PX389-7.5 Cosmology

20/21

Department
Physics
Level
Undergraduate Level 3
Module leader
Grant Kennedy
Credit value
7.5
Module duration
5 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Questions about the origin of the Universe, where it is going and how it may get there are the domain of cosmology. One of the questions addressed in the module is whether the Universe will continue to expand or ultimately contract. Relevant experimental data include those on the Cosmic Microwave Background radiation, the distribution of galaxies and the distribution of mass in the Universe.

Starting from fundamental observations such as that the night sky is dark and, by appealing to principles from Einstein's General Theory of Relativity, the module develops a description of the Universe. This leads to the Friedmann equation, Hubble's law, the cosmological redshift and eventually to the Big Bang Model, with singular behaviour at the origin of the Universe. The module also discusses the evolution of the primeval fireball, the synthesis of Helium and the origin of structure.

Module web page

Module aims

To present the credentials of the Universe as we know it (via experiment) and introduce the simplest models that can describe it. The module will stress the role of experimental data and emphasize cosmology as a physical science, which makes testable predictions that describe the

observed Universe.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1. The history and foundations of modern cosmology: Olber's Paradox, Hubble's Law and the Cosmological Principle.
2. Describing the evolution of the Universe: basics of space time and relativity, curvature, Friedmann equation, fluid and acceleration equations.
3. Model universes: describing the evolution when dominated by single component and multiple-components - the standard cosmological (benchmark) model.
4. Key properties of our Universe: tests of the standard cosmological model, evidence for dark matter; models for dark matter, origin of structure.
5. The early Universe: the Big Bang, connection to elementary particle physics and grand-unified field theories (GUTS), inflation, Big Bang nucleosynthesis, formation of the cosmic background radiation.

Learning outcomes

By the end of the module, students should be able to:

- Discuss the current status of cosmology
- Recognise the importance of observations in constraining possible cosmological theories
- Explain the evolution of model universes, and how this evolution depends on their energy density components
- Discuss areas of cosmology where more work is needed to reconcile theory and observations

Indicative reading list

The following are useful, but not compulsory.
B. Ryden: Introduction to Cosmology, Pearson 2013
Michael Berry: Principles of cosmology and gravitation, IoP 1989
A. Liddle: An Introduction to Modern Cosmology, Wiley, 2003

View reading list on Talis Aspire

Subject specific skills

Knowledge of mathematics and physics. Skills in modelling, reasoning, thinking.

Transferable skills

Analytical, communication, problem-solving, self-study

Study

Study time

Type	Required
Lectures	15 sessions of 1 hour (20%)
Private study	60 hours (80%)
Total	75 hours

Private study description

Working through lecture notes, solving problems, wider reading, discussing with others taking the module, revising for exam, practising on past exam papers

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

Assessment component	Weighting	Study time	Eligible for self-certification
In-person Examination Answer 2 questions from 3	100%		No

- Answerbook Green (8 page)
- Students may use a calculator

Reassessment component is the same

Feedback on assessment

Personal tutor, group feedback

Past exam papers for PX389

Availability

Courses

This module is Option list A for:

- Year 3 of UPXA-F300 Undergraduate Physics (BSc)
- Year 3 of UPXA-F303 Undergraduate Physics (MPhys)
- Year 4 of UPXA-F301 Undergraduate Physics (with Intercalated Year)

This module is Option list B for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
    - Year 3 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- Year 3 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
    - Year 3 of G106 Mathematics (MMath) with Study in Europe
    - Year 4 of G106 Mathematics (MMath) with Study in Europe
- Year 3 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- Year 3 of UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 3 of GF13 Mathematics and Physics
    - Year 3 of FG31 Mathematics and Physics (MMathPhys)
- Year 4 of UPXA-GF14 Undergraduate Mathematics and Physics (with Intercalated Year)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year
- Year 3 of UPXA-F303 Undergraduate Physics (MPhys)