### UNIVERSITY OF EDINBURGH

College of Science and Engineering:
Taught Postgraduate Programme Proposal Form Cover Sheet

**SUMMARY INFORMATION**
- Please insert the requested information into the boxes below

<table>
<thead>
<tr>
<th>Programme Title</th>
<th>Mathematical Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme qualification</td>
<td>MSc</td>
</tr>
<tr>
<td>Host School</td>
<td>Physics and Astronomy</td>
</tr>
<tr>
<td>Name of proposer(s)</td>
<td>Dr R Horsley, Dr W J Hossack and Dr B J Pendleton</td>
</tr>
<tr>
<td>Name of intended Programme Director</td>
<td>Dr R Horsley and Dr B J Pendleton</td>
</tr>
<tr>
<td>Duration of study (tick as applicable, and give months for FT)</td>
<td>Full time, 12 months</td>
</tr>
<tr>
<td>Mode of study / delivery (tick as many as applicable)</td>
<td>Resident at Edinburgh University</td>
</tr>
<tr>
<td>Date of intended first intake</td>
<td>September 2013</td>
</tr>
<tr>
<td>Date approved by School Board of Studies</td>
<td>7th November 2012</td>
</tr>
<tr>
<td>Approval of Head of School (signature and date) (This is taken to indicate that all issue of resource have been addressed within the School)</td>
<td></td>
</tr>
<tr>
<td>Date submitted to College Learning and Teaching Committee</td>
<td>20th November 2012</td>
</tr>
</tbody>
</table>

Please attach the following documents for your proposed programme:

- Programme Specification
  
  *Attached*

- Course cover sheets (for new or substantially revised courses)

  *Three new courses are required (form attached)*

- Degree Programme Table

  *The DPT is included in the Degree Programme Specification (attached)*

- Further programme information – see below
Further programme information required:
Note: If the documentation that went to the Board of Studies contains all the information requested below, then please just attach that documentation.

(a) Strategy and planning

(i) Indicate the relevance of the programme to the School plan; how its fits within any School suite of taught postgraduate courses and how it relates to active areas of research work.

The discovery of the Higgs boson has led to a resurgence of interest in theoretical and mathematical physics. We aim to harness this interest to attract and train a new generation of researchers in theoretical and mathematical sciences for academia and industry. This is commensurate with the School plan to increase taught postgraduate provision, and to increase both taught and research student numbers.

We propose two new MSc programmes, in Mathematical/Theoretical Physics, which will be run in association with the Higgs Centre for Theoretical Physics. Due to the recent success of having both Mathematical Physics and Theoretical Physics undergraduate degrees in attracting more students, we wish to follow the same path and offer two complementary postgraduate degrees. The two degrees have similar structure, the principal difference being that Mathematical Physics students must take at least 20 points of Mathematics courses.

These programmes are low-cost in that they utilise mainly pre-existing courses. No new lecture courses are required. This is consistent with plans for MSc development within the School.

The proposed programmes require two new continuously assessed 10-point courses. Problem Solving in Theoretical Physics and Research Skills for Theoretical Physics, and a 60-point Dissertation in Theoretical/Mathematical Physics.

The two new courses and the MSc Dissertation will make use of (at least) two new academic appointments associated with the Higgs Centre, plus postdoctoral fellows, and PhD students in their later years.

In the future, it is hoped that longer-term visitors to the Higgs Centre will give specialist courses.

The Higgs Centre will support a number of students on the MSc programmes. This support will be in the form of bursaries or a limited number of fully- or partially-funded studentships; the Management Committee will determine the precise funding model.

The two MSc programmes have been included in the University’s bid for SFC “additional taught provision” scheme, which aims to provide up to 1000 taught postgraduate places from 2013/14.

(ii) To assist with College planning, indicate how many students to you expect to admit each year (in steady state), and the recruitment profile expected whilst building up to this steady state.

We aim to recruit circa 5-10 students across the two degrees in the first year, with numbers building up towards 15-20 students in the steady state.

It is difficult to give an accurate estimate the number of suitably qualified applicants the degrees will attract. The numbers above are based on our desired number of students, together
with the existing known market for attracting such students. Indeed, there are a number of well-established MSc courses in Theoretical Physics in the UK.

