

Syllabus 2007

Observational Overview of the Universe

The Universe as seen in visible light: stars, galaxies, clusters of galaxies, superclusters and quasars. The Universe as seen in other wavebands. The expansion of the Universe: redshift and the Hubble law. Homogeneity and isotropy. Olbers' paradox. Particles and radiation in the Universe. [3]

The Basic Equations of Cosmology

Newtonian gravity. The Friedmann, fluid and acceleration equations. [3]

Cosmological Models

The Hubble Law. Expansion and redshift. Solutions: matter-, radiation-dominated Universes and mixtures. The fate of the Universe. [4]

Observational Parameters

The Hubble constant: the distance scale and the value of H_o . The density parameter Ω_o . The deceleration parameter q_o . The cosmological constant Λ . Measurements of the age, geometry and matter and energy densities of the Universe. [6]

The Cosmic Microwave Background

Properties and origin. The photon to baryon ratio. [3]

The Early Universe

Matter-radiation equality. Temperature vs. time relationship. Thermal evolution of the Universe. Primordial nucleosynthesis. [4]

The Inflationary Universe

Successes and failures of the Hot Big Bang cosmology. The flatness, horizon and monopole problems. Inflationary expansion as a solution. Inflationary models. Before inflation. [3]

Structure in the Universe

Observed structures. The origin and growth of structure. [4]

Prerequisites

There are no prerequisites for this course other than standard physics and mathematics taught at second year level of the Physics degree. In particular, students are not required to have any knowledge of astronomy or cosmology.

Aims

1. To introduce the subject of modern cosmology using an approach that is grounded in physics rather than mathematics.
2. To present the basic theoretical framework of cosmology.
3. To compare the latest observations of the Universe with theoretical predictions.

Objectives

On successful completion of this course, students should be able to:

- describe the constituents of the Universe.
- understand its evolution from the Big Bang to the present day.
- discuss the formation and importance of the Cosmic Microwave Background.
- discuss the problems of observational measurement, for example the Hubble constant and the density parameter.
- appreciate the controversies encountered in cosmology today; for example, the values of the density parameter and the cosmological constant.
- appreciate how these controversies may be resolved in the future with new observational techniques.

Text Books

An Introduction to Modern Cosmology, 2nd Edition, A. Liddle, 2003, John Wiley & Sons (Recommended book)

Introduction to Cosmology, 3rd Edn., M. Roos, 2003, John Wiley & Sons, ISBN 0 471 97383 1

Galaxies and Cosmology (Theoretical Astrophysics; Volume 3), T. Padmanabhan, 2002, Cambridge University Press (Advanced)

Cosmological Physics, J.A. Peacock, 1999, Cambridge University Press, ISBN 0521422701 (Advanced)

Principles of Physical Cosmology, P.J.E. Peebles, 1993, Cambridge University Press (Advanced)

Methodology and Assessment

30 lectures and 3 problem class/discussion periods.

Written examination (90%) and two problem sheets (10%).