

## PROGRAMME SPECIFICATION

This document describes the **MSc in Physics (Euro Masters)** programme offered in the Physics Department. This specification is valid for new entrants from **September 2009**.

This is a two-year programme designed to conform to the highest European (and international) standards. Similar programmes are under development at other physics departments of the South-East Physics Network (SEPNet), a consortium of the departments from RHUL, QMUL and the Universities of Southampton, Surrey, Sussex and Kent. A key feature of the programme is the possibility of combining studies at more than one partner department; thus a student could spend one year at one department and the second at another.

The aim of this programme is to equip students for future careers, in the UK and internationally, including research in universities, industry and other organisations as well as to provide a technical background for a broader range of careers in the industrial scientific instrument sector and elsewhere. The programme is aimed, primarily, at overseas students from the EU and farther afield. The scope of the programme caters for a spectrum of students, from those whose predominant interest is in fundamental science, to those whose interests are more applied.

The aims of the programme are in accord with the College Mission Statement, with its emphasis on ensuring 'the highest quality of teaching and learning, led by active research and scholarship'.

In this programme we aim to provide a stimulating and supportive learning environment in which students will:

- develop an advanced knowledge of a chosen area of contemporary physics via lecture courses;
- obtain training in research techniques through lecture courses, directed study, and an individual project;
- develop key skills relevant for a postgraduate science student.

Upon successful completion of the programme students will be well-prepared for doctoral research in the best universities around the world.

The Department has close links with Rutherford Appleton Laboratory and the Harwell Science and Innovation Campus (including ISIS neutron spallation source and DIAMOND synchrotron x-ray scattering facility), Oxford Instruments plc (a major employer in the field), the National Physical Laboratory, CERN and other institutions. An important element of this programme, which ensures its wider relevance, involves external involvement in the programme. This entails:

- input on the course content;
- collaborative projects (some projects may involve time spent at these collaborators)
- visits to industrial facilities and laboratories;
- guest lectures.

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This document provides a summary of the main features of the programme(s), and of the outcomes which a student might reasonably be expected to achieve if full advantage is taken of the learning opportunities provided. Further information is contained in the College prospectus, the College Regulations and in various handbooks issued to students upon arrival. Whilst Royal Holloway keeps all its information for prospective applicants and students under review, programmes and the availability of

individual courses are necessarily subject to change at any time, and prospective applicants are therefore advised to seek confirmation of any factors which might affect their decision to follow a specific programme. In turn, Royal Holloway will inform applicants and students as soon as is practicable of any substantial changes which might affect their studies.

### **Learning outcomes**

The programme complies fully with Descriptors for a Masters level qualification set out by the Quality Assurance Agency for Higher Education in England and Wales (QAA) as all of its learning outcomes are at Masters (M) level. The programme conforms to the Bologna specifications (including the 'Dublin' Descriptors) for a Second Cycle qualification in both level and volume. In general terms the programme provides opportunities for students to develop and demonstrate the following learning outcomes:

#### *Knowledge and understanding*

On successfully completing the programme a student should have a very good understanding of a range of physics topics and they will have increased their knowledge and understanding of the chosen topics. In particular they will have demonstrated:

- a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of the discipline;
- a comprehensive understanding of techniques applicable to their own research or advanced scholarship;
- originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline.

#### *Skills and other attributes*

The students should develop a range of generic key skills as required by a scientific researcher, including:

- problem-solving skills – applied in new or unfamiliar environments;\*
- learning skills – including self-directed and autonomous study;\*
- investigative skills;\*
- information retrieval skills;\*
- communication skills – to both specialists and non-specialists;\*
- analytical skills;\*
- IT skills;\*
- personal skills such as teamwork and independence.\*

As a result of carrying out the research project students should develop research skills using a mix of experimental, theoretical and computational techniques appropriate to the field together with related transferable skills. The project will provide students with an opportunity for originality in developing and applying their ideas. Students should develop their communication skills and apply them to the writing of the project report and the presentation of an oral report on the project.

\* transferable skills

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### **Teaching, learning and assessment**

A variety of teaching methods will be used, including lectures, directed study, seminars and one-on-one sessions. The Programme makes use of the Department's dedicated Audio-Visual suite so that courses may be shared with other institutions of the South-East Physics Network (SEPnet) and/or other colleges of the University of London.

Assessment is based on the Project thesis, course examinations and coursework. Full details of the assessments for individual courses can be obtained from the [Department](#).

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### **Details of the programme structure(s)**

The programme lasts for two years full-time, with each year comprising 60 ECTS. Lecture courses are delivered in 7.5 ECTS courses (MSci half-course units).

In their first year students will take six taught courses from the list below, including PH4211 Statistical Mechanics and PH4226 Advanced Quantum Theory. They will also conduct a double-course (15 ECTS) Project PH4100. Students who can demonstrate that they have already achieved a high grade in Statistical Mechanics and in Quantum Theory may be allowed to choose two other courses instead.

