Astro 735 - Observational Cosmology

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Overview – Fall 2000

This is a graduate level course that focuses on the observational tests of cosmological models. We will focus on tests in the post-recombination era of what is known as the "Standard Model."

The field of observational cosmology is changing and growing very rapidly. It is an exciting field! A component of this class will be to discuss current literature in the field. *The primary text for for this course* is Malcolm Longair's book "Galaxy Formation," which is available at the University Bookstore. We will be using this book as a starting point to get into the current literature. I will at times also draw upon Chris Impey's (University of Arizona) excellent lecture-notes on observational cosmology. To further develop your working theoretical understanding of modern cosmology, you may wish to acquire other standard reference textbooks for your personal library. I recommend, for example, one by Narlikar, but there are many others (listed below).

The flow of this course is as follows. An overview of the Standard Model will be used (a) to establish the key observables of the model, and (b) to identify the outstanding observational questions. We will then proceed to discuss, in turn, measurements of the expansion and deceleration rates, counter-posed with discussion of the primary biases inherent to these measurements. This will lead us to consider the effects of large scale structure, its growth, galaxy formation and evolution – topics of cosmological interest in their own right. The expansion and deceleration rates can be coupled, within the model framework, to the mean density, the age of the Universe, as well as to the value of what is known as the "Cosmological Constant." These topics, and their measurement, will be discussed as well. Then, we will return to the study of large-scale distribution of galaxies, and tie it together with measurements of fluctuations in the cosmic microwave background radiation (CMBR), to understand better the growth of structure and the 'complementarity' of these measures for estimating key cosmological parameters. Finally, we will summarize where cosmologists are today in terms of verifying and constraining the parameters of the Standard Model.

A rough schedule of classes is as follows:

Seq #	Topic	# of classes	chapters[1,2]
1	Introduction to the Standard Model	4	5,(6),7
2	H_0 and Large Scale Structure	5	8, 17-19
3	q_0, Ω_0, Λ and evolution	10	8, 17-19
4	t_0 and other issues	3	(9,10)
5	Fluctuations and the growth of structure	4	11-16
6	the CMBR and Large Scale Structure	3	11-16
7	Summary: theory vs observation		

[1] read chapter 1 (history) on your own

[2] read chapters 2-4 (overview of phenomenology) in background during the first part of the course.

Class format: Classes will consist of discussion centered on Longair's text and the current literature. While a certain amount of 'lecturing' is inevitable, the goal is for everyone to engage. To prompt engagement, students should aim to lead discussion of at least one paper in the literature during the course of the semester.

Course grades: There are three components on which you will be evaluated. An indication of their relative weight is given, but these numbers are not rigid.
(i) problem sets (5 ± 2) (30%)
(ii) in-class discussion/participation (40%)
(iii) final exam (30%)

Required text:

- "Galaxy Formation," by Malcolm Longair (Springer) – the University Book Store.
- papers in the literature (assigned during the semester)

Other reference texsts:

"Introduction to Cosmology," J.V. Narlikar, Cambridge University Press (1993), ISBN 0-521-41250-1 (hbk), 0-521-42352-X (pbk), QB981.N3
"Principles of Cosmology and Gravitation," M.V. Berry, Adam Hilger Press (1989), ISBN 0-85274-037-9
"Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity," Steven Weinberg, ISBN 0-471-92567-5, QC6.W47
"Structure Formation in the Universe," T. Padmanabhan, Cambridge University Press (1993), ISBN 0-521-41448-2 (hbk), 0-521-42486-0 (pbk), QB981.P245
"The Large Scale Structure of the Universe," P.J.E. Peebles, Princeton University Press (1980)
"The Early Universe," E.W. Kolb and M.S. Turner, Addison-Wesley (1990) ISBN 0-201-11603-0 (hbk), 0-201-62674-8 (pbk), QB981.K687
"Cosmological Physics," J.A. Peacock, Cambridge University Press (1998) ISBN 0-521-41072-X (hbk), 0-521-42270-1 (pbk)
"The Early Universe," G. Borner, Springer-Verlag (1992), ISBN 0-387-54656-1, 0-387-16187-2, QB981.B725
"Galaxies and Cosmology," F. Combes, P. Boisse, A. Mazure, A. Blanchard, Springer-Verlag (1995), ISBN 3-540-58933-3, QB857.G3913
"Cosmology: The Origin and Evolution of Cosmic Structure," P. Coles and F. Lucchin, John Wiley & Sons (1995), ISBN 0-471-95473-X, QB981.C644