# Ph 608 Term Paper

For the term paper in this course you will each need to choose a separate, well-defined topic in cosmology and present a *critical assessment* of the recent literature. Thus, you will need to digest and judge the literature — not simply present a summary of one or two papers.

The topic may be anything in the general area of the course, but must *not* be closely related to your research. I give a suggested list of topics below, but each can be broadened or restricted as desired. You are also encouraged to suggest your own topic, but you should clear it with me well before the preliminary plan is due.

The term paper will count for 50% of your class grade. The assessment will occur in three parts.

a. A preliminary plan (10%) is due on Wednesday, March 8. It should be in the form of an outline about one page in length and list the main issues to be discussed in the final paper and cite relevant references.

b. The written paper (25%), which must be typewritten and approximately 12 pages in length, is due Monday, April 17.

c. Oral presentation (15%): during the last two weeks of the semester, you will make a 20 minute presentation of your paper to the rest of the class. The presentation will be graded on finishing within the allotted time and for clear explanations of why the topic is of interest, of the central few points of your paper, and of the main uncertainties in and criticisms of the published work on the topic. I will be out of town on Wednesday, April 26 and we will need to move that class to a date and time convenient for everyone.

**Topics**

1. How can the mass density of the universe be estimated and what are the main sources of uncertainty?

2. What are the observed estimates of the primordial abundances of deuterium, helium, and lithium and how well determined are they? Are these abundances consistent with Big Bang Nucleosynthesis?

3. What restrictions are there on the masses of the dark matter objects? What astronomical observations and laboratory experiments could be/are being conducted to reduce the allowed ranges?

4. Give a critical assessment of the idea of bias. Is the mass distribution in the universe traced by the light? Does bias depend on the mass or type of the luminous objects?

5. Discuss the evidence for, and implications of, large-scale flows in the universe.

6. Is the distribution of dark matter in dwarf galaxies consistent with theoretical predictions? In large galaxies?

7. What causes the Lyman-$\alpha$ absorption line systems seen in QSOs and what have we learned from them?

8. What are the observational constraints and/or theoretical ideas about Population III — the first generation of stars to form in the universe?

9. What are the observational constraints on how and when reionization took place?

10. Can gamma ray bursts be used as cosmological probes? What might we learn from them?

11. What is the origin of the relation between the mass of a supermassive black hole at the center of a galaxy and the velocity dispersion of the bulge of the galaxy?

12. What are the successes of and problems with models for inflation?

13. What is the origin of the different Hubble types of galaxies?

14. How can we measure the number density of galaxy clusters as a function of redshift? What would we learn from such a measurement?

15. What are the properties of the protogalaxies seen at high redshift (greater than 1.5, say)? How do these protogalaxies relate to the galaxies we see today? How are protogalaxies discovered? What constraints do protogalaxies place on cosmological models?