

**MMathPhys/MSc in Mathematical and Theoretical
Physics Handbook (2025-26 Entry)**

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Prelude

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This handbook applies to students studying the MMathPhys/MSc Mathematical and Theoretical Physics degree in the 2025-2026 academic year. The information in this handbook may be different for students starting in other years.

The Examination Regulations relating to this course are available at:

<https://examregs.admin.ox.ac.uk/>.

If there is a conflict between the information in this handbook and the Examination Regulations then you should follow the Examinations Regulations.

Please consider this a draft, until otherwise notified by the course administrator. While the current information is provided for students' benefit, and is generally accurate, it is not officially confirmed as the final version until it is reviewed and approved by the Joint Supervisory Committee for the course in week 3 of Michaelmas Term.

It may be necessary, under exceptional circumstances, to publish further changes to the course details at a later date. If such changes are made, the department will publish a new version of this handbook together with a list of the changes and students will be informed. For details, please see <https://www.ox.ac.uk/admissions/graduate/courses/changes-to-courses>

If you have any concerns please contact:

mathematical.physics@maths.ox.ac.uk

Welcome

Welcome to the Oxford Master's Course in Mathematical and Theoretical Physics. Our course provides a high-level education in the areas of Theoretical Particle Physics/String Theory, Condensed Matter Theory, Theoretical Astrophysics/Fluids and Mathematical Foundations of Theoretical Physics up to the level of research.

As you are probably aware, there is considerable flexibility in designing your path through the course; you can decide to focus on one of the above subject areas or study a broader span across areas. It is important that you consider your choices carefully. Consult the syllabi and case studies in this handbook for more information and, if in doubt, talk to your personal tutor or an academic related to the programme.

For an advanced programme of this kind, written examinations are not always the best form of assessment. You will find that the way we evaluate your work often correlates with the nature of the material. Typically, there will be formal written exams for the basic, foundational courses; other forms of assessment such as take-home exams or mini-projects for intermediate courses, and a home-work completion requirement for advanced courses. There are certain constraints on assessment — for example you have to sit four units of written exams. Be sure that your course choices are consistent with these constraints. Also note that Trinity term is devoted to advanced courses and there is no designated "revision" period.

Passing exams is a necessary and important part of learning and education but we hope you agree that there is significantly more to it. Enthusiasm, engagement with the subject, the desire for deep and profound understanding is what truly motivates us and we hope this is how you will engage with the course. We wish you a successful, productive and insightful year.

Best wishes,

Prof Caroline Terquem and Prof Lionel Mason

1. Introduction

This handbook contains important information about the Master's Course in Mathematical and Theoretical Physics. It is intended as a guide and reference for you throughout the course. There are a number of other sources of information that you will need to refer to during your course and links to these are given in the following section.

1.1 Key Sources of Information

Course website: <http://mmathphys.physics.ox.ac.uk/>

Mathematical Institute website: <http://www.maths.ox.ac.uk/>

Department of Physics website: <http://www.physics.ox.ac.uk/>

Examination Regulations: <https://examregs.admin.ox.ac.uk/>

The University's examination regulations govern all academic matters within the University and contain the general regulations for the conduct of University examinations, as well as specific regulations for each degree programme offered by the University)

Examination Conventions: <http://mmathphys.physics.ox.ac.uk/students>

The examination conventions for the course set out how each unit will be assessed and how the final degree classification will be derived from the marks obtained for the individual units.

Oxford student website: <http://www.ox.ac.uk/students>

Oxford Student Handbook: <https://www.ox.ac.uk/students/academic/student-handbook>

This contains general information and guidance about studying at the University of Oxford, and gives you formal notification and explanation of the University's codes, regulations, policies and procedures.

College Handbook: The handbook for your college will be available on the college website.

1.2 Key Contacts



Course Director, Prof Lionel Mason, lionel.mason@maths.ox.ac.uk



Chair of the Joint Supervisory Committee, Prof Caroline Terquem, caroline.terquem@physics.ox.ac.uk



Course Administrator, Eleanor Kowol, mmathphys@maths.ox.ac.uk

Mathematical Institute Reception: reception@maths.ox.ac.uk

Department of Physics Reception: reception@physics.ox.ac.uk

1.3 Maps

In-person teaching for the course will take place in the Mathematical Institute and in the Denys Wilkinson Building or in the Clarendon Laboratory of the Department of Physics.

To enter the Denys Wilkinson Building, go up the wide concrete steps from Keble Road; turn left at the top and the entrance is facing you:

<https://www.accessguide.ox.ac.uk/denys-wilkinson-building>

The main entrance to the Clarendon Laboratory is on Parks Road, next to the University

Parks: <https://www.accessguide.ox.ac.uk/clarendon-laboratory>

At the Mathematical Institute, all lecture rooms and classrooms are located on the mezzanine level. <http://www.maths.ox.ac.uk/about-us/travel-maps>

The building has been designed with accessibility in mind. More details of the disability policy and the access guide are given at <https://www.maths.ox.ac.uk/members/building-information/accessibility>

A searchable, interactive map of all college, department and libraries can be found at <https://maps.ox.ac.uk/>

1.4 Buddy System

All MSc students will be buddied by an internal 4th year MMathPhys student, who has transferred from MMath/MPhys or MMathPhil undergraduate at Oxford, to help integrate the MSc students to the university and department. We try to pair people from the same college, or a nearby college though this is not always possible. MSc students will receive their buddy's college e-mail address and they can arrange to meet and seek advice about aspects of student life which interest them such as exams, social events or courses.

1.5 The Academic Year

The academic year at Oxford is in three terms, named Michaelmas, Hilary and Trinity terms. You will often see these written as MT, HT and TT.

Each term has 8 weeks. Weeks are counted from Sunday, not Monday. So that the first day of week 1 would be Sunday, 12th October 2025.

There is also a 0th week, which is not included in the published term dates, as no teaching takes place. In Michaelmas term, 0th week is akin to an induction or 'freshers' week, with many induction talks and events happening in departments and colleges.

In Hilary and Trinity terms, written exams are scheduled in 0th week (as well as further exams later in term), so you should return to Oxford the week *before* term starts to sit exams.

