Syllabus for G6010: Physical Cosmology

Fall Semester 2014

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Class Time: Tuesday & Thursday, 2:40 to 3:55 PM
Class Location: Pupin Hall, Room 420
Office Hours: Thursday from 4:00 to 5:00 PM or by appointment

Course Description

This course is designed to broadly introduce the topics associated with cosmology, which is the branch of physics dealing with the origin and evolution of the Universe. We will start the course with a historical overview to define context. The remaining time will be devoted to three main areas: (i) expansion of the universe, (ii) the early universe, and (iii) large-scale structure. Where appropriate, we will discuss experimental cosmology topics, such as cosmological parameters, measurements of the cosmic microwave background radiation, measurements of large-scale structure, and measurements of the accelerating universe. The lectures on the expansion of the universe will primarily focus on general relativity, redshift, methods for measuring distances, the Robertson-Walker metric, and other associated topics. The lectures on the early universe will primarily focus on inflation, nucleosynthesis and the cosmic microwave background radiation. The lectures on large-scale structure will primarily focus on galaxy formation, galaxy cluster formation and the Sunyaev Zel'dovich effect.

Prerequisites

This course is a graduate-level physics course. All students in the class should have a solid understanding of undergraduate physics. It is assumed that you know how to numerically solve problems with a computer. We will discuss some aspects of general relativity, though no prior experience with general relativity is required.

Textbooks

The course will not directly follow any textbook. However, the recommended textbook is *Modern Cosmology* by Scott Dodelson [1]. If you have not taken a cosmology course previously, you also may want to read *Introduction to Cosmology* by Barbara Ryden as a supplement [4]. Ryden's textbook is designed for advanced undergraduates. Other textbooks that may be useful are listed in the bibliography below.

Grades

Your grade for the course will be computed from a class participation score and scores on problem sets. There will be no mid-term exams or final exam. The problem sets will be composed of derivations and example problems that are designed to develop your understanding of cosmology. You will be given approximately

fourteen problems spread over three problems sets. Consequently, you should be solving approximately one problem per week on average. The problem sets will be handed out in class, and the precise due dates will be communicated in due course. Each problem will be worth one point. No partial credit will be given. However, if you turn in your solutions on time and actually try each problem (as judged by the instructor), then you will be allowed to re-work problems you solve incorrectly. This policy is designed to emphasize learning rather than grades. No late work will be accepted. Your final score will be computed using the following equation:

$$\text{grade} = \frac{N}{N_{total}} \times \frac{P}{P_{total}}, \tag{1}$$

where N is the number of classes in which you participate, N_{total} is the total number of classes, P is the number of problems you solve correctly, and P_{total} is the total number problems.

Bibliography

[1] Dodelson, Scott. *Modern Cosmology*. San Diego, California: Academic Press, 2003. ISBN: 0-12-219141-2.

[2] Weinberg, Steven. *Cosmology*. Oxford New York: Oxford University Press, 2008. ISBN: 978-0-19-852682-7.

[3] Weinberg, Steven. *The First Three Minutes : A Modern View of the Origin of the Universe*. New York: Basic Books, 1993. ISBN: 0-465-02437-8.

[4] Ryden, Barbara. *Introduction to Cosmology*. San Francisco: Addison-Wesley, 2003. ISBN: 0-8053-8912-1.

[5] Coles, Peter & Lucchin, Francesco. *Cosmology : The Origin and Evolution of Cosmic Structure*. Chichester, England: John Wiley, 2002. ISBN: 978-0-471-48909-2.