Royal Holloway, University of London
Course specification for an undergraduate award
BSc Physics with Particle Physics (F370)

Section 1 – Introduction to your course

This course specification is a formal document, which provides a summary of the main features of your course and the learning outcomes that you might reasonably be expected to achieve and demonstrate if you take full advantage of the learning opportunities that are provided. Further information is contained in the College prospectus, and in various handbooks, all of which you will be able to access online. Alternatively, further information on the College's academic regulations and polices can be found here. Further information on the College's Admissions Policy can be found here.

Your degree course in BSc Physics with Particle Physics is delivered in three stages, each of which comprises one year of full-time study during which you must follow modules to the value of 120 credits. For some courses there is the option of part-time study. In that case a stage may be spread over two years of study; in each part-time year you will follow modules to the value of 60 credits. The curriculum is characterised by strong progression and opportunities for specialisation throughout the course. Stages one and two provide a foundation for the later stages through a compulsory spine of modules that complete a core, discipline-specific, knowledge base. Stage three offers a wide range of optional modules for Single Honours students; for those taking Joint or Combined Honours, the compulsory spine extends into this stage.

Specifically, stage one gives a balanced foundation for progression, offers opportunities for students to select and move between degree courses according to their interests and provides a foundation which serves students from a wide variety of educational backgrounds. The stage one curriculum aims:

1. to extend and develop classical physics covered at A-level, to bring you to a common level and to set your knowledge into an appropriate context;
2. to develop modern physics and establish it on a firm foundation, enabling you to experience the flavour of modern physics, without excessive technical detail;
3. to extend and develop the mathematics covered at A-level;
4. to start the course of discipline-specific and transferable skills.

Stage two builds on this and applies the skills and knowledge acquired to specific subjects. The available modules complete the essential physics core consisting of classical and modern physics, emphasising Electromagnetism, Quantum Mechanics, and Classical and Statistical Thermodynamics. Skills are further developed and Physics specialists take modules in Mathematical Methods, Solid State Physics, and Optics. Other modules are available for the other courses.

In stage three, you take a number of advanced modules including options depending on your degree course and personal interests. An important component of the final year is a project, PH3110, which may be of an experimental, theoretical, or computational or nature. Some third year modules closely reflect the research interests of members of staff, who are active specialists in their fields.

While Royal Holloway keeps all the information made available under review, courses and the availability of individual modules, especially optional modules are necessarily subject to change at any time, and you are therefore advised to seek confirmation of any factors which might affect your decision to follow a specific course. In turn, Royal Holloway will inform you as soon as is practicable of any significant changes which might affect your studies.

The following is brief description for some of the most important terminology for understanding the content of this document:

Degree course – May also be referred to as 'degree programme' or simply 'programme'; these terms refer to the qualification you will be awarded upon successful completion of your studies.
Module– May also be referred to as 'course', this refers to the individual units you will study each year to complete your degree course. Undergraduate degrees at Royal Holloway comprise modules to the value of 120 credits per year. On some degree courses a certain number of optional modules must be passed for a particular degree title.

Section 2 – Course details			
Date of specification update	August 2019	**Location of study**	Egham Campus
Course award and title	BSc Physics with Particle Physics	**Level of study**	Undergraduate
Course code	1348	**UCAS code**	F370
Year of entry	2020/21		
Awarding body	Royal Holloway, University of London		
Department	Physics	**Other departments involved in teaching the course**	N/A
Mode(s) of attendance	Full-time or part-time	**Duration of the course**	Three years
Accrediting Professional, Statutory or Regulatory Body requirement(s)	Institute of Physics (IOP) – successful completion of this course partially meets the educational requirement for becoming a Chartered Physicist.		
Link to Coursefinder for further information:	https://www.royalholloway.ac.uk/studying-here/	**For queries on admissions:**	study@royalholloway.ac.uk.