The term dates for the academic year 2025-2026, *not including 0th weeks*, are as follows:

Term	Start Date	End Date
Michaelmas	Sunday, 12th October 2025	Saturday, 6th December 2025
Hilary	Sunday, 18th January 2026	Saturday, 14th March 2026
Trinity	Sunday, 26th April 2026	Saturday, 20th June 2026

Note, many timetables, emails and schedules will refer to dates by week number, not by the Gregorian calendar date,

e.g. 'the lecture on Bosons is rescheduled to Tue, Week 4.'

You might even see a week written as 4 MT for '4th week Michaelmas term' or the terms MT25, HT26, TT26 to indicate the term *and* year.

1.6 Resources and Facilities

Departmental Work and Social Spaces

You will be able to use the computers and desks in the Mezzanine Study Room to work within the Mathematical Institute. The study room has power sockets for students wishing to use their own laptops and there is wi-fi throughout the building.

The Institute's café is also located on the mezzanine level and has seating and tables for 100. The café serves drinks, snacks and meals from 08.30am - 4pm, Monday -Friday.

The menu for each week can be found here: <https://estates.admin.ox.ac.uk/sitefiles/beyond-ordinary-cafe-menu-andrew-wiles-cafe-p>

The Denys Wilkson building's café is open 10am - 2pm, Monday-Friday. Menu here: <https://estates.admin.ox.ac.uk/sitefiles/beyond-ordinary-cafe-menu-denys.pdf>

Departmental Safety Policies

You are urged to act at all times responsibly, and with a proper care for your own safety and that of others. Departmental statements of safety policy are posted in all departments, and you must comply with them. Students should note that they (and others entering onto departmental premises or who are involved in departmental activities) are responsible for exercising care in relation to themselves and others who may be affected by their actions.

In the Mathematical Institute accidents should be reported immediately to reception, telephone 73525, who keep the accident book. There is a first aid room located on the ground floor of the South wing. If you require access to this room please report to reception. Each lecture theatre has its own proper escape route and you are urged to familiarise yourself with these. Those for the Mathematical Institute lecture and seminar rooms are set out online:

<http://www.maths.ox.ac.uk/members/building-information/security-safety-and-reporting-building-issues>.

Libraries

The main source of borrowed books is your own College library. You will also have access to the Radcliffe Science Library (RSL) on Parks Road.

Website: <https://www.bodleian.ox.ac.uk/libraries/rsl>

Information about all Bodleian Libraries can be found here: <https://www.bodleian.ox.ac.uk/libraries>

The Mathematics Institute also has a small library of its own, the Whitehead Library. Students completing a dissertation may request a book for consultation if it is held only by the Whitehead Library (and not held by their College library, RSL or as an e-book), by emailing the Librarian at: library@maths.ox.ac.uk . The book will be sent to the RSL where it can be consulted for reference (not borrowing).

Website: <https://www.maths.ox.ac.uk/members/library>

IT facilities

The IT services website details all the resources you can access for IT support, including digital skills tools, specialist software such as MatLab and Mathematica, as well as IT training.

<https://www.it.ox.ac.uk/>

Email

MSc students will receive a University 'single-sign-on' IT account. This will have an email address associated with it which will be of the format firstname.lastname@college.ox.ac.uk.

It is important that students either read this email regularly or set up a forward from it to an account which they do read regularly. MMathPhys students will retain the account they were issued with at the start of their degree. For further information about Departmental IT matters, including rules and regulations surrounding the use of IT facilities, please see

1.7 Glossary

The University of Oxford and its colleges have a unique collection of jargon, and nicknames for things, compiled over the centuries, some of which you may not have come across if you are a new student, or even if you've been here several years!

A non-exhaustive list has been compiled at this link: <https://www.ox.ac.uk/about/organisation/history/oxford-glossary>.

Other useful terms include:

Bodcard: An informal name for your student identification card and University library card, issued once you have signed and returned your university contract and delivered to College.

Bop: A large college party usually run in the bar or similar location. Undergraduate bops generally admit students from the college in question. Graduate bops are usually much larger and involve many colleges.

Candidate Number: A number assigned to each student for the use of formal assessments and written examinations, which is usually available to students via student self-service after they have made their first exam entry. Candidate numbers are used instead of names to anonymise students during assessments. It is different from the student number.

Classes: Each Part C and MTP lecture course is accompanied by a set of classes (called 'intercollegiate classes' if they are held at Maths Institute and 'classes' if they are held in Physics.) For Maths courses, these will be run by a tutor and teaching assistant (TA), for Physics courses, these will be led by a TA, and will cover any problems that have arisen from the problem sheets.

Consultation Sessions: Revision sessions which take place for courses run by the Maths Institute in Weeks 2-5 of Trinity term.

Consultative Committee for Graduates (CCG): A committee consisting of postgraduate representatives from the Mathematical Institute and the departments two DGSs.

Course: This is the colloquial term both for the degree programme you are taking *and* individual courses, such as Kinetic Theory or C2.1 Lie Algebras, where these might be referred to as modules in other universities.

Examination Conventions: The Examination Conventions act as a supplement to the Examination Regulations. The Conventions explain how a student will be assessed for their course within the framework of the Examination Regulations.

Examination Schools: The building located on High Street where most in-person written examinations take place.

Formal Assessment: In the context of your degree, these are dissertations, mini-projects and take-Home Exams.

GSR: Graduate Supervision Reporting. Supervisors will submit termly reports through GSR on their student's academic progress.

JSC: Acronym for the Joint Supervisory Committee in Mathematical and Theoretical Physics, consisting of Maths and Physics academics who meet at least once a term to make decisions about the degree. Student representatives for the degree also attend these meetings

MCF: Masters in Mathematical and Computational Finance. A Master's course run by the Mathematical Institute.

MFoCS: Masters in Mathematics and Foundations of Computer Science. An MSc course run jointly by the Mathematical Institute and the Department of Computer Science.

MMSC: Masters in Mathematical Modelling and Scientific Computing. An MSc course run at the Mathematical Institute.

MPLS: Mathematical, Physical and Life Sciences Division.

MTP: The acronym for your degree, Mathematical and Theoretical Physics.

OMMS: Oxford Master's course in Mathematical Sciences.

Part C: The term given to the fourth-year undergraduate students studying for an integrated Masters. Part C is used to describe the courses that are open to these students.

PhysSoc: Oxford University Physics Society

Practicals: In the context of your degree, this means the homework options you choose. This is what they are called in Student Self Service, when you enter for exams.

