PX443-15 Planets, Exoplanets and Life

24/25

Department
Physics
Level
Undergraduate Level 4
Module leader
Dimitri Veras
Credit value
15
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The detection of planets orbiting stars other than the sun is technically challenging and it was not achieved until 1995. This module looks at how exoplanets are now being discovered in large numbers and how these discoveries are challenging existing theories of planet formation and evolution. Various methods of detection are considered, as well as methods used to determine physical properties such as temperature, density and composition. We explore likely physical explanations for the observed properties and identify questions that remain open in this active research field. Finally, we consider the prospects for detecting life on distant planets.

Module web page

Module aims

To explore the impact of recent advances in the field on our understanding of planet formation, structure and evolution. To illustrate how established theories can be challenged using careful experimentation.

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.

Geometry and contents of the Solar System; the interior, atmospheric composition and structure of the Solar System planets

Models of planet formation developed to explain the observed properties of the Solar System: accretion discs, dust coagulation, planetesimal formation, gas accretion, orbital evolution, disc evaporation

Challenges and opportunities presented by exoplanetary systems; Debris discs and protoplanetary discs

Observational techniques relevant to exoplanets: precision radial velocities, transits, microlensing, direct imaging, polarimetry, astrometry, Rossiter-McLaughlin effect, transmission spectroscopy

Physical properties of exoplanets: mass, radius, temperature, albedo, composition, irradiation, evaporation, meteorology, orbital orientation, dynamical stability

Challenges to planet formation theory: migration, evaporation, system geometry, free-floating planets. Future observational techniques: extreme adaptive optics, nulling interferometry

Conditions for life: definition of life, extremophiles, energy sources, carbon chemistry, water, habitable zone, alternative habitats; detection of extra-terrestrial life: in-situ measurements, atmospheric spectroscopy, biomarkers, planned space missions, Drake equation, SETI.

Learning outcomes

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

- Describe the interior, atmospheric composition and structure of the Solar System planets
- Explain the experimental methods used to search for extra-solar system planets
- Explain the models being developed to describe exoplanets and discuss the open questions in the field
- Evaluate critically the prospects for the discovery of extra-terrestrial life

Indicative reading list

The module is based on the primary research literature and students are expected to read selected journal articles. In addition the following books are recommend for additional background:
R Dvorak (Ed.), Extrasolar Planets, Wiley-VCH;
I de Pater and JJ Lissauer, Planetary Sciences, CUP;
M Perryman, 2011, The Exoplanet Handbook, CUP;
Philip J. Armitage, Astrophysics of Planet Formation, CUP

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	30 sessions of 1 hour (20%)
Private study	120 hours (80%)
Total	150 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 B2

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

- Answerbook Pink (12 page)
- Students may use a calculator

Feedback on assessment

Personal tutors, group feedback

Past exam papers for PX443

Availability

Courses

This module is Optional for:

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

This module is Option list B for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
  - Year 4 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)
- Year 4 of UMAA-G107 Undergraduate Mathematics (MMath) with Study Abroad
- Year 4 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
- Year 4 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- Year 4 of UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year