Section 3 – Degree course structure

3.1 Mandatory module information
The following table summarises the mandatory modules which students must take in each year of study

Year	Module code	Module title	Contact hours*	Self-study hours	Written exams**	Practical assessment**	Coursework**	Credits	FHEQ level	Module status (see below)
1	PH1110	Mathematics for Scientists 1	68	82	80%	0	20%	15	4	MNC
1	PH1120	Mathematics for Scientists 2	68	82	80%	0	20%	15	4	MNC
1	PH1140	Scientific Skills 1	71	79	0	6%	96%	15	4	MC
1	PH1150	Scientific Skills 2	72	78	0	2%	98%	15	4	MC
1	PH1320	Classical Mechanics	40	110	80%	0	20%	15	4	MC
1	PH1420	Fields and Waves	40	110	80%	0	20%	15	4	MC
1	PH1620	Classical Matter	40	110	80%	0	20%	15	4	MC
1	PH1920	Physics of the Universe	40	110	80%	0	20%	15	4	MC
2	PH2130	Mathematical Methods	61	89	80%	0	20%	15	5	MC
2	PH2150	Scientific Computing Skills	82	68	0	0	100%	15	5	MC
2	PH2210	Quantum Mechanics	38	112	90%	0	10%	15	5	MC
2	PH2270	Scientific Skills for Particle Physics	78	72	0	10%	90%	15	5	MC
2	PH2310	Optics	38	112	90%	0	10%	15	5	MC
2	PH2420	Electromagnetism	38	112	90%	0	10%	15	5	MC

2	PH2610	Classical and Statistical Thermodynamics	38	112	70%	0	30%	15	5	MC
2	PH2710	The Solid State	38	112	90%	0	10%	15	5	MC
3	PH3010	Advanced Skills	56	94	0	15%	85%	15	6	MC
3	PH3110	Experimental/Theoretical Project	94	56	0	20%	80%	15	6	MC
3	PH3210	Quantum Theory	35	115	90%	0	10%	15	6	MC
3	PH3520	Particle Physics	35	115	90%	0	10%	15	6	MC
3	PH3530	Particle Detectors and Accelerators	35	115	90%	0	10%	15	6	MC
3	PH3930	Particle Astrophysics	35	115	90%	0	10%	15	6	MC

This table sets out the most important information for the mandatory modules on your degree course. These modules are central to achieving your learning outcomes, so they are compulsory, and all students on your degree course will be required to take them. You will be automatically registered for these modules each year. Mandatory modules fall into two categories; 'condonable' or 'non-condonable'.

In the case of mandatory 'non-condonable' (MNC) modules, you must pass the module before you can proceed to the next year of your course, or to successfully graduate with a particular degree title. In the case of mandatory 'condonable' (MC) modules, these must be taken but you can still progress or graduate even if you do not pass them. Please note that although Royal Holloway will keep changes to a minimum, changes to your degree course may be made where reasonable and necessary due to unexpected events. For example; where requirements of relevant Professional, Statutory or Regulatory Bodies have changed and course requirements must change accordingly, or where changes are deemed necessary on the basis of student feedback and/or the advice of external advisors, to enhance academic provision.

*Contact hours come in various different forms, and may take the form of time spent with a member of staff in a lecture or seminar with other students. Contact hours may also be laboratory or, studio-based sessions, project supervision with a member of staff, or discussion through a virtual learning environment (VLE). These contact hours may be with a lecturer or teaching assistant, but they may also be with a technician, or specialist support staff.
**The way in which each module on your degree course is assessed will also vary, however, the assessments listed above are all 'summative', which means you will receive a mark for it which will count towards your overall mark for the module, and potentially your degree classification, depending on your year of study. On successful completion of the module you will gain the credits listed. 'Coursework' might typically include a written assignment, like an essay. Coursework might also include a report, dissertation or portfolio. 'Practical assessments' might include an oral assessment or presentation, or a demonstration of practical skills required for the particular module.

3.2 Optional modules

In addition to mandatory modules, there will be a number of optional modules available during the course of your degree. The following table lists a selection of optional modules that are likely to be available. However, not all may be available every year. Although Royal Holloway will keep changes to a minimum, new options may be offered or existing ones may be withdrawn. For example; where reasonable and necessary due to unexpected events, where requirements of relevant Professional, Statutory or Regulatory Bodies (PSRBs) have changed and course requirements must change accordingly, or where changes are deemed necessary on the basis of student feedback and/or the advice of External Advisors, to enhance academic provision.There may be additional requirements around option selection, so it is important that this specification is read alongside your department's Student Handbook.