Proctors: The two Proctors (Senior and Junior) are elected each year by colleges in rotation to serve for one year. The statutes provide that they shall generally ensure that the statutes, regulations, customs, and privileges of the University are observed. They serve on the University's main committees, and where not members of committees, may receive their papers and attend meetings but not vote. They have responsibilities under the statutes and regulations for aspects of student discipline, for ensuring the proper conduct of examinations and for dealing with complaints. They also carry out ceremonial duties, e.g. at degree ceremonies.

Student number: A number used to identify you as a student in day to day tasks, and can be used in conjunction with your name, unlike your candidate number.

Student Self Service: Student Self Service allows a student to access their student record and complete other tasks such as examination entry, and viewing examination results.

2. Course Overview and Structure

The course is offered in two modes: the MMathPhys for Oxford 4th year undergraduates, and the MSc for students from outside Oxford. **The academic content is identical for both modes.**

If you are an Oxford MPhys, MMath or MPhysPhil student who transfers to the MMathPhys, you will graduate as a “Master of Mathematical and Theoretical Physics” with a double classification consisting of the BA degree class in your original subject and an MMathPhys degree class. If you are a student on the MSc course, you will graduate with an “MSc in Mathematical and Theoretical Physics.”

These qualifications may be compared to national standards for higher education qualifications through the Framework for Higher Education Qualifications (FHEQ). The University Awards Framework (UAF) maps the awards of the University against the levels of the FHEQ. The FHEQ level for both the MMathPhys course and MSc course is 7. The relevant subject benchmark statements for the course, which set out expectations about standards of degrees in a given subject area, are Physics & Astronomy ([QAA 2025](#)), and Mathematics, Statistics & Operational Research ([QAA 2023](#)).

2.1 Aims

The Oxford Master's Course in Mathematical and Theoretical Physics aims to provide students with a high-level, internationally competitive training in mathematical and theoretical physics, right up to the level of modern research in the area.

As a graduate of this programme you will be in a prime position to compete for research degree places in an area of Theoretical and Mathematical Physics at leading research universities in the UK or overseas; or to pursue a research-related career, based on the acquired high-level ability in mathematics and its applications to physical systems, outside academia.

2.2 Learning Outcomes

During the course you will develop a knowledge and understanding of:

- Theoretical and Mathematical Physics, focusing on one of the areas of Theoretical Particle Physics, Theoretical Condensed Matter Physics, Theoretical Astrophysics/Fluids, or studying across these areas.
- A broad range of physical phenomena and their description within Theoretical and Mathematical Physics.
- A wide range of advanced mathematical techniques and structures and how they are applied in Theoretical Physics.

You will also have the opportunity to develop the following skills:

- Intellectual Skills
 - An appreciation of the principles of Theoretical and Mathematical Physics and their application to natural phenomena.
 - The ability to model physical phenomena and deploy a wide range of mathematical methods for their description.
 - A working knowledge of high-level mathematical methods and their application to systems in physics and beyond.
- Practical Skills
 - Ability to apply mathematical methods to practical problems.
 - Ability to construct, write-up and communicate logical arguments of some complexity.
- Transferable Skills
 - Ability to solve problems effectively and to apply high-level mathematical methods to a wide range of problems.
 - Ability to manage your time and to acquire a complex body of knowledge in a limited time.
 - Ability to manage your own learning and study for research or other professional qualifications.

2.3 Structure

The course requires that you 'offer', meaning that you choose to be assessed, in 10 units worth of courses.

The unit weighting of courses is decided by the course director and usually corresponds to the length of the lecture course. For example, a course with 16 hours of lectures will usually be worth 1 unit. A course with 24 hours of lectures, is worth 2 units.

In order to qualify for a Pass, students **must** offer:

- four units that are assessed by written invigilated exams
- a further three units that are assessed by written invigilated exams or by other formal assessments (dissertation or mini-project)
- three other units, which can be written invigilated exams, formal assessments or homework completion courses

It is your responsibility to ensure that you fulfil the requirements for the overall number of units and the number of assessed units. The modes of assessment and details on completion requirements for all courses are provided in the courses synopses of this handbook and Appendix A of the exam conventions.

There are no compulsory courses on this degree. So, you can tailor your choices to your personal interests.

Course synopses are available on the MMathPhys website: <https://mmathphys.physics.ox.ac.uk/students>

You are responsible for managing your course load

You should carefully consider how many courses you take each term and how many assessments you are prepared to undertake. Written examinations are sat in 0th week Hilary term, 0th week Trinity term and weeks 6-8 of Trinity term. Dissertations are also due in Week 6 of Trinity term. So it's especially important not to overburden yourself in Trinity term.

You will be offered academic guidance by your assigned Academic Adviser on choosing an individual path suitable for you. You may also reach out to the Course Director for advice. Course lecturers will also advise on the recommended background for their courses or possible follow-up courses you might wish to choose.

2.4 Approved Subjects

In addition to the courses listed in Appendices A-C students are allowed to choose a maximum of three units from other Maths Part C (<https://courses.maths.ox.ac.uk/mod/folder/view.php?id=55865>) or Physics Part C courses:

C1. Astrophysics C2. Laser Science and Quantum Information Processing C3. Condensed Matter Physics C4. Particle Physics C5. Physics of Atmospheres and Oceans C7. Biological Physics **C6. Theoretical Physics is not a permitted option.**

However, these must be approved by the Course Director.

Please do not email Prof Mason directly. A webform will be provided during 0th week and you should complete it by the end of week 1.

The Course Director will review your choices and the courses that you've selected from the curriculum to decide if your request is appropriate. **Approvals will be confirmed no later than Friday week 4.**

Please note, even if your request is approved, your place is dependent on there being room for you in the lectures and classes for the course. The MSc Course Administrator will liaise with the undergraduate team in Maths and the teaching administrator in Physics to ensure there is available space before confirming you can take this course.

3. Teaching and Learning

Teaching for the course will be provided jointly by the Department of Physics and the Mathematical Institute through lectures and classes.

You will be assigned an academic adviser from one or the other of these faculties, based on your areas of interest. Please note, this is separate to your college adviser.

Students undertaking a dissertation will have a separate dissertation supervisor with whom they will have supervision meetings.

Course timetables can be found on the MMathPhys website:

The Physics department hosts its course materials on Canvas:

There you will find lecture notes, recordings, reading lists and problem sheets for each course.