In the second year students will conduct a Research Project PH4050 (60 ECTS) which will include research training, through directed study.

First year courses – the lecture courses are taught by members of the University of London intercollegiate MSci consortium. Please note that the list of available courses offered is subject to change and not all courses run each year. A full list of courses including optional courses for the current academic year can be obtained from the [Department](#).

| Code   | Course Title  | ECTS |            |
|--------|---|------|------------|
| PH4100 | Project   | 15   | compulsory |
| PH4201 | Math Methods for Theoretical Physics                            | 7.5  | optional   |
| PH4205 | Lie Groups and Lie Algebras                                     | 7.5  | optional   |
| PH4211 | Statistical Mechanics   | 7.5  | compulsory |
| PH4226 | Advanced Quantum Theory   | 7.5  | compulsory |
| PH4242 | Relativistic Waves & Quantum Fields                             | 7.5  | option     |
| PH4245 | Advanced Quantum Field Theory                                   | 7.5  | option     |
| PH4261 | Electromagnetic Theory  | 7.5  | option     |
| PH4317 | Galaxy and Cluster Dynamics                                     | 7.5  | option     |
| PH4421 | Atom and Photon Physics   | 7.5  | option     |
| PH4427 | Quantum Computation and<br>Communication                        | 7.5  | option     |
| PH4431 | Molecular Physics   | 7.5  | option     |
| PH4442 | Particle Physics  | 7.5  | option     |
| PH4450 | Particle Accelerator Physics                                    | 7.5  | option     |
| PH4472 | Order and Excitations in Condensed Matter                       | 7.5  | option     |
| PH4473 | Theoretical Treatments of Nano-systems                          | 7.5  | option     |
| PH4475 | Physics at the Nanoscale  | 7.5  | option     |
| PH4478 | Superfluids, Condensates and                                    | 7.5  | option     |
| PH4501 | Superconductors   | 7.5  | option     |
| PH4512 | Standard Model Physics and Beyond<br>Nuclear Magnetic Resonance | 7.5  | option     |
| PH4515 | Computing and Statistical Data Analysis                         | 7.5  | option     |
| PH4534 | String Theory and Branes  | 7.5  | option     |
| PH4541 | Supersymmetry and Gauge Symmetry                                | 7.5  | option     |
| PH4600 | Stellar Structure and Evolution                                 | 7.5  | option     |
| PH4601 | Advanced Cosmology  | 7.5  | option     |
| PH4602 | Relativity and Gravitation                                      | 7.5  | option     |
| PH4603 | Astrophysical Fluid Dynamics                                    | 7.5  | option     |
| PH4630 | Planetary Atmospheres   | 7.5  | option     |
| PH4640 | Solar Physics   | 7.5  | option     |
| PH4650 | Solar System  | 7.5  | option     |
| PH4660 | The Galaxy  | 7.5  | option     |
| PH4680 | Space Plasma and Magnetospheric Physics                         | 7.5  | option     |
| PH4690 | Extrasolar Planets and Astrophysical Discs                      | 7.5  | option     |
| PH4670 | Astrophysical Plasmas   | 7.5  | option     |
| PH4800 | Molecular Biophysics  | 7.5  | option     |
| PH4810 | Theory of Complex Networks                                      | 7.5  | option     |
| PH4820 | Equilibrium Analysis of Complex Systems                         | 7.5  | option     |
| PH4830 | Dynamical Analysis of Complex Systems                           | 7.5  | option     |
| PH4840 | Mathematical Biology  | 7.5  | option     |
| PH4850 | Elements of Statistical Learning                                | 7.5  | option     |

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## **Progression and award requirements**

Students leaving or transferring to another SEPnet partner after completion of the first year will be awarded a Postgraduate Diploma in Physics (PGDip Physics) from RHUL.

To pass the PGDip programme a student must achieve an overall weighted average of at least 50.00%, with no mark in any element which counts towards the final assessment falling below 50%. Failure marks between 40-49% are not usually condoned for the award of a Postgraduate Diploma, but if they are, such condoned fails would be in courses which do not constitute more than 25% of the final assessment, provided that the overall weighted average is at least 50.00%, but a failure mark (i.e. below 50%) in the Project cannot be condoned.

The PGDip degree with Merit may be awarded if a student achieves an overall weighted average of 65.00% or above, with no mark in any element which counts towards the final assessment falling below 50%.

The PGDip degree with Distinction may be awarded if a student achieves an overall weighted average of 70.00% or above, with no mark in any element which counts towards the final assessment falling below 60%. A Distinction will not normally be awarded if a student re-sits or re-takes any element of the programme. In exceptional circumstances a viva may be held for a student at the request of the Examiners.