Year 1	Year 2	Year 3
None	None	PH3040 Energy and Climate Science
		PH3130 Advanced Classical Physics
		PH3150 Further Mathematical Methods
		PH3160 Nonlinear Systems and Chaos
		PH3170 C++ and Object Oriented Programming
		PH3710 Metals and Semiconductors
		PH3510 Atomic Physics
		PH3730 Superconductivity and Magnetism
		PH3810 Frontiers of Metrology
		PH3900 Astronomy
		PH3910 General Relativity and Cosmology
		PH3920 Stellar Astrophysics
		Earth Sciences: GL3510 Planetary Geology and Geophysics

3.3 Optional module requirements

In Stage 3, you must choose options to the value of 30 credits from the modules offered by the Department. In choosing options you may take no more than 30 credits of Stage 2 (FHEQ Level 5) modules in the third year. When choosing optional modules you must be sure to satisfy any prerequisites.

Section 4 - Progressing through each year of your degree course

For further information on the progression and award requirements for your degree, please refer to Royal Holloway's Academic Regulations.

Part-time study - a stage may be spread over two years of study; in each part-time year you will follow modules to the value of 60 credits.

Stage 1a
PH1110 Mathematics for Scientists 1 (MNC)
PH1120 Mathematics for Scientists 2 (MNC)
PH1320 Classical Mechanics
PH1420 Fields and Waves

Stage 1b
PH1140 Scientific Skills 1
PH1150 Scientific Skills 2
PH1920 Physics of the Universe
PH1620 Classical Matter

Stage 2a
PH2130 Mathematical Methods (MNC)
PH2210 Quantum Mechanics (MNC)
PH2310 Optics
PH2610 Classical and Statistical Thermodynamics

Stage 2b
PH2150 Scientific Computing Skills
PH2420 Electromagnetism
PH2270 Scientific Skills for Particle Physics
PH2710 The Solid State

Stages 3a & b
PH3010 Advanced Skills
PH3110 Experimental or Theoretical Project
PH3210 Quantum Theory
PH3520 Particle Physics
PH3530 Particle Detectors and Accelerators
PH3930 Particle Astrophysics

In Stage 3 you must choose options to the value of 30 credits from the modules offered by the Department. In choosing options you may take no more than 30 credits of Stage 2 (FHEQ Level 5) modules in the third year. When choosing optional modules you must be sure to satisfy any prerequisites.

In Stage 3 students may choose, with advice, which modules they take in which years. This is largely a matter of personal choice, although a balance of modules between the first and second terms must be ensured.

Section 5 – Educational aims of the course

The aims of this course are:

- to impart a secure knowledge of the fundamental elements of Physics;
- to nurture confidence in the use of appropriate mathematical techniques;
- to develop the skills and knowledge required for experimentation and/or theoretical modelling;
- to promote oral and written communication skills;
- to teach the effective use of information technology and computing facilities for the treatment and presentation of experimental data;
- to provide a sound awareness of safety procedures and environmental issues;
- to develop and strengthen problem solving abilities;
- to provide a firm foundation for postgraduate research and further study in the physical sciences or for entry into a wide range of both scientific and non-vocational careers.

Section 6 - Course learning outcomes

In general terms, the course provides opportunities for students to develop and demonstrate the following learning outcomes. (*Categories – Knowledge and understanding (K), Skills and other attributes (S), and Transferable skills (*)*)

1. A broad knowledge of the inanimate physical universe to a level appropriate for a Bachelor's degree **(K);**
2. A sound knowledge of the fundamental concepts of Physics and how these may be applied to understand complex physical systems and address associated problems **(K);**
3. An understanding of the quantum and continuum descriptions of natural phenomena **(K);**
4. An appreciation of the microscopic and macroscopic structure of all the states (phases) of matter and their interactions with different forms of energy **(K);**
5. A knowledge and understanding of important physical laws and principles, and competence in the application of these principles to more diverse areas of physics and, where appropriate, to other disciplines **(K);**
6. A secure understanding of the experimental and/or theoretical techniques and diagnostic tools appropriate to the particular field of endeavour and an awareness of such techniques in other fields **(K);**
7. A critical approach to the gathering, collating, analysis and reporting of experimental data based on an understanding of errors and the limits of measurement **(K);**
8. An understanding of mathematical modelling and of the role of approximation **(K);**
9. Use appropriate mathematical and/or computational tools to formulate and tackle problems in physics and to model physical behaviour, making necessary approximations, thus comparing critically the results of calculations with those from experimental observation **(S);**
10. Use appropriate methods to analyse data and to evaluate the level of its uncertainty and to relate any conclusions to current theories of the physics involved **(S);**
11. Execute an experiment or investigation, analyse critically the results of it and draw valid conclusions including evaluation of the level of uncertainty in the results and comparison with expected outcomes, published results or theoretical predictions **(S);**
12. Plan, execute and report the results of an experiment or investigation in physics **(S);**
13. Communicate scientific information clearly and accurately with correct use of technical language **(S*);**
14. Use a range of laboratory apparatus competently and safely **(S);**
15. Read demanding textbooks, and other available literature, search databases and listen carefully and interact with colleagues to extract important information. Make use of appropriate IT packages/systems for the retrieval and analysis of this data **(S*);**
16. Manipulate numerical data, and present and interpret information graphically **(S*);**
17. Analyse complex information, manipulating precise and intricate ideas to construct logical arguments and then presenting them in a clear and concise manner **(S*).**

