BSc Physics and Music Performance

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information				
Award(s)	BSc			
Associateship	Royal College of Science			
Programme Title	Physics and Music Performance			
Programme code	F3W3			
Awarding Institution	Imperial College London Royal College of Music			
Teaching Institution	Imperial College London Royal College of Music			
Faculty	Faculty of Natural Sciences			
Department	Department of Physics			
Mode and Period of Study	4 academic years full-time			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Physics, Astronomy and Astrophysics Music The Physics Degree (Institute of Physics)			
Total Credits	ECTS:	309	CATS:	618
FHEQ Level	Level 6			
EHEA Level	1st cycle			
External Accreditor(s)	Institute of Physics (IOP)			
Specification Details				
Student cohorts covered by specification	2016-17 entry			
Person responsible for the specification	Dr Robert Forsyth (DUGS)			
Date of introduction of programme	2012-13 (date of last review)			

Date of programme specification/revision	August 2016

Description of Programme Contents

The Physics and Music Performance degree programme provides students with an opportunity to achieve a degree level education in both physics and music performance, delivered jointly by Imperial College London and the Royal College of Music (RCM). Students cover all the core material from the first two years of the Imperial BSc Physics degree (thus meeting the curriculum requirements for accreditation set by the Institute of Physics), complete a project and take some elective modules, thus ensuring that they graduate as well-qualified physicists. In parallel students complete the main performance elements of the RCM BMus degree on one principal instrument. Because of the demanding workload the programme is spread out over four years rather than three. The programme aims to prepare students for a professional career or further Masters level study in both disciplines.

Learning Outcomes

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

Knowledge and Understanding of:

- The fundamentals of physics, which all students need to cover, including electromagnetism, optics, quantum and classical mechanics, relativity, statistical physics and thermodynamics, wave phenomena and the properties of matter.
- The application of the fundamental principles to particular areas. These include nuclear and particle physics, condensed matter physics and atomic structure.
- A few subjects which students study in greater depth and appreciate current developments at the frontiers of the subject.
- Repertoire and stylistic studies in music
- Selected elective studies in music at a greater depth.

Intellectual Skills

Students will learn how to:

- Formulate and tackle problems in physics, including the identification of appropriate physical principles and the use of special and limiting cases and order-of-magnitude estimates, to arrive at a solution which is presented with an explicit statement of assumptions and approximations.
- Use mathematics to describe the physical world, selecting appropriate equations, constructing models, interpreting mathematical results and critically comparing them with experiment and observation.
- Participate, under supervision, in an extended physics investigation.
- Research and collate musical information and ideas
- Make informed and mature musical judgments
- Present historically- and analytically-informed musical performances.

Practical Skills
Students will learn how to:

- Plan, execute and report the results of a complex extended experiment or investigation, using appropriate methods to analyse data and to evaluate the level of its uncertainty.
- Use appropriate software such as programming languages and packages in a physics investigation.
- Perform music with high levels of technical command and interpretative insight in a variety of contexts: as a soloist; in a small/large ensemble; at short notice; to an intensive schedule.

Transferable Skills
Students will learn how to:

- Solve open-ended problems and problems with well-defined solutions by formulating problems in precise terms, identifying key issues and trying different approaches in order to make progress.
- Carry out an independent investigation using textbooks and other available literature, searching databases and interacting with colleagues and staff to extract important information.
- Communicate effectively by listening carefully and presenting complex information in a clear and concise manner orally, on paper and using ICT.
- Use analytical skills, paying attention to detail and using technical language correctly, to manipulate precise and intricate ideas, and to construct logical arguments.
- Use ICT skills for communication and analysis.
- Work independently with self-motivation, determination and emotional resilience, use their initiative, organise themselves to meet deadlines, plan and execute a project.
- Work in groups, interacting constructively with others.
- Approach tasks with adaptability, enterprise, resourcefulness and realism
- Act entrepreneurially, identifying customer needs, using skills of self-promotion, networking and negotiation

Entry Requirements	
Academic Requirement	**For the Physics component with Imperial:** A*A*A or equivalent overall to include A* in Mathematics and A in Physics. **For the Music component with RCM:** a standard broadly equivalent to a Grade 8 with Distinction in the ABRSM examination.
Non-academic Requirements	
Home and EU students will be invited to attend an audition and interview; international students are dealt with on an individual basis	
English Requirement	Grade B at GCSE or IELTS 6.5 with a minimum of 6.0 in each element or equivalent