The best known is the Master of Advanced Studies (MASt) at the University of Cambridge, which is perhaps better known as Part III of the Mathematics Tripos. This attracts circa 120 students annually from a large number of countries.

The MSc in Quantum Fields and Fundamental Forces at Imperial courses attracts 30-40 students each year.

Other UK MSc programmes in the general area of theoretical physics exist, for example Glasgow, Durham, King’s College, London, but student numbers are not publicly available.

(b) Fees

(i) Tuition fees
Indicate the level of tuition fee proposed - for both home and overseas students. Applicants are encouraged to consider premium fees based on market rates. Please justify the level of premium, either the level of the premium fee, or why a Standard Laboratory-Based Fee (i.e. in accordance with the existing Fees Schedule) is appropriate.
http://www.registry.ed.ac.uk/Fees/PGFees.htm

We propose the standard Band 1 fees for taught MSc courses, which in 2012/13 are £5,750 for Home/EU students, and £13,050 for Overseas students.

(ii) Other programme costs
None

(c) Programme Structure

The structure of the programme does not differ from the standard curricula models.

(d) Collaboration

The programme does not involve any other institution

PROCEDURES FOR SUBMISSION OF PROPOSAL

The completed proposal, containing all the information requested above, should be sent in electronic format to: lynda.m.henderson@ed.ac.uk
Note: Lynda Henderson is the Secretary to the College Learning and Teaching Committee. The dates of the meetings of that Committee are available on the College web site:
http://www.scieng.ed.ac.uk/Admin/Committees/Index.asp

Lynda Henderson would be pleased to receive draft versions of the proposal to provide you with informal comment and advice prior to a formal submission. Sources of advice to assist you in the development of the proposal are contained in the Appendix.
APPENDIX: SOURCES OF ADVICE AND INFORMATION

If you wish advice or further information on any aspect of the preparation or submission of a new MSc programme proposal, please contact the people below:

Business Plans and Resource Information

Mr Terry Fox, College Accountant; 505991; Terence.fox@ed.ac.uk

Mr Jim Galbraith; College Management Information & Planning Support; 507529; Jim.Galbraith@ed.ac.uk

The College Office has developed a spreadsheet to assist Schools in the financial modelling of the development of new programmes. A template and guidance notes for completing the spreadsheet can be obtained from http://www.scieng.ed.ac.uk/admin/procedures/mscdev/

Regulations, programme structure and fees

Lynda Henderson; Administrative Officer, Academic Affairs Section, College Office; 505765; Lynda.M.Henderson@ed.ac.uk

Strategy

Dr Nick Hulton (Dean of Learning and Teaching); Nick.Hulton@ed.ac.uk

Prof Nigel Seaton (Assistant Principal, Taught Programme Development); nigel.seaton@ed.ac.uk

Market information

Communications and Marketing; 51 4158; john.cavani@ed.ac.uk

Admissions Officers, Recruitment and Admissions, College Office; 50 5755; SCE.Admissions.Officer@ed.ac.uk

International Office: enquiries.international@ed.ac.uk

Student Recruitment & Admissions; 50 4360; sra.enquiries@ed.ac.uk

Careers Service (King's Buildings); 50 5773; careers@ed.ac.uk
MSc Degree in Mathematical Physics

Degree aims

The aim of the Mathematical Physics MSc degree at Edinburgh is to give students a good grounding in various areas of mathematical/theoretical physics as a preparation for research in academia or industry. It will give students with a first degree in Mathematics or Physics or in a related subject who have an interest in further study in theoretical or mathematical physics a solid foundation. The main objective of the degree is to introduce advanced ideas and techniques emphasising the physics background rather than more formal mathematical methods.

The taught part of the programme, from September to May, has two components. The first component consists of a selection of core courses bringing all the students to an advanced level in subjects such as statistical physics, general relativity, cosmology, condensed matter physics, quantum field theory and the standard model of particle physics. All these courses are delivered by the School of Physics and Astronomy. The second component allows for each student to choose from wider pool of available courses, including specialist courses in mathematics and computing. Thus each student can tailor a programme to suit their individual needs.