Section 7 - Teaching, learning and assessment
Teaching is mostly by means of lectures, seminars, laboratory practical classes and problem-solving sessions; the latter generally providing a forum for you, with the support of your instructors, to work through problem sets and applications in a smaller and more interactive setting. Learning is through participation in lectures and seminars, designated reading, completion of problem sets and guided independent study and research. You are expected to meet basic standards in information technology, for which training is provided by the College Computer Centre. Assessment of knowledge and understanding is mainly by formal, unseen written examination; coursework exercises, laboratory reports, oral and poster presentations and a Project dissertation are also assessed. A detailed mapping of the ways in which particular modules achieve the courses' learning outcomes may be found in the Department of Physics Student Handbook. Full details of the assessments for individual modules can be obtained from the Department.

Section 8 – Additional costs
£55
These estimated costs relate to studying this particular degree course at Royal Holloway. General costs such as accommodation, food, books and other learning materials and printing etc., have not been included, but further information is available on our website.

Section 9 – Indicators of quality and standards	
QAA Framework for Higher Education Qualifications (FHEQ) Level	4-6
Your course is designed in accordance with the FHEQ to ensure your qualification is awarded on the basis of nationally established standards of achievement, for both outcomes and attainment. The qualification descriptors within the FHEQ set out the generic outcomes and attributes expected for the award of individual qualifications. The qualification descriptors contained in the FHEQ exemplify the outcomes and attributes expected of learning that results in the award of higher education qualifications. These outcomes represent the integration of various learning experiences resulting from designated and coherent courses of study.	
QAA Subject benchmark statement(s)	http://www.qaa.ac.uk/quality-code/subject-benchmark-statements
Subject benchmark statements provide a means for the academic community to describe the nature and characteristics of courses in a specific subject or subject area. They also represent general expectations about standards for the award of qualifications at a given level in terms of the attributes and capabilities that those possessing qualifications should have demonstrated.	

Section 10 – Further information
This specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate when taking full advantage of the learning opportunities that are available. More detailed information on modules, including teaching and learning methods, and methods of assessment, can be found via the online Module Catalogue. The accuracy of the information contained in this document is reviewed regularly by the university, and may also be checked routinely by external agencies, such as the Quality Assurance Agency (QAA). Your course will be reviewed regularly, both by the university as part of its cyclical quality enhancement processes, and/or by your department or school, who may wish to make improvements to the curriculum, or in response to resource planning. As such, your course may be revised during the module of your study at Royal Holloway. However, your department or school will take reasonable steps to consult with students via appropriate channels when considering changes. All continuing students will be routinely informed of any significant changes.

Section 11 – Intermediate exit awards (where available)		
You may be eligible for an intermediate exit award if you complete part of the course as detailed in this document. Any additional criteria (e.g. mandatory modules, credit requirements) for intermediate awards is outlined in the sections below.		
Award	**Criteria**	**Awarding body**
Diploma in Higher Education (DipHE)	Pass in 210 credits of which at least 90 must be at or above FHEQ Level 4 and at least 120 of which must be at or above FHEQ Level 5	Royal Holloway and Bedford New College
Certificate in Higher Education (CertHE)	Pass in 120 credits of which at least 90 must be at or above FHEQ Level 4	Royal Holloway and Bedford New College

Section 12 - Associated award(s)	
BSc Physics with Particle Physics (F370)	MSci Physics with Particle Physics (F370)