Imperial College London

Module Specification (Curriculum Review)

Basic details

			Earliest cohort	Latest cohort
UID		Cohorts covered	2022-23	

Long title: Unification - the Standard Model

New code	PHYS70011	New short title	

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

The module describes the structure of the Standard Model of particle physics and explains how it can be understood as arising from symmetry principles. Using classical field theory, the module covers different types of fields and the Lagrangians they can have. It shows how symmetries are represented mathematically and reflected in physical observables. This way, it identifies the symmetries present in the Standard Model and uses them to determine its Lagrangian.

466 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	26	
Group teaching	10	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	20	*Incl. project supervision, fieldwork, external visits.*
Independent study	131.5	*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		Other	Term 1, exam in term 3

Ownership

Primary department: Physics

Additional teaching:

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	334425	Arttu	Rajantie

Learning and teaching

Module description

Learning outcomes	On completing the Unification module, students will: • know the properties required for the Lagrangian of a field theory • be able to derive the equations of motion from a field-theory Lagrangian • know the difference between global and local symmetries • be able to find the conserved currents associated with a symmetry • be able to find the particle spectrum of a classical field theory consisting of scalars, vectors and spinors • understand how broken and unbroken global and local symmetries are reflected in the particle spectrum • know how Dirac and Weyl spinors transform under Lorentz transformations • know the Standard-Model Lagrangian and understand how its form follows from symmetries
Module content	• Scalar, spinor and vector fields • Global and gauge symmetries • Abelian and non-Abelian symmetries • Noether's theorem and conservation laws • Yang-Mills theory • Spontaneous symmetry breaking and Goldstone's theorem • Higgs mechanism and the Higgs boson • Electroweak unification • The Standard-Model Lagrangian • Symmetries of the Standard Model
Learning and Teaching Approach	The module will consist of lectures supported by eleven problem sheets, where answers are discussed in weekly Rapid Feedback sessions.
Assessment Strategy	100% written exam.

Feedback	Problem sheet answers are marked and returned to the students. The questions and their solutions are discussed in weekly Rapid Feedback session.
Reading list	Self-contained typed lecture notes are provided. Recommended textbooks are: • W.N. Cottingham and D.A. Greenwood, “An Introduction to the Standard Model of Particle Physics, 2nd Edition” (Cambridge University Press, 2007) • M. Robinson, “Symmetry and the Standard Model” (Springer, 2011) • D. Goldberg, “The Standard Model in a Nutshell” (Princeton University Press, 2017)

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Arttu Rajantie

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
		Advanced Classical Physics	Prerequisite
		Quantum Field Theory	Corequisite

Assessment details

		Pass mark
Grading method	Numeric	50%

Assessments

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