

# PX444-7.5 The Distant Universe

**22/23**

**Department**

Physics

**Level**

Undergraduate Level 4

**Module leader**

Elizabeth Stanway

**Credit value**

7.5

**Module duration**

5 weeks

**Assessment**

100% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

Recent observations are beginning to reach back into the Cosmic Dawn - the era when the first stars and galaxies formed. The physical conditions at the time of their formation set the properties of these objects, and their evolution in turn fixes the properties of the stars, galaxies and planets that follow. This module investigates the formation of structure in the early Universe, starting from the Cosmic Microwave Background and moving through the first generations of stars, and onto the large scale structures that we see today.

The module discusses the theory behind the formation of the first stars and galaxies from primordial density perturbations, the build-up of mass through hierarchical structure formation and the importance of feedback in shaping galaxies. It also highlights observations currently being conducted to observe distant structures, which formed when the Universe was less than 5% of its current age. It outlines the insights that arise from them, and discusses how new observations from missions set for launch in the next few years might answer some of the unanswered questions in the field.

[Module web page](#)

### Module aims

To study what is known about the Universe to the limits of current observations and beyond, to

identify gaps in current knowledge and to look at future prospects.

## 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.

The module will explore the evolution of structure in the Universe, its physical explanations and interpretation, and the techniques used by astronomers to probe the early stages of galaxy formation and evolution.

1. Setting the initial conditions. The Big Bang; Inflation and Nucleosynthesis; the Cosmic Microwave Background radiation and its interpretation.
2. Reionization; the first stars and galaxies; 21cm radiation and the temperature history of the Universe
3. Probes of the Distant Universe; Lyman break galaxies; AGN and supermassive black holes; gamma ray bursts; Submillimeter galaxies and radio galaxies.
4. The evolution of the Universe; metallicity evolution; the star formation rate history of the Universe; luminosity function evolution.
5. The formation of large-scale structure; the Cosmic Web; baryon acoustic oscillations.

## Learning outcomes

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

- Explain the evolution of the early Universe, from the Big Bang to the development of large scale structure
- Explain theories of galaxy and structure formation, and how observations inform those theories
- Discuss critically observational evidence for stars, galaxies and structure in the distant Universe

## Indicative reading list

Loeb & Furlanetto, The First Galaxies in the Universe, Princeton, 2013

[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

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## 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.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group B2

	Weighting	Study time
In-person Examination	100%	
Answer 2 questions		

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

## Feedback on assessment

Personal tutor, group feedback

[Past exam papers for PX444](#)

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## Availability

## Courses

This module is Optional for:

- Year 4 of UPXA-F303 Undergraduate Physics (MPhys)

This module is Option list B for:

- Year 4 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
  - Year 4 of FG31 Mathematics and Physics (MMathPhys)
  - Year 4 of FG31 Mathematics and Physics (MMathPhys)