The programme's competency standards documents can be found at: https://www.imperial.ac.uk/natural-sciences/departments/physics/students/current-students/student-welfare/	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Lectures • Tutorials • Laboratory Classes • Computing Labs • Office hours • Music tuition
E-learning & Blended Learning Methods	• Support of lecture courses through online course materials and lecture recordings
Project and Placement Learning Methods	• Group and individual project work
Assessment Strategy	
Assessment Methods	• Written Examination • Assessed problem sheets • Laboratory notebook • Laboratory and project reports • Essay • Interview • Group and individual presentations • Music technical examination • Music performance recital • Portfolio and diary preparation
Academic Feedback Policy	
• All students receive feedback on their progress from their academic tutor in weekly tutorials. • Assessed coursework in Years 1 and 2 is returned to students with comments within approximately one week of submission. Students may discuss their marks with their academic tutor if they wish. • Laboratory and computing reports are returned to students normally within 2 weeks of submission and students have the opportunity of discussing their report with the marker if they wish. Heads of Laboratories are responsible for ensuring that feedback is prompt and effective • Students are encouraged to discuss their examination performance with their Personal Tutor.	
The College's Policy on Re-sits is available at: www.imperial.ac.uk/registry/exams/resit	
The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/registry/exams	

Assessment Structure
Marking Scheme

Year One

A student must:

- Achieve an aggregate mark of at least 40% in each module

Year Two

A student must:

- Achieve an aggregate mark of at least 40% in each module

Year Three

A student must:

- Achieve an aggregate mark of at least 40% in each module

Year Four

A student must:

- Achieve an aggregate mark of at least 40% in each module

Final Degree Classifications

Third – a student must achieve an aggregate mark of 40%
Lower Second – a student must achieve an aggregate mark of 50%
Upper Second – a student must achieve an aggregate mark of 60%
First - a student must achieve an aggregate mark of 70%

Candidates who fall no more than 2.5% below the minimum mark for a higher honours classification shall be eligible for review of their final classification. This review will be at the discretion of the Board of Examiners and is usually available to students who have achieved the higher class in 50% or more of the total credits awarded for the programme weighted by year.

Year	% Year Weighting	Institution	Module		% Module Weighting
Year One	7.69%	Imperial	Laboratory and Computing I		10.34%
			Professional Skills and Basic Electronics I		5.75%
			Electricity & Magnetism, Relativity		8.62%
			Mathematics		17.24%
			Mechanics, Vibrations & Waves		9.20%
			Quantum Physics and Structure of Matter		8.62%
		RCM	Professional Portfolio (Alexander Technique)		5.75%
			Principal Study 1		34.48%
Year Two	23.06%	Imperial	Professional Skills II		2.50%
			Quantum Mechanics		7.50%
			Solid State Physics		6.25%
			Atomic , Nuclear and Particle Physics		7.50%
			Mathematics and Statistics of Measurement		11.25%
			Thermodynamics and Statistical Physics		8.75%
		RCM	Principal Study 2		37.50%
			Historical Studies Level 4 [1]		12.50%
			Aural Training		6.25%
Year Three	30.77%	Imperial	Element I	Electromagnetism & Optics	10.97%
				6 ECTS of electives from groups A or B	7.32%
				Project or Essay Project (one of elective E) [2]	10.97%
			Element II	Comprehensive Physics and Professional Skills III	21.95%
		RCM	Element III	Principal Study 3	36.59%
				Practical Musicianship Level 4 [1]	12.20%

Year Four	38.46%	Imperial	Element I [3]	24-30 ECTS of electives from groups A-D [2, 3] • At least 12 ECTS from Group B • Maximum of one from Group A (if not taken in Year 3) • Maximum of 8 ECTS from Group C • Maximum of one from Group D	100%
		RCM		30 or 40 ECTS of Principal Study plus optionally one elective from Group F [3,4]	

- [1] Historical Studies in Year 2 may be replaced by Practical Musicianship; students must then take Historical Studies in place of Practical Musicianship in Year3.
- [2] Students may take their project or essay project in Year 4 instead of Year 3. An elective would then be taken in Year 3 in place of the project and one less elective in Year 4.
- [3] There are three permissible combinations of the Year 4 Element:
  - 30 ECTS of principle study and 30 ECTS of Imperial electives, of which 24 must be physics (Total 60 ECTS).
  - 30 ECTS of principle study, 10 ECTS of RCM electives (Group F) and 24 ECTS of Imperial electives, of which 18 ECTS must be physics (Total 64 ECTS).
  - 40 ECTS of principle study and 24 ECTS of Imperial electives, of which 18 ECTS must be physics (Total 64 ECTS).
- [4] Students must have authorisation from the RCM to take 40 ECTS of Principle Study.

