Imperial College London

Module Specification (Curriculum Review)

Basic details

			Earliest cohort	Latest cohort
UID		Cohorts covered	2023-24	

Long title: Space Physics

New code: PHYS70019 | New short title:

Brief description of module *(approx. 600 chars.)*:

This module focuses on the physics of plasmas encountered in the solar system. It introduces students to the different domains of space physics, including the Sun, the corona and solar wind, the interaction of the solar wind with the Earth and other planets, comets and moons and some aspects of space weather. It acquaints students with plasma-physics concepts applied to space plasmas and enables them to understand and predict space-physics phenomena and properties of the space environment.

494 characters

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit
Credit value	7.5	15	N

HECOS codes:

FHEQ level: Level 7

Allocation of study hours

	Hours	
Lectures	24	
Group teaching	2	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	22	*Incl. project supervision, fieldwork, external visits.*
Independent study	139.5	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	187.5	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode: Taught/ Campus | Other:

Delivery term: Term 2 | Other: Exam in term 3

Ownership

Primary department: Physics

Additional teaching: None

departments	
Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N
External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Lorenzo	Matteini
Course Associate		Marina	Galand

Learning and teaching

Module description

Learning outcomes	On completing the Space Physics module, students will be able to: • Classify the main domains where space physics applies and enumerate their properties, • Describe and apply the relevant key physical theories that control the properties of different space plasmas and plasma phenomena, • Calculate the quantitative behaviour of different space physics phenomena using plasma physics analysis methods, • Demonstrate an understanding of how space physics has a practical impact on everyday life in the field of space weather, • Identify ways in which experimental studies of space physics phenomena have advanced our understanding of basic plasma physics.
Module content	Basic properties of the different space physics bodies/regions (e.g. Sun, planetary magnetospheres) and plasmas (solar wind, magnetospheric plasma, ionosphere) encountered in the Solar System; Origin and loss of these plasmas (e.g., pick-up processes, open magnetosphere); how plasmas interact (solar wind interaction with solar system bodies) and implications (space weather). This will be studied by applying the following theories and concepts: - Debye length; plasma frequency, Larmor radius, Cyclotron frequency - Single particle motion; Kinetic theory; Fluid theory/MHD - Hydrostatic equilibrium, stationary flows - Fluid: Continuity, momentum and energy equations - MHD: single-fluid, generalised Ohm's law, ideal MHD, magnetic induction equation, magnetic Reynolds number, frozen-in-field theorem; plasma beta; waves (Alfven, magnetosonic, shock waves); scale analysis - Kinetic desciption: Distribution functions and kinetic waves - Magnetic field equilibria and magnetic reconnection Students will familiarise with the manipulation and plotting of spacecraft plasma observations in dedicated data-analysis sessions.
Learning and Teaching Approach	Students will be taught over one term using a combination of lectures, office hours, seminars and quizzes.

Assessment Strategy	95% summative assessment based on final exam: written exam of 2h 5% (2.5% quiz during the two seminar sessions)
Feedback	Some problem sheets will be given with questions and examples students can practise with. Feedback will also be given during the seminar sessions through oral interaction with the lecturer or TAs. The solution of the assessed quiz will also be presented and discussed. Feedback will be posted online regarding the final exam for each of the questions.
Reading list	Lecture notes are provided to students. Whilst the lectures and handouts form the basis of the examinable material, textbooks are a useful resource as supplementary reading. Core books on space physics - Physics of solar system plasmas (T. E. Cravens), Cambridge University Press, 1997 - Basic space plasma physics (W. Baumjohann and R. Treumann), Imperial College Press, 1997 (1st edition), World Scientific Press 2012 (2nd edition) - Space Physics: An Introduction (C. T. Russell, J.G. Luhmann, R.J. Strangeway), Cambridge University Press, 2016 Other books on plasma physics relevant for space physics - The physics of plasmas (T. J. M. Boyd and J. J. Sanderson), Cambridge University Press 2003 - Introduction to Plasma Physics: With Space, Laboratory and Astrophysical Applications, (D. A. Gurnett, A. Bhattacharjee), Cambridge University Press, 2017 (2nd edition) - Basics of Plasma Astrophysics (C. Chiuderi, M. Velli), Springer, 2015 More specialist text: - Magnetohydrodynamics of the Sun (E. Priest), Cambridge University Press, 2014

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Lorenzo Matteini

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments

Template version 16/06/2017

Programme structure
Associated modules

UID	Legacy code	Module title	Requisite type

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Assessment details

		Pass mark
Grading method	Numeric	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
			50%	
Examination	2 hour written examination.	95%	50%	N
	Seminar quizzes	5%	50%	N
		100%		