In order to progress from the first to the second year of the MSc programme a student must achieve the standard of a PGDip in their first year.

To pass the MSc programme a student must achieve an overall weighted average of at least 50.00%, with no mark in any element which counts towards the final assessment falling below 50%. Failure marks between 40-49% can be condoned in courses which do not constitute more than 25% of the final assessment, provided that the overall weighted average is at least 50.00%, but a failure mark (i.e. below 50%) in the Research Project cannot be condoned.

The Masters degree with Merit may be awarded if a student achieves an overall weighted average of 65.00% or above, with no mark in any element which counts towards the final assessment falling below 50%.

The Masters degree with Distinction may be awarded if a student achieves an overall weighted average of 70.00% or above, with no mark in any element which counts towards the final assessment falling below 60%. A Distinction will not normally be awarded if a student re-sits or re-takes any element of the programme. There is an oral examination, normally in the last week of the programme, at which the Visiting Examiner and at least one other examiner is present.

Students from other SEPNet partners and elsewhere joining the second year of the programme, having satisfied the admission requirements (to the second year) specified below, will be assessed on their second-year performance only.

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## **Student support and guidance**

The Director of Graduate Studies holds an induction meeting for all new postgraduate students in the first week of the programme. The Programme Director is also normally present at this meeting. Formal aspects of being a member of the College and the Physics Department are discussed, and guidance on safety matters is given. Introductions are made to other members of the Department, the Library, computing facilities and other central services.

The Programme Director provides primary support for each student, including overall personal and academic welfare. The project supervisor provides additional academic support. Teachers of the lecture courses monitor progress on the courses. Supervisors and teachers provide progress reports on each student at each meeting of the Postgraduate Committee.

As this is a postgraduate programme, the social integration of students is achieved by incorporating them into the activities of the appropriate research group and other postgraduate activities and structures already in place in the Department. These include postgraduate seminars and meetings, research colloquia, Physics Society meetings and parties.

All other College support services are available to students on the programmes. These are described in the *College Student Handbook* and the *Student Union Handbook*. Part 1 of the *Department's Handbook for Physics Students* also contains useful information about facilities available in the Department.

Students worried about any aspects of the programme or the support they are receiving may consult the Programme Director or the Director of Graduate Studies at any time. At College level they may contact the Dean of the Graduate School.

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### **Admission requirements**

Admission to the programmes depends on the applicant's qualifications and experience, which must satisfy the conditions of entry to the MSc degree established by the University of London. Graduates of British universities are normally required to have a First or Second Class Honours degree in Physics. Alternatively, students may have such a degree in a related subject such as electronics or engineering; such students will be expected to have taken courses in those topics relevant to their project and programme of study. Applications from candidates who hold other qualifications or who have relevant work experience will also be considered.

Entry to the second year of the programme will be available to students from the other SEPNet partners and other universities. Such students will be required to have successfully completed their first year to the PGDip level specified above, and to have an appropriate level of preparedness for the chosen Research Project, established by interview/discussion/examination results.

Students whose first language is not English may also be asked for a qualification in English Language at an appropriate level. For further details please refer to the [Prospective Students](#) web page. It may also be helpful to contact the [Admissions Office](#) for specific guidance on the entrance requirements for particular programmes.

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### **Further learning and career opportunities**

This programme provides an ideal grounding for students to pursue PhD programmes in universities, and to equip them for future research careers in universities, industry and other organisations in Europe and around the world. The programmes will also provide a technical background for a broader range of careers in the industrial scientific instrument sector and elsewhere around the world. For more details on further learning and career opportunities please refer to the [Careers Service](#).

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### **Indicators of quality and standards**

Royal Holloway's position as one of the UK's leading research-intensive institutions was confirmed by the results of the most recent Research Assessment Exercise (RAE 2008) conducted by the Higher Education Funding Council (HEFCE). The new scoring system for the RAE 2008 measures research quality in four categories, with the top score of 4\* indicating quality that is world-leading and of the highest standards in terms of originality, significance and rigour. 60% of the College's research profile is rated as world-leading or internationally excellent outperforming the national average of 50%. The College is ranked 16<sup>th</sup> in the UK for research of 4\* standard and 18<sup>th</sup> for 3\* and 4\* research. 55% of the Physics Department's research profile is of 3\* and 4\* standard.

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### **List of programmes**

The programmes are taught by staff at Royal Holloway, in conjunction with staff from other colleges of the University of London for some of the taught courses. The Masters leads to the award of the University

of London. The Postgraduate Diploma leads to an award of Royal Holloway and Bedford New College. Programmes in Physics are not subject to accreditation by a professional body. The Banner programme codes are given in parentheses.

- MSc in Physics (Euro Masters) (2441)
- PG Diploma Physics

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