Module List												
Code	Title	Core/Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
PH1-MU	Measurement and Uncertainty	CORE	1	4	4	0	0	0%	0%	0%	4	0
MPH.1	Mathematics	CORE	1	142	233	0	375	85%	15%	0%	4	15
P1.1.1	Mechanics, Vibrations & Waves	CORE	1	72	128	0	200	85%	15%	0%	4	8
P1.2.1	Electricity & Magnetism, Relativity	CORE	1	64	123.5	0	187.5	85%	15%	0%	4	7.5
P1.3.1	Quantum Physics & Structure of Matter	CORE	1	73	114.5	0	187.5	85%	15%	0%	4	7.5
PL1.1	Laboratory and Computing I	CORE	1	75	150	0	225	0%	50%	50%	4	9
P1.7	Professional Skills and Basic Electronics I	CORE	1	32	93	0	125	57%	43%	0%	4	5
RCM	Professional Portfolio (Alexander Technique)	CORE	1	19	81	0	100	50%	50%	0%	4	5
RCM	Principal Study 1	CORE	1	198	175.5	1.5	375	0%	0%	100%	4	30
P2.8	Atomic , Nuclear and Particle Physics	CORE	2	54	96	0	150	85%	15%	0%	5	6
P2.4	Electromagnetism & Optics	CORE	3	80	145	0	225	85%	15%	0%	5	9
P2.7	Professional Skills II	CORE	2	4	46	0	50	0%	100%	0%	5	2
P2.1	Quantum Mechanics	CORE	2	58	92	0	150	85%	15%	0%	5	6
P2.9	Solid State Physics	CORE	2	44	81	0	125	85%	15%	0%	5	5
P2.5	Mathematics & Statistics of Measurement	CORE	2	80	145	0	225	85%	15%	0%	5	9
P2.2	Thermodynamics & Statistical Physics	CORE	2	71	104	0	175	85%	15%	0%	5	7
RCM	Aural Training	CORE	2	44	18.5	0	62.5	0%	0%	100%	4	5
RCM	Historical Studies Level 4	CORE	2 or 3	64	61	0	125	30%	50%	20%	4	10
RCM	Principal Study 2	CORE	2	198	175.5	1.5	375	0%	0%	100%	5	30
P.COMP12	Comprehensive Physics	CORE	3	20	380	0	400	100%	0%	0%	6	16
P3.4	Professional Skills III	CORE	3	4	46	0	50	0%	0%	100%	6	2
RCM	Principal Study 3	CORE	3	310	63.5	1.5	375	0%	0%	100%	6	30
RCM	Practical Musicianship Level 4	CORE	2 or 3	32	93	0	125	30%	50%	20%	4	10

Module List												
Code	Title	Core/Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
MPh2	Mathematical Methods	ELECTIVE (A)	3 or 4	57	93	0	150	100%	0%	0%	5	6
PO2.3	Environmental Physics	ELECTIVE (A)	3 or 4	47	103	0	150	100%	0%	0%	5	6
PO2.1	Sun, Stars & Planets	ELECTIVE (A)	3 or 4	49	101	0	150	100%	0%	0%	5	6
P3.12b	Fluid Dynamics	ELECTIVE (B)	3 or 4	16	21.5	0	37.5	100%	0%	0%	6	1.5
P3.11	Light & Matter	ELECTIVE (B)	3 or 4	53	97	0	150	100%	0%	0%	6	6
P3.12a	Physics of the Universe	ELECTIVE (B)	3 or 4	41	71.5	0	112.5	100%	0%	0%	6	4.5
PP3.3	Physics Project	ELECTIVE (E)	3 or 4	90	135	0	225	0%	100%	0%	6	9
PEP3.1	Physics Essay III	ELECTIVE (E)	3 or 4	90	135	0	225	0%	100%	0%	6	9
PT3.5	Computational Physics	ELECTIVE (B)	3 or 4	58	92	0	150	40%	60%	0%	6	6
PO3.4	Advanced Classical Physics	ELECTIVE (B)	3 or 4	57	93	0	150	100%	0%	0%	6	6
PO3.6	Astrophysics	ELECTIVE (B)	3 or 4	47	103	0	150	100%	0%	0%	6	6
PO3.9	Communicating Physics	ELECTIVE (B)	3 or 4	45	105	0	150	0%	100%	0%	6	6
PT3.6	Complexity & Networks	ELECTIVE (B)	3 or 4	57	93	0	150	20%	80%	0%	6	6
PT3.1	Foundations of Quantum Mechanics	ELECTIVE (B)	3 or 4	57	93	0	150	100%	0%	0%	6	6
PT3.2	Group Theory	ELECTIVE (B)	3 or 4	57	93	0	150	100%	0%	0%	6	6
PO3.3a	Lasers	ELECTIVE (B)	3 or 4	28.5	46.5	0	75	100%	0%	0%	6	3
PO3.3b	Imaging & Biophotonics	ELECTIVE (B)	3 or 4	28.5	46.5	0	75	100%	0%	0%	6	3
PO3.7a	Medical Imaging: X-Rays & Ultrasound	ELECTIVE (B)	3 or 4	23.5	51.5	0	75	100%	0%	0%	6	3
PO3.7b	Medical Imaging: Nuclear Diagnostics & MRI	ELECTIVE (B)	3 or 4	23.5	51.5	0	75	100%	0%	0%	6	3
PO3.2	Plasma Physics	ELECTIVE (B)	3 or 4	47	103	0	150	100%	0%	0%	6	6
PO3.5	Principles of Instrumentation	ELECTIVE (B)	3 or 4	58	92	0	150	80%	20%	0%	6	6
PT3.4	Statistical Mechanics	ELECTIVE (B)	3 or 4	57	93	0	150	100%	0%	0%	6	6
PT4.1	Advanced Particle Physics	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6

