- Sketch the Schechter Luminosity Function. What is an L^* galaxy?

PS. I will *not* ask you to describe the psychedelic barred-spiral movie. None of us are ready for that!

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[1] See lecture notes, and also http://antwrp.gsfc.nasa.gov/diamond_jubilee/papers/trimble.html
[2] See http://www.rosebowlhistory.org/rose-bowl-1903.php