Degree structure

The MSc degree consists of a total of 180 points. Students must take 120 points of taught courses, at least 90 points of which must be at SCQF Level 11, and the remainder may be at Level 10. This is followed by a 60 point Dissertation.

A general description of degrees is given in [1], [2]. A brief summary of requirements is:

- MSc for successful completion of 120 points and 60 points dissertation. For progression to dissertation:
  - pass at least 80 credits with pass mark 50%;
  - achieve an average of 50% for 120 credits.

  The pass mark for the dissertation is 50%.
  A ‘Distinction’ requires 70% in both the courses and the dissertation.

- Diploma for the successful completion of credit 120 points. From [1],
  - pass at least 80 credits;
  - achieve an average 40% for 120 credits.
Student background, minimum entrance requirement for the MSc

- A 3/4 year BSc Honours degree (or equivalent);
- At least a UK 2:1 honours or equivalent;
- Although there will be a formal deadline for applications for the MSc/PgDip programmes, it will be stated that late applications will be considered;

Model DPT

- 20 points of compulsory courses;
- 20 points of Mathematics courses;
- 40 points of standard courses;
- At least a further 20 points must be taken from the Mathematics list or the standard-course list;
- MSc: Dissertation (60 points);
- The final 20 points may be chosen freely from the lists below

Compulsory courses – pass/fail only

<table>
<thead>
<tr>
<th>Course</th>
<th>Points</th>
<th>Semester</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving in Theoretical Physics</td>
<td>10pt</td>
<td>S1</td>
<td>[Workshops, take home problems oral exam …]</td>
</tr>
<tr>
<td>Research Skills for Theoretical Physics</td>
<td>10pt</td>
<td>S2</td>
<td>[Project planning, oral presentation]</td>
</tr>
</tbody>
</table>

Standard courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Points</th>
<th>Semester</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Statistical Physics</td>
<td>10pt</td>
<td>S1</td>
<td>(PHYS11007)</td>
</tr>
<tr>
<td>Relativistic Quantum Field Theory</td>
<td>10pt</td>
<td>S1</td>
<td>(PHYS11021)</td>
</tr>
<tr>
<td>Quantum Theory</td>
<td>10pt</td>
<td>S1</td>
<td>(PHYS11019)</td>
</tr>
<tr>
<td>Advanced Cosmology</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11035)</td>
</tr>
<tr>
<td>Classical Electrodynamics</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11045)</td>
</tr>
<tr>
<td>Frontiers of Condensed Matter Physics</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11039)</td>
</tr>
<tr>
<td>General Relativity</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11010)</td>
</tr>
<tr>
<td>Hamiltonian Dynamics</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11012)</td>
</tr>
<tr>
<td>Modern Quantum Field Theory</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11047)</td>
</tr>
<tr>
<td>The Standard Model</td>
<td>10pt</td>
<td>S2</td>
<td>(PHYS11036)</td>
</tr>
</tbody>
</table>

Mathematics courses

A complete list of available Mathematics courses is given below. (These courses are provided by the School of Mathematics.)
### Optional courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Semester</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods of Mathematical Physics</td>
<td>10pt</td>
<td>S1</td>
<td>PHYS10034</td>
</tr>
<tr>
<td>Astrophysical Cosmology</td>
<td>10pt</td>
<td>S1</td>
<td>PHYS10024</td>
</tr>
<tr>
<td>Computational Astrophysics</td>
<td>10pt</td>
<td>S1</td>
<td>PHYS11037</td>
</tr>
<tr>
<td>Condensed Matter</td>
<td>10pt</td>
<td>S1</td>
<td>PHYS10028</td>
</tr>
<tr>
<td>Statistical Physics</td>
<td>10pt</td>
<td>S1</td>
<td>PHYS11024</td>
</tr>
<tr>
<td>Particle Physics</td>
<td>10pt</td>
<td>S2</td>
<td>PHYS11042</td>
</tr>
<tr>
<td>Symmetries of Quantum Mechanics</td>
<td>10pt</td>
<td>S2</td>
<td>PHYS10083</td>
</tr>
<tr>
<td>High Energy Astrophysics or Radiation and Matter</td>
<td>10pt</td>
<td></td>
<td>PHYS11013</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[alternates with R&amp;M]</td>
</tr>
</tbody>
</table>

All of the courses listed above are given by the School of Physics and Astronomy, and all those shown with course codes already exist and are given annually as part of the MPhys programme.