Module List												
Code	Title	Core/Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
PO4.1	Atmospheric Physics	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
BE4-MCNS	Computational Neuroscience	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
PO4.10	Nanotechnology in Consumer Electronics	ELECTIVE (C)	3 or 4	23.5	51.5	0	75	100%	0%	0%	7	3
PT4.2	General Relativity	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
PO4.9	Advanced Hydrodynamics	ELECTIVE (C)	3 or 4	23.5	51.5	0	75	100%	0%	0%	7	3
PH4-LT	Laser Technology	ELECTIVE (C)	3 or 4	47	103	0	150	100%	0%	0%	7	6
PO4.4a	Optical Communications	ELECTIVE (C)	3 or 4	23.5	51.5	0	75	100%	0%	0%	7	3
PO4.4b	Information Theory	ELECTIVE (C)	3 or 4	23.5	51.5	0	75	100%	0%	0%	7	3
PO4.9	Plasmonics & Metamaterials	ELECTIVE (C)	3 or 4	47	103	0	150	100%	0%	0%	7	6
PT4.4	Quantum Field Theory	ELECTIVE (C)	3 or 4	57	143	0	200	100%	0%	0%	7	8
PT4.8	Quantum Information	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
PO4.6	Quantum Optics	ELECTIVE (C)	3 or 4	47	103	0	150	100%	0%	0%	7	6
PT4.5	Quantum Theory of Matter	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
PO4.5	Cosmology	ELECTIVE (C)	3 or 4	57	93	0	150	100%	0%	0%	7	6
PO4.3	Space Physics	ELECTIVE (C)	3 or 4	47	103	0	150	100%	0%	0%	7	6
PT4.6	Unification	ELECTIVE (C)	3 or 4	57	143	0	200	100%	0%	0%	7	8
N/A	Imperial Horizons	ELECTIVE (D)	4	Various			150	Various				6
N/A	Business for Professional Engineers & Scientists	ELECTIVE (D)	4	Various			150	Various				6
RCM	Principal Study 4	CORE	4	310	188.5	1.5	500	0%	0%	100%	6	40
RCM	Advanced Stylistic Studies	Elective (F)	4	Various			250	Various			6	10
RCM	Alexander Technique Level 5	Elective (F)	4	Various			250	Various			5	10
RCM	Alexander Technique Level 6	Elective (F)	4	Various			250	Various			6	10
RCM	Aural in Professional Context	Elective (F)	4	Various			250	Various			6	10

Module List												
Code	Title	Core/Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
RCM	Chamber Music (including Duo) Level 5	Elective (F)	4	Various			250	Various			5	10
RCM	Chamber Music (including Duo) Level 6	Elective (F)	4	Various			250	Various			6	10
RCM	Classical CD Production	Elective (F)	4	Various			250	Various			5	10
RCM	Conducting Level 5	Elective (F)	4	Various			250	Various			5	10
RCM	Conducting Level 6	Elective (F)	4	Various			250	Various			6	10
RCM	Contemporary Music in Action	Elective (F)	4	Various			250	Various			6	10
RCM	Historical Performance	Elective (F)	4	Various			250	Various			6	10
RCM	Historical Studies Level 5	Elective (F)	4	Various			250	Various			5	10
RCM	Historical Studies Level 6	Elective (F)	4	Various			250	Various			6	10
RCM	Repertoire Project	Elective (F)	4	Various			250	Various			6	10
RCM	Research Project HIP	Elective (F)	4	Various			250	Various			6	10

Supporting Information
The Programme Handbook is available at: http://www.imperial.ac.uk/natural-sciences/departments/physics/students/current-students/undergraduates/physics-student-handbook/
The Module Handbook is available at: https://www.imperial.ac.uk/natural-sciences/departments/physics/students/current-students/undergraduate-and-masters-degree-courses-list/
The College's entry requirements for undergraduate programmes can be found at: www.imperial.ac.uk/study/ug/apply/requirements/
The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance
The programme is consistent with the Qualifications Framework of the European Higher Education Area which is available at: http://www.ehea.info/Uploads/qualification/QF-EHEA-May2005.pdf