For courses taught by the Mathematical Institute, these are hosted on Moodle:

3.2 Lectures and Course Material

Lecture timetables can be found on the MMathPhys website:

Please note that with the number of courses offered on this course, there will inevitably be clashes on the timetable.

All lectures are recorded. So if you are not able to attend in person, you can watch these online (see following subchapter).

Course materials include lecture notes, recordings, reading lists and problem sheets recordings. Students will access these on two different platforms, depending on which department manages the course.

Physics

Canvas:

Maths

Moodle:

3.3 Classes

Enrolment

The majority of lecture courses will be accompanied by problem sets and weekly or fortnightly problem classes. These will be held in the same department that does the lecturing for the course.

Classes are not mandatory but it is in your own best interest to attend and complete the problem sheets, especially if you intend to offer the course as one of your assessed units. **Note that for Groups and Representations, you are assessed on both homework completion and the written invigilated exam.**

If you wish to be assessed by homework completion, then you **must** officially sign-up for the class and submit the required problem sheets.

If you wish to attend classes and receive feedback on submitted problem sheets, then you must officially sign-up to a class.

Dates and times of Physics classes can be found on Canvas:

To sign-up officially, you will need to log-in to the Teaching Management System (TMS) and enrol yourself for a class.

(Link)

Dates and times of Maths classes can be found on Moodle:

You also enrol in classes via Moodle.

Instructions can be found at the following link:

Class enrolment will be available by the end of 1st week each term and you will be notified by the MSc Course Administrator when it opens.

Please note, if you are taking the Advanced Philosophy of Physics option, you will arrange tutorials directly with the course tutor and there will not be a separate class registration process.

Withdrawal

You will have until Monday week 4 of each term to request a class switch or to withdraw from the class altogether. To do so, please contact your class tutor as well as the MTP administrator.

It is important to withdraw from a class if you no longer wish to take it. If you do not withdraw from a class, then your college will be charged for your attendance. Furthermore, when you withdraw from a class, your tutor and teaching assistant will know not to expect you to attend, and will not need to enquire any further to the reason for non-attendance or be concerned about your absence from classes.

If you have made an official exam entry for a course via student self-service (see page 14) and decide that you no longer wish to take that course, please note that in addition to withdrawing from the classes that accompany the lecture course and assessment, you must also withdraw from the assessment itself. Please contact your college office to officially withdraw from any exams, formal assessments or homework options for which you have made an official exam entry.

3.4 Dissertations

TBC

3.5 Advice on Teaching and Learning Matters

There are a number of people you can consult for advice on teaching and learning matters. Academic advisors will be appointed for all students at the start of the course and will be available for consultation on any academic matter. Students can also seek guidance on academic matters from their college personal tutor. All students will receive academic guidance from the Course Director.

If you have any issues with teaching or supervision please raise these as soon as possible so that they can be addressed promptly. Details of who to contact are provided in Section 7.2 Complaints and Appeals.

3.6 Skills and Learning Development

Expectations of Study

You are responsible for your own academic progress. Therefore, in addition to the formal teaching you receive through lectures, classes and dissertation tutorials, you will be expected to undertake a significant amount of self-directed independent study, both during term time and in the vacations. You are advised to read the University's guidance on undertaking paid work at <http://www.ox.ac.uk/students/life/experience>. You should seek advice from your advisor if you find it impossible to complete your academic work without spending significantly longer than 48 hours per week on a regular basis.

Your academic progress will be monitored by your academic advisor and also your college tutor. College tutors will receive reports from the class tutors for the classes you attend. In addition, academic advisors of MSc students will submit termly reports on their student's progress via the Graduate Supervision Recording (GSR). These reports are reviewed by the Course Director. If you are concerned about your academic progress, please contact your college tutor, academic advisor or the Course Director.

For MSc students, it is also mandatory to complete a self-assessment report via GSR for every reporting period. You can access GSR via the following link: <https://www.ox.ac.uk/students/selfservice>. Students will be sent a GSR automated email notification with details of how to log in at the start of each reporting window, and who to contact with queries. Completing the self-assessment will provide the opportunity to:

- Review and comment on your academic progress during the current reporting period

- Measure your progress against the timetable and requirements of your programme of study
- Identify skills developed and training undertaken or required
- List your engagement with the academic community
- Raise concerns or issues regarding your academic progress to your Academic Advisor
- Outline your plans for the next term (where applicable)

If you have any difficulty completing this you must speak to your Academic Advisor or the Course Director. Your self-assessment report will be used by your Academic Advisor as a basis to complete a report on your performance this reporting period, for identifying areas where further work may be required, and for reviewing your progress against agreed timetables and plans for the term ahead. GSR will alert you by email when your Academic Advisor has completed your report and it is available for you to view.

3.6 University Lectures and Departmental Seminars

University lectures in all subjects are open to all students. A consolidated lecture list is available on the University website at: <http://www.ox.ac.uk/students/academic/lectures/>.

Seminars and colloquia given in the Mathematical Institute and Physics Department, often by mathematicians and physicists of international repute, are announced on the departmental notice boards: <https://www.maths.ox.ac.uk/events/list> and <https://www.physics.ox.ac.uk/seminars-and-colloquia>. You are encouraged to attend any which interest you.

Particle Theory seminars are listed [here](#) and [here](#).

3.7 Study Skills

Much of the advice and training in study skills will come in the regular class teaching you receive. A wide range of information and training materials are available to help you develop your academic skills – including time management, research and library skills, referencing, revision skill and academic writing – through the Oxford Student website: <https://www.ox.ac.uk/students/academic/guidance/skills>.

3.8 Key Teaching Links

Lecture Timetable: <http://mmathphys.physics.ox.ac.uk/course-schedule>

<https://www.maths.ox.ac.uk/members/students/lecture-lists>

Maths Class Lists: <https://courses.maths.ox.ac.uk/course/index.php?categoryid=857>

Physics Class Information: Follow links to course pages from <https://mmathphys.physics.ox.ac.uk/course-schedule>

And on Canvas: <https://canvas.ox.ac.uk/courses/276069>

Problem Sheet Submission: <https://courses.maths.ox.ac.uk/course/index.php?categoryid=857> (Maths) and <https://canvas.ox.ac.uk/courses/226235/assignments> (Physics)

3.1 Lectures and Course Materials

Lecture timetables can be found on the MMathPhys website: <https://mmathphys.physics.ox.ac.uk/course-schedule>

Please note that with the number of courses offered on this course, there will inevitably be clashes on the timetable.