### Courses for the future

The following courses would strengthen the degree, but are not necessary to launch it.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Semester</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many-Body Quantum Systems</td>
<td>10pt</td>
<td></td>
<td>PHYS10085</td>
</tr>
<tr>
<td>Symmetries and Particles</td>
<td></td>
<td></td>
<td>[approved (in Euclid)]</td>
</tr>
<tr>
<td>Advanced General Relativity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beyond the Standard Model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supersymmetry/String Theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosmology and Particle Physics</td>
<td></td>
<td></td>
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<tr>
<td>Lattice QCD/Perturbative QCD</td>
<td></td>
<td></td>
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<tr>
<td>Quantum Computers</td>
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</tbody>
</table>

Formal proposals for these courses will be submitted as and when there are sufficient resources available to teach them.

### Additional courses (not directly given by us)

#### Mathematics courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Semester</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebraic Geometry</td>
<td>10pt</td>
<td>S1</td>
<td>MATH11120</td>
</tr>
<tr>
<td>Applied Analysis and PDEs 1</td>
<td>20pt</td>
<td>S1</td>
<td>MATH11107</td>
</tr>
<tr>
<td>Applied Analysis and PDEs 2</td>
<td>20pt</td>
<td>S1</td>
<td>MATH11108</td>
</tr>
<tr>
<td>Applied Mathematical Methods 1</td>
<td>20pt</td>
<td>S1</td>
<td>MATH11105</td>
</tr>
<tr>
<td>Applied Mathematical Methods 2</td>
<td>20pt</td>
<td>S2</td>
<td>MATH11106</td>
</tr>
<tr>
<td>Analysis of Nonlinear Waves</td>
<td>10pt</td>
<td>S1</td>
<td>MATH11093</td>
</tr>
<tr>
<td>Basic Algebra 1</td>
<td>20pt</td>
<td>S1</td>
<td>MATH11125</td>
</tr>
</tbody>
</table>
Basic Algebra 2 20pt S2 (MATH11126)(pg)
Differential Geometry 10pt S2 (MATH10002)
Dynamical Systems 10pt S2 (MATH11027)
Geometry and Topology 1 20pt S1 (MATH11104)(pg)
Geometry and Topology 2 20pt S2 (MATH11103)(pg)
Introduction to Lie Groups 10pt S2 (MATH11053)
Probability 1 20pt S2 (MATH11100)(pg)
Probability 2 20pt S2 (MATH11099)(pg)
Pure Analysis 1 20pt S1 (MATH11198)(pg)
Pure Analysis 2 20pt S2 (MATH11197)(pg)
Simulation 10pt S1 (MATH11028)(pg)
Stochastic Models in Biology 10pt S2 (MATH11116)
Topology 20pt S1+2 (MATH10027)

- Courses labelled ‘pg’ are Scottish Mathematical Sciences Training Centre (SMSTC) courses, and are part of the Edinburgh Mathematics MSc. They are delivered using VC technology from several universities (à la SUPA), but tutorials are run, and examinations set, by Edinburgh. They are 2×20-point courses, but parts 1 & 2 may be taken independently in most cases.
- Courses from the Financial Mathematics MSc are not generally available to students on the Mathematics MSc, and we anticipate this will apply to MP MSc students.

**High Performance Computing courses**

These are held by EPCC as part of their post graduate MSc in ‘High Performance Computing’, [3, 4]. They are intended for students interested in programming, and in general emphasise more practical aspects. All courses are possible, but more useful courses are

Programming Skills 10pt S1 (PGPH11079)(pg) Lec+Lab, cw assessment
Message-Passing Programming 10pt S1 (PGPH11078)(pg) Lec+Lab, cw assessment
Threaded Programming 10pt S1 (PGPH11077)(pg) Lec+Lab, cw assessment
Parallel Numerical Algorithms 10pt S1 (PGPH11076)(pg) Lec+Lab
Applied Numerical Algorithms 10pt nd (PGPH11008)(pg)

**Geoscience courses**

Atmospheric Dynamics 10pt S1 (METE10001)
Introduction to 3D Climate Modelling 10pt S1 (ENVI11002)

**SUPA courses**

SUPA run a large number of postgraduate courses. We have already included those which are taught as part of the Edinburgh MPhys programme. A number of courses are given locally by CMCS; some of these may be suitable for the MSc if some form of assessment is provided by the course organisers.
Business case

- This proposal is largely cost-neutral:
  - All required lecture-based courses are already running;
  - The main costs will be
    * Setting up and running the two new courses Problem Solving in Theoretical Physics and Research Skills for Theoretical Physics;
    * Staff time in supervising MSc dissertations over the summer.
  In each case we plan to make significant use of RAs and PhD students (for example, Principal’s Career Development PhD Scholarships.)
  - Relatively small recurrent administration costs – support from the Teaching Office will be available.
  - Some effort will need to be put into recruitment, at least for the first few years.

- Income, will be small (at first) as we expect up to 15 students, but this will be more than enough to cover administration costs. Any additional revenue can be ploughed back into bursaries.

- Higgs Bursaries to best qualified applicants and prizes to the top students. Startup funds for bursaries have already been provided by the Higgs Centre.

- Gains:
  - Prestige;
  - Better selection of possible PhD candidates, especially from overseas.

References

1) **Awarding Institution:** The University of Edinburgh

2) **Teaching Institution:** The University of Edinburgh

3) **Programme accredited by:** n/a

4) **Final Award:** MSc

5) **Programme Title:** MSc in Mathematical Physics

6) **UCAS Code:** Relevant QAA Subject Benchmarking Group(s): Physics, astronomy and astrophysics.

7) **Postholder with overall responsibility for QA:** Dr Victoria Martin

8) **Date of Production/Revision:** 19th November 2012

9) **External Summary (200-250 words)**

Mathematical Physics aims to develop a precise quantitative understanding of the nature, structure and evolution of the physical world through the language of mathematics. Its scope runs from quarks and leptons, the smallest fragments of the universe, through the material world we perceive directly with our senses, and on to stars and galaxies, and the origins and fate of the universe itself. It thus builds directly on the work of Newton, Maxwell, Einstein, Heisenberg, Dirac, Feynman, Hawking, Higgs and countless others. Our aim is to equip you with the precise analytical thinking necessary to understand this vast subject, and thereby prepare you for a broad range of subsequent careers in Mathematical, Theoretical or Computational Physics, Applied Mathematics or any profession requiring the solution of difficult problems through mathematical modelling.

The MSc in Mathematical Physics at Edinburgh allows the student to develop:

- The skills necessary to use mathematics to solve complex problems
- A thorough grounding in mathematical physics, and a deep understanding of its fundamental ideas and principles
- The attitude of mind conducive to critical questioning and creative thinking
- The confidence and ability to formulate problems mathematically, and solve them analytically
- The confidence and ability to solve problems numerically, through computer programming
- Expertise required for a career in mathematical physics, computational physics, or applied mathematics
10) **Educational Aims of Programme:**

The educational aims of the MSc in Mathematical Physics at Edinburgh are:

- To provide a degree programme with flexibility and choice;
- To provide a thorough grounding in the fundamental principles and theoretical underpinnings of physics;
- To provide exposure to frontier activities, capitalising on the strengths of a thriving and diverse research environment in Edinburgh;
- To provide a balanced training in the methodologies of modern theoretical physics, with opportunities for options in Mathematics and Computation;
- To develop general transferable skills related to problem-solving, research, and communication;
- To provide a platform for employment in research, science-based industry, education and the wide spectrum of professions calling for numerate problem-solvers.
- Knowledge of frontier activities capitalising on the strengths of a thriving and diverse research environment;

11) **Programme Outcomes:**

11a) **Knowledge and Understanding**

By engaging with and completing a Masters degree in Mathematical Physics, graduates will acquire knowledge and understanding of:

- The core knowledge base of mathematical physics selected from a wide range: Hamiltonian Dynamics; Quantum Theory; General Relativity; Classical Electrodynamics; Statistical Physics; Condensed Matter; Quantum Field Theory; together with courses in Pure and Applied Mathematics;
- A balanced training in the methodologies of modern mathematical physics.

11b) **Graduate Attributes: Skills and Abilities in Research and Enquiry**

The degree programme aims to develop:

- An attitude of mind conducive to critical questioning and creative thinking;
- The capacity to formulate ideas mathematically and explore them algebraically, graphically, and numerically;
- The ability to harness these skills in tandem with the core knowledge base to solve problems;
- The ability to assimilate and evaluate advanced literature from a range of diverse sources.

11c) **Graduate Attributes: Skills and Abilities in Personal and Intellectual Autonomy**

The degree programme aims to develop:

- A disposition to approach unfamiliar situations with a spirit of critical enquiry;
- The ability to formulate a physical problem using the appropriate mathematical methodologies.

11d) **Graduate Attributes: Skills and Abilities in Communication**

The degree programme aims to develop:

- The ability to formulate a coherent written and oral presentation based on material gathered and organised independently on a given physics topic;
- The ability to formulate a mathematical argument and communicate this effectively to peers and educators;

11e) **Graduate Attributes: Skills and Abilities in Personal Effectiveness**

The degree programme aims to develop:

- The ability to collaborate effectively and productively with others in the process of inquiry and learning including those with a range of backgrounds and knowledge;
- The ability to organise their own independent learning to an effective schedule;
• The commitment to manage time effectively, utilise resources and meet deadlines.

11f) **Technical/Practical Skills**
The degree programme aims to develop:
- Problem solving skills, especially in mathematics;
- Research skills;
- Facility with IT systems;

12) **Programme Structure and Features**
The programme is a full-time, 180-point taught Masters’ Programme, and is fully compliant with the University’s Curriculum Framework and Scottish Qualification Framework.

The normal entry requirements are a UK 2:1 honours degree in Physics or Mathematics (assuming it has sufficient mathematical-physics content), or equivalent qualifications recognised under the University’s admissions policy.

**Taught Courses**
Taught courses must consist of 120 points, at least 90 points must be at SCQF Level 11 and 30 points at Level 10 or 11, of which there must be:
- 20 points of Compulsory Courses;
- 20 points of Mathematics Courses
- At least a further 20 points of Standard Courses or Mathematics Courses
- 20 points chosen freely from the lists below.

**Compulsory Courses:**
- Problem Solving in Theoretical Physics 10pt S1 L11
- Research Skills for Theoretical Physics 10pt S2 L11

**Standard Courses:**
- Advanced Statistical Physics 10pt S1 L11
- Relativistic Quantum Field Theory 10pt S1 L11
- Quantum Theory 10pt S1 L11
- Advanced Cosmology 10pt S2 L11
- Classical Electrodynamics 10pt S2 L11
- Frontiers of Condensed Matter Physics 10pt S2 L11
- General Relativity 10pt S2 L11
- Hamiltonian Dynamics 10pt S2 L11
- Modern Quantum Field Theory 10pt S2 L11
- The Standard Model 10pt S2 L11

**Optional Courses (Physics and Astronomy):**
- Astrophysical Cosmology 10pt S1 L10
- Computational Astrophysics 10pt S1 L11
- Condensed Matter 10pt S1 L10
- Statistical Physics 10pt S1 L11
- Particle Physics 10pt S2 L11
- Symmetries of Quantum Mechanics 10pt S2 L11
- High Energy Astrophysics or Radiation and Matter 10pt S2 L11
Optional Courses (Mathematics)

- Algebraic Geometry 10pt S1 L11
- Applied Analysis and PDEs 1 (*) 20pt S1 L11
- Applied Analysis and PDEs 2 (*) 20pt S1 L11
- Applied Mathematical Methods 1 (*) 20pt S1 L11
- Applied Mathematical Methods 2 (*) 20pt S2 L11
- Analysis of Nonlinear Waves 10pt S1 L11
- Basic Algebra 1 (*) 20pt S1 L11
- Basic Algebra 2 (*) 20pt S2 L11
- Differential Geometry 10pt S2 L10
- Dynamical Systems 10pt S2 L11
- Geometry and Topology 1 (*) 20pt S1 L11
- Geometry and Topology 2 (*) 20pt S2 L11
- Introduction to Lie Groups 10pt S2 L11
- Probability 1 (*) 20pt S2 L11
- Probability 2 (*) 20pt S2 L11
- Pure Analysis 1 (*) 20pt S1 L11
- Pure Analysis 2 (*) 20pt S2 L11
- Simulation (*) 10pt S1 L11
- Stochastic Models in Biology 10pt S2 L11
- Topology 20pt S1+2 L10

(*) These Scottish Mathematical Sciences Training Centre courses may be available with the agreement of the School of Mathematics

High Performance Computing Courses

- Programming Skills 10pt S1 L11
- Message-Passing Programming 10pt S1 L11
- Threaded Programming 10pt S1 L11
- Parallel Numerical Algorithms 10pt S1 L11
- Applied Numerical Algorithms 10pt nd L11

Geosciences Courses

- Atmospheric Dynamics 10pt S1 L10
- Introduction to 3D Climate Modelling 10pt S1 L11

Progression to the Dissertation requires 120pt of courses at first sit, with an overall average of 50%, and 80 points of courses above 50%.

Diploma available as exit award on completion of taught courses

Dissertation

- Theoretical Physics Dissertation 60pt Summer L11

Equality and Diversity

The School is an active participant in the Institute of Physics JUNO project with "practitioner" status where we monitor and report on the equality and diversity across the whole School including activities of academic staff, research staff, post and undergraduate students.

13) Teaching and Learning Methods and Strategies

The bulk of the teaching programme is conducted through lectures; the class sizes vary from about 80 in Level 10 Honours courses to about 15 in Level 11 optional courses. This teaching is supported through tutorial sessions and supervised workshops in which
students work in groups of about 5, and through study resources generally delivered through WWW. These resources vary in extent and character; they invariably include a detailed syllabus, reading list and problem-sets. The course Problem Solving in Theoretical Physics utilises peer assisted learning, and all courses feature tailored problem sheets and extensive tutor feedback in extended workshop classes.

**Innovative Learning Week**
The University of Edinburgh Innovative Learning Week runs in the week following Week 5 of Semester 2. During this week 'normal' teaching is suspended which provides time out of the curriculum for staff and students to explore new learning activities. Some examples of the types of activities held in Physics and Astronomy are workshops, peer assisted learning activities, public engagement activities, careers events.

14) **Assessment Methods and Strategies**
Each course has its own assessment criteria appropriate to the specified Learning Objects of the course as detailed in the on-line course specification. All courses are assessed using the University Common Marking Scheme. Typical modes of assessment through the programme are detailed below.

Lecture-based physics and mathematics courses are mainly assessed by end of course, or end of year written unseen examinations. Students are encouraged to attempt course questions in advance and seek feedback on their work at the course workshops/tutorials. All students have access to their marked examination scripts via the School Teaching Office.

Using Mathematics to Solve Physics Problems is assessed by take-home problems and an oral examination. Research Skills for Theoretical Physics is assessed by an oral presentation.

The Dissertation component is assessed primarily via a written dissertation. During the Dissertation period the student is supervised by member of staff who supplies feedback on performance and development. Further written feedback is also supplied on the dissertation.

15) **Career Opportunities**
The Theoretical Physics MSc programme offers the preparation for a research career in physics either via further academic study, typically towards a PhD, or via industrial research. In addition a wide range of employers recognise that Physics graduates have advanced problem-solving skills and the ability to think logically and critically about complex situations. Add this to a high level of mathematical ability, together with written and oral communication skills, and Theoretical Physics graduates have opportunities in a diverse range of careers.

16) **Personal Tutors**
Each student is assigned a Personal Tutor who provides both academic and pastoral guidance. Throughout a student's time at the university the Personal Tutor guides the student in choice of courses and provides general support. Courses are administered and run through the Teaching Organisation in the School. These produce detailed online course guides for new students and for continuing students. These guides provide details of courses and also advise students on assessment and general university policy and regulations.