PX392-7.5 Plasma Electrodynamics

21/22

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

Description

Introductory description

Plasmas are 'fluids' of charged particles. The motion of these charged particles is controlled by the electromagnetic fields which are imposed from outside and by the fields which the moving charged particles themselves set up. This module will cover the key equations which describe such plasmas. It will examine some predictions derived on the basis of these equations and compare these with results from laboratory experiments and with observations from in situ measurements of solar system plasmas and remote observations of astrophysical systems. It will also be important to look at instabilities in plasmas and how electromagnetic waves interact with the plasmas.

Module web page

Module aims

The module should discuss particle dynamics in plasmas. The interaction of EM fields with a fully ionised fluid (plasma) should be considered in detail leading to ideas of magnetohydrodynamics.

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. Single particle dynamics guiding centre motion and adiabatic invariants. The plasma approximation, waves in plasmas
2. Propagation of EM waves through plasmas
3. MHD description of plasmas and fluid like plasma instabilities
4. Vlasov's equation and micro-instabilities

Learning outcomes

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

- Discuss the interaction of electromagnetic waves with plasmas
- Describe single particle dynamics, guiding centre motion and adiabatic invariants, the plasma approximation and waves in plasmas
- Explain the nature of bulk fluid-instabilities with application to confinement devices and astrophysics
- Describe micro-instabilities and their description via distribution functions

Indicative reading list

N.A. Krall and A.W. Trivelpiece, Principles of Plasma Physics, San Fransisco Press/McGraw Hill; R. O. Dendy. Plasma Dynamics, OUP 1990.

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	12 sessions of 1 hour (16%)
Other activity	3 hours (4%)
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

Other activity description

12 lectures and 3 problem classes

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

	Weighting	Study time	Eligible for self-certification
Assessment component			
In-person Examination	100%		No
Reassessment component is the same			

Feedback on assessment

Personal tutor, group feedback

Past exam papers for PX392

Availability

Courses

This module is Option list A for:

- Year 3 of UMAA-G100 Undergraduate Mathematics (BSc)
- Year 3 of UMAA-G103 Undergraduate Mathematics (MMath)

- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year
- Year 3 of UPXA-F300 Undergraduate Physics (BSc)
- UPXA-F303 Undergraduate Physics (MPhys)
    - Year 3 of F300 Physics
    - Year 3 of F303 Physics (MPhys)

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
- UMAA-G103 Undergraduate Mathematics (MMath)
    - 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 3 of UPXA-F303 Undergraduate Physics (MPhys)