All lectures are recorded. So if you are not able to attend in person, you can watch these online at the associated platform below.

Course materials including lecture notes, recordings, reading lists and problem sheets are available on one of the two platforms listed below, depending on which department manages the course. You will submit problem sheets and receive feedback on them at the same platforms.

Physics: <https://canvas.ox.ac.uk/courses/294961>

The Physics department uses Canvas. Guides to Canvas can be found here:

<https://www.ox.ac.uk/students/academic/guidance/canvas>

Maths: <https://courses.maths.ox.ac.uk/course/index.php?categoryid=931>

The Mathematical Institute uses Moodle. Guides to Moodle can be found here:

<https://www.maths.ox.ac.uk/members/it/faqs/moodle-courses-system/students>

3.2 Classes

The majority of lecture courses are accompanied by problem sets and weekly or fortnightly problem classes. These will be held in the same department that does the lecturing for the course.

Classes are not mandatory but it is in your own best interest to attend and complete the problem sheets, especially if you intend to offer the course as one of your assessed units. **Note that for Groups and Representations, you are assessed on both homework completion and the written invigilated exam.**

If you wish to attend classes and receive feedback on submitted problem sheets, then you **must** officially sign-up to a class.

If you wish to be assessed by homework completion, then you **must** officially sign-up for the class and submit the required problem sheets.

Enrolment

Note: This is not the same as enrolling for the exam – you must enrol for your exams in a separate process (see Chapter 4).

Physics Classes

Dates and times of Physics classes will be published on Canvas wherever possible, though not all lecturers choose to set up webpages. In which case, they will be on TMS (see below).

To sign-up officially for any Physics classes, you will need to log-in to the Teaching Management System (TMS) and enrol yourself for a class: <https://tms.ox.ac.uk/>

Log-in with your SSO. You will then see a list of the courses that you are eligible to register for. Clicking into these courses will provide you with a list of groups and class times which you can sign up for.

Maths Classes

Dates and times of Maths classes can be found on Moodle. You also enrol in classes via Moodle.

Instructions can be found at the following link: <https://www.maths.ox.ac.uk/members/it/faqs/moodle-courses-system/students/course-enrolment>

Class enrolment will be available by the end of 1st week each term and you will be notified by the MSc Course Administrator when it opens.

Please note, if you are taking the Advanced Philosophy of Physics option, you will arrange tutorials directly with the course tutor and there will not be a separate class registration process.

Withdrawal

Note: This is not the same as withdrawing from an examination or other assessment. To do that, you need to contact your college's academic office.

You will have until Monday week 4 of each term to request a class switch or to withdraw from the class altogether. To do so, please contact your class tutor as well as the MSc Course Administrator.

It is important to withdraw from a class if you no longer wish to take it. **If you do not withdraw from a class, then your college will be charged for your attendance.** Furthermore, when you withdraw from a class, your tutor and teaching assistant will know not to expect you, and will not need to enquire any further or be concerned about your absence from classes.

3.3 Expectations of Study

You are responsible for your own academic progress. Therefore, in addition to the formal teaching you receive through lectures, classes and dissertation tutorials, you will be expected to undertake a significant amount of self-directed independent study, both during term time and in the vacations.

You should seek advice from your advisor if you find it impossible to complete your academic work without spending significantly longer than 48 hours per week on a regular basis.

There are a number of resources available to help develop your study skills:

<https://www.ox.ac.uk/students/academic/guidance/skills>

and especially at master's level: <https://www.ox.ac.uk/students/academic/guidance/skills/postgrad-taught-skills>

3.4 Academic Advisors and Reporting

Your college will assign you a tutor and the Maths and Physics departments will choose an academic advisor for you.

Advisors should be the first point of contact for students on all academic matters and are expected to monitor their student's progress throughout the year.

Advisors and students are expected to meet a minimum of two times in Michaelmas Term: once at the beginning of term and once at the end. In Hilary Term and Trinity Term, students will meet with their supervisors a minimum of once per term.

Advisors should make initial contact with their advisees to arrange further contact. After the initial meeting between student and advisor, **the onus will be on the student to arrange further meetings.**

Your academic progress will be monitored by your academic advisor and also your college tutor. College tutors will receive reports from the class tutors for the classes you attend. In addition, academic advisors of MSc students will submit termly reports on their student's progress via the Graduate Supervision Recording (GSR). These reports are reviewed by the Course Director.

For MSc students, it is mandatory to complete a self-assessment report via GSR for every reporting period. You can access GSR via the following link: <https://www.ox.ac.uk/students/selfservice>. Students will be sent a GSR automated email notification with details of how to log in at the start of each reporting window, and who to contact with queries.

- Completing the self-assessment will provide the opportunity to:
 - Review and comment on your academic progress during the current reporting period
- Measure your progress against the timetable and requirements of your programme of study
- Identify skills developed and training undertaken or required
- List your engagement with the academic community
- Raise concerns or issues regarding your academic progress to your Academic Advisor
- Outline your plans for the next term (where applicable)

If you have any difficulty completing this you must speak to your Academic Advisor or the Course Director. Your self assessment report will be used by your Academic Advisor as a basis to complete a report on your performance this reporting period, for identifying areas where further work may be required, and for reviewing your progress against agreed timetables and plans for the term ahead. GSR will alert you by email when your Academic Advisor has completed your report and it is available for you to view.

3.5 Working while Studying

The master's is a demanding course and it is not advised to take-up paid work during your studies. For international students on student visas there is a strict 20hr per week limit on paid work in term time. Please view the following University guidance for more information: <https://academic.admin.ox.ac.uk/policies/paid-work-guidelines-graduate-students>

Information on work experience, internship opportunities and careers services is available here:
<http://www.ox.ac.uk/students/life/experience>.

3.6 Further Learning Opportunities

University lectures in all subjects are open to all students. A consolidated lecture list is available on the University website at: <http://www.ox.ac.uk/students/academic/lectures/>

Seminars and colloquia given in the Mathematical Institute and Physics Department, often by mathematicians and physicists of international repute, are announced on the departmental notice boards:

<https://www.maths.ox.ac.uk/events/list>

<https://www.physics.ox.ac.uk/seminars-and-colloquia>.

You are encouraged to attend any which interest you.

4. Examinations and Assessments

All of the units you undertake will have either a component of formal assessment (written invigilated exam, take-home exam, mini-project or dissertation) or a homework completion option/requirement. Each unit will be assessed by the method most suited to the material being taught.

Both the course synopses and the examination conventions show which courses are assessed, by which method, and which courses have a homework completion option/requirement.

For revision purposes, past papers for invigilated written examinations, take-home exams and mini-projects can be found here: <https://mmathphys.physics.ox.ac.uk/past-examination-papers>

Exam Conventions

The examination conventions for the course are the formal record of the specific assessment standards for the course. They set out how each unit will be assessed and how the final degree classification will be derived from the marks obtained for the individual units. They include information on marking scales, marking and classification criteria, scaling of marks, formative feedback, re-sits, and penalties for late submission.

This is the most important course document for you to familiarise yourself with. Please make sure to read it thoroughly and refer back to it whenever you have a query regarding exams and assessment. **However, if there is a conflict between the information in the exam conventions and the University-wide Examination Regulations then you should follow the Examinations Regulations.**

The examination conventions for 2025-26 can be found on the course website at <http://mmathphys.physics.ox.ac.uk/>.

University-wide Examination Regulations: <https://examregs.admin.ox.ac.uk/>

Examiners' Reports

Past examiner's reports can be found here: <http://mmathphys.physics.ox.ac.uk/students>

Prizes

A prize may be awarded by the Examiners for excellence in examination for the Master of Mathematics and Physics (MMathPhys) or MSc in Mathematical and Theoretical Physics. The assessors of a dissertation that, in their view, shows particular originality and/or insight may recommend to the Examiners that this dissertation be given a commendation. A prize may be awarded by the examiners for the best dissertation.

4.1 Exam Entry

You will need to formally enter for the units you wish to be assessed on, including those courses which only have a homework completion requirement, by completing an examination entry form. This is done online through Student Self Service (<https://evision.ox.ac.uk/>) and further information on the process can be found at <https://www.ox.ac.uk/students/academic/exams/examination-entry>.

For this course there will be three examination entry dates:

Exam Entry Period	Assessments	Example
30th October - 6th November 2025	0th week Hilary invigilated written examinations approved subjects assessed in Michaelmas or Hilary term	Quantum Field Theory exam C3 Condensed Matter Physics
22nd - 29th January 2026	0th week and 6th-8th week Trinity invigilated written examinations Michaelmas Term practicals (homework) Hilary term submissions (such as mini-projects released in Hilary Term)	Cosmology exam; Algebraic Geometry exam Anyons and Topological Phases of Matter homework Galactic and Planetary Dynamics mini-project
7th -14th May 2026	Hilary term practicals (homework) Trinity term practicals (homework) Trinity term submissions (such as the dissertation)	Advanced Fluid Dynamics homework Astroparticle Physics homework Dissertation (1 unit); Dissertation (2 units)

When completing your examination entry, you should try to ensure that the decisions you make are as final as possible. Please note that you must take care in selecting the correct options; it is your responsibility to ensure you are entered for the courses you intend, and it is not always possible to make amendments to your entries once you have submitted the form. In particular, please keep the below terminology in mind when completing your entries, as it is not always possible to rectify mistakes

Exam	Papers assessed by written in-person examination
Submission	Work assessed by written submissions; this includes dissertations, mini-projects, and papers assessed by take-home exam. This does not include homework completion.
Practical	This only denotes homework completion courses; you should always select this where you wish to be assessed on homework completion rather than any alternative assessment method for the course.

If you wish to withdraw from an assessment after the exam entry window has closed, you can request a withdrawal from your college up to a week before the exam/assessment deadline takes place. For homework completion courses, you must withdraw before the final homework deadline. If a course requires both homework completion and an examination, you will not be able to withdraw from the examination once the final homework completion deadline has passed.

Please discuss with your college tutor or academic advisor before making the decision to withdraw. **There is no fee for withdrawal.**

If you wish to add an additional assessment after the exam entry window has closed, you will need to make a 'Change of Option' request to your college and **pay a late entry fee.** You should do this at least ten days before the assessment, so that the Academic Records Office has time to process the request.

4.2 Invigilated Written Examinations

Written invigilated exams take place in the Examination Schools in 0th week Hilary, 0th week Trinity. Part C (4th year undergraduate) exams, and papers that share material with Part C exams take place between 6-8th week Trinity.

The examination timetable for invigilated written examinations will be set by the Examination Schools and published a month prior to the exam period at: <http://www.ox.ac.uk/students/academic/exams/timetables>.

Candidates are required to wear sub fusc to written invigilated exams, unless they have a specific exam adjustment in place to excuse it.

A guide to sub fusc requirements can be found here: <https://www.ox.ac.uk/students/academic/dress>

Further information on required conduct for in-person examinations is available here: <https://www.ox.ac.uk/students/academic/exams/completing-an-exam/in-person-exams>

Please make sure to read it thoroughly.

4.2.1 Exam Adjustments

Students may be entitled to exam adjustments such as taking in-person examinations in college, having extra time, wearing noise cancelling headphones etc.

To apply for exam adjustments, you will need to contact your college office or disability advisor, who can advise on reasonable adjustments and what information you will need to provide to support an application for those adjustments to be considered. **You must do this as soon as possible after matriculation and before Friday of week 4 the term before your exams.**

Then, contact the [Disability Advisory Service](#) (DAS) to assess your requirements. They can provide a Student Support Plan, which may be used in evidence for an application for adjustments.

Provide evidence to your college office to support your request. Then your college office will submit an application for consideration on your behalf.

Approved adjustments will be notified to your college office and your course organiser/s. Your approved adjustments will be visible to you in self service and your individual exam timetable (when this is published). Any issues should be raised with your college office as soon as possible.

For more information, see here: <https://www.ox.ac.uk/students/academic/exams/examination-adjustments>

You can also apply for adjustments/alternative arrangements on the grounds of religious observance, for example if an exam is likely to take place during Ramadan or a religious holiday on which you are not allowed to work. You should apply for this through your college office, ideally before week 6 of Michaelmas term. Further guidance is also available at: <https://www.ox.ac.uk/students/academic/exams/examination-adjustments>

4.2.2 If you cannot attend your exam

If you can't attend an exam due to 'illness or other urgent cause that is unforeseeable, unavoidable and/or insurmountable' you should ask your college to apply to the Proctor's for you to be excused, meaning that your absence does not impact your overall marks and degree classification at the end of the year. Your college can apply **up to 4 weeks before the date of the exam and within 14 days after.**

For more information, see here: <https://www.ox.ac.uk/students/academic/exams/problems-completing-your-assessment>

4.4 Mini-projects and take-home exams

Some units will be assessed wholly or partially by submitted work. This will take one of two forms: mini-project or take-home examination. The deadline for the submission of the assessment for each unit is given in the table included in the examination conventions.

These should be submitted through Inspira. Instructions for using Inspira can be found at:

<https://www.ox.ac.uk/students/academic/exams/submission>

The examiners will send out notices to candidates detailing where your work should be submitted and what format your submission should be in (e.g. handwritten or word-processed). Candidates will be required to submit an electronic copy and instructions on the online submission process will be included in the notice to candidates.

It is vital that you submit your work by the given deadline as any late submission will be reported to the Proctors and a late submission penalty may be applied. Please see the examination conventions and the following webpage (<https://www.ox.ac.uk/students/academic/exams/problems-completing-your-assessment>) for advice on what to do if you are unable to submit your work on time due to medical emergency or other urgent cause.

4.5 Dissertations

You may offer a dissertation for one or two units.

For a one-unit dissertation, you are expected to spend the equivalent time and effort on your dissertation as a 16-hour lecture course, including the associated private study, completion of problem sheets, and dedicated revision for examinations. For a two-unit dissertation, you are expected to spend the equivalent time and effort on your dissertation as a 32-hour lecture course, with the same considerations for associated work.

Please note, that if you choose to do a single-unit dissertation, **you will be required to give an informal presentation to your supervisor and at least one other person as part of your supervision.**

Topics are available from Appendix A of this handbook. Please note, this list is not considered final until after the first meeting of the Joint Supervisory Committee for MMathPhys/MSc Mathematical and Theoretical Physics, around week 3 of Michaelmas term.

You can also propose a topic of your own, in which case you must find an appropriate faculty member or research staff to supervise. You must make an initial proposal to them and they will approve or help you make changes to the proposal where necessary. If they are unable to supervise you or feel your work is more suited to another member of staff, they may suggest someone else.

All students wishing to take a dissertation must formally apply through the following link on the Maths website (make sure you are signed in with your SSO): <https://www.maths.ox.ac.uk/form/webform-16642>

The form will be open between week 4 - 6. The deadline to apply is **Monday of Week 6 in Michaelmas term.**

More specific guidance is available on the course website: <http://mmathphys.physics.ox.ac.uk/students>

The deadline for submission of the dissertation is 12 noon on Monday of week 6, Trinity term. Dissertations must be submitted electronically and instructions on the online submission process will be included in the notice to candidates.

4.6 Extensions

If you are not able to submit a mini-project or your dissertation by the required deadline then you can request an extension.

You can request **two 7-day extensions** over the course of the academic year by self-certification through Student Self-Service. These do not require any approval and will be granted automatically. You may not request two 7-day extensions for the same submission, that is, you cannot have a 14 day extension by self-certification.

You can request these up to 2 weeks in advance of the deadline or 24 hours after the deadline.

For any more extensions, or for an extension longer than 7 days, your college must make the request for you and these will be granted by the Proctors' Office.

See here for more details: <https://www.ox.ac.uk/students/academic/exams/problems-completing-your-assessment>

The maximum extension that can be granted for any piece of work is 12 weeks. **If you are granted an extension of a month or longer for a piece of work in Trinity term, you should not book your graduation ceremony until you have received your results. Otherwise, you may have to cancel your booking if the Examiners are delayed in confirming your results.**

If you submit an assessment after the deadline and do not have an extension, then marks will be deducted from your assessment. Please refer to the Examination Conventions to see how many marks are deducted per hour overdue.

If you were unable to submit on time due to 'illness or other urgent cause that was unforeseeable, unavoidable and insurmountable', you can contact your college to apply to have the late penalty removed. Your college must apply to the Proctors within 14 days of your deadline. It is not guaranteed that the Proctors will agree to remove the penalty.

4.7 Homework completion

For course with a homework completion option or requirement, the lecturer of the course will assign problem sheets to be completed. There may be between one to four problem sheets, depending on how the lecturer's choice.

Each submission will be marked by a teaching assistant (TA) based on solutions provided by the lecturer. Problem sheets will be marked using a letter system A/B/C for problems solved or attempted competently (A for excellent, B good, C fair), and F for those problems which are not handed in or, if attempted, show insufficient understanding of the concepts taught in the lectures. The TA will record the mark of each problem and return the marked scripts as promptly as possible.

The homework requirement for a course will have been completed if **50% of each problem sheet** assigned has a mark A/B/C. Otherwise the homework requirement will normally be judged to have not been completed. The Examiners will make the final determination as to whether or not each student has completed the homework requirement for any given unit. **If you fail to submit any of the problem sheets for the course, you will fail**, unless you have been granted an extension or excusal (see below).

Some of the courses will be accompanied by classes led by tutors in order to discuss the homework assignments. Please note, due to the short eight week teaching structure at Oxford, the teaching and homework schedules may not always align perfectly. Lecturers may sometimes assign problem sheets on topics that have not yet been covered in lectures. Students are expected to engage in self-study, referring to the lecture notes that are provided in advance and other reading material available.

Late homework submission

Each homework will have a submission deadline after which submissions will not be accepted and an F will be automatically given.

If you cannot submit your homework on time due to acute illness or other urgent cause (see [Annex J of the Examinations and Assessments Framework](#), Points 14-25, for the definition of 'urgent cause') students should submit a formal request for an extension or excusal for that homework using this form: <https://forms.office.com/e/Ka8efNgANC>.

DO NOT informally request an extension from your tutor, TA or lecturer. Nor may you contact the Course Administrator, Course Director or any of the Examiners for this.

Do not request an extension via Student Self-Service either. The only way to request an extension is through the form linked above.

Where the extended deadline requested falls before the class at which the work will be discussed, the request will be considered by the lecturer of the course; where the extended deadline would fall after the class, or where an excusal is requested, the request will be considered by the Chair of Examiners.

4.8 Mitigating Circumstances

If you suffer from an acute illness or other personal circumstances that you believe has affected your performance in an assessment (either during an exam, or in the revision period before, or while writing up a submission), you can submit a mitigating circumstances notice to your examiners (MCE) to let them know. The Examiners will consider whether the outcome for affected papers or overall classification should be adjusted.

You can submit an MCE via Student Self-Service. However, you are encouraged to contact your college first, so that they can advise you on how to gather evidence.

Please see student guide here:

<https://www.ox.ac.uk/sites/files/oxford/Mitigating%20Circumstances%20Notices%20%E2%80%93%20Student%20Guidance.docx>

You are encouraged to submit an MCE as soon as possible after completing the affected assessment. You can submit an MCE at any time after the assessment is completed however, it must be submitted no later than noon the day before the final exam board meeting (mid-July, exact date to follow), or it will not be considered by the Examiners.

You may submit an MCE after that point, no more than a month after the final exam board meeting, but you must provide a reason for why you did not submit before. The Proctor's Office will review the cases and they will decide if the MCE should be forwarded to the Examiners at that point. So if you submit an MCE after the exam board, it is not guaranteed that the Examiners will review it.

Please note, if you are struggling with your studies for any reason, please contact your academic advisor and your college's welfare team for support. Don't wait until the last moment and only apply for an MCE. Your college is there to support you and you are more likely to succeed in your studies if you reach out for help when you need it.

4.9 Plagiarism

Presenting work or ideas from another source as your own, with or without consent of the original author, by incorporating it into your work without full acknowledgement constitutes plagiarism. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition, as is the use of material generated wholly or in part through use of artificial intelligence (save when use of AI for assessment has received prior authorisation e.g. as a reasonable adjustment for a student's disability). Plagiarism can also include re-using your own work without citation. Under the regulations for examinations, intentional or reckless plagiarism is a disciplinary offence.

Please see the University's guidance on plagiarism:

<http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism>

5. Services

The Oxford students' website will provide most of the information you need on what services are available to you through the university. <https://www.ox.ac.uk/students>

Please refer to your college website and handbook for college specific services.

More detail is provided in the following subchapters.

University Policies

The University has a wide range of policies and regulations that apply to students. These are easily accessible through the A–Z of University regulations, codes of conduct and policies available at <http://www.ox.ac.uk/students/academic/regulations/a-z>. Particular attention is drawn to the following University policies.

Equal Opportunities Statement: <https://edu.admin.ox.ac.uk/equality-policy>

Intellectual Property Rights: <https://www.ox.ac.uk/students/academic/guidance/intellectual-property>

Code on Harassment: <https://edu.admin.ox.ac.uk/harassment-advice>

Policy on Plagiarism: <http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism>

5.1 Who is Responsible

Different parts of the university are responsible for providing different support services and administrative support. Here is a brief summary of who to go to for what issue.

Issues with Moodle, Canvas, TMS - Course Administrator (mmathphys@maths.ox.ac.uk)

General course information and administrative queries - Course Administrator (mmathphys@maths.ox.ac.uk)

Academic advice - Academic advisor or Course Director (lionel.mason@maths.ox.ac.uk)

Mitigating Circumstances - College

Extensions - College

Excusals and late penalty waivers - College

Exam entry change - College

Suspending your studies/return from suspension - Course Administrator (mmathphys@maths.ox.ac.uk)

Welfare - College welfare support. There is also the university counselling service: <https://www.ox.ac.uk/students/welfare/counselling>; counselling@admin.ox.ac.uk

Disability support -

University's Disability Advisory Service: <http://www.ox.ac.uk/students/welfare/disability>

Disability Coordinator (Mathematics): Charlotte Turner-Smith (academic.administrator@maths.ox.ac.uk)

Disability Coordinator (Physics): Carrie Leonard-McIntyre (c.leonard-mcintyre@physics.ox.ac.uk)

Every college has their own systems of support for students, please refer to your college handbook or website for more information on who to contact and what support is available through your college.

Details of the wide range of sources of support available more widely in the University are available from the Oxford Student website (<http://www.ox.ac.uk/students/welfare>), including in relation to mental and physical health and disability.

5.2 Student Representation and Feedback

Joint Supervisory Committee

Students will be able to nominate two representatives (one MSc MTP student, one MMathPhys student) to sit on the Joint Supervisory Committee (JSC) which oversees the course. Volunteers will be sought at the Induction Session and an election held if necessary. The student representatives will be able to raise matters with the JSC on behalf of the cohort.

Consultative Committee for Graduates – Mathematics

The Consultative Committee for Graduates meets regularly once a term and discusses any matters that graduate students wish to raise. Students will be invited to nominate a representative to serve as an MSc rep on this committee via email in Michaelmas term.

The Physics Joint Consultative Committee

The Physics Joint Consultative Committee (PJCC) has elected undergraduate members who meet twice in MT and HT, and once in TT to discuss both academic and administrative matters with academic staff representatives. See <https://pjcc.physics.ox.ac.uk/> for more information.

Divisional and University Representatives

The MPLS Division also runs a divisional Undergraduate Joint Consultative Forum, a divisional Graduate Joint Consultative Forum, and is establishing a Joint Consultative Forum for Graduate Taught Courses. Each Forum is chaired by the senior MPLS Academic who is responsible for that area across the Division, an undergraduate or graduate representative from each department, the undergraduate or graduate representative on the Academic Committee and Divisional Board, and the Oxford Student Union (Vice-President (Access and Academic Affairs) or Vice-President (Graduates).

Student representative sitting on the MPLS Divisional Board are selected through a process organised by Oxford SU. Details can be found on the Oxford SU website along with information about student representation at the University level.

Opportunities to Provide Feedback

Students will be asked to complete questionnaires evaluating the teaching received for each unit. Please take time to complete these as your feedback is valuable for future course planning.

MSc students, like all students on matriculated courses, will be surveyed on all aspects of their course (learning, living, pastoral support, college) through the annual PTES (Postgraduate Taught Experience Survey). Previous results can be viewed by students, staff and the general public at: <https://www.ox.ac.uk/students/life/student-surveys>. MMathPhys students, as final year undergraduates, will be surveyed through the National Student Survey instead. Results from previous NSS can be found at <https://www.thestudentsurvey.com/>.

Key Student Representation Links

CCG: <http://www.maths.ox.ac.uk/members/students/postgraduate-courses/doctor-philosophy/consultative-committee-graduates>. (Minutes of meetings and list of student representatives.)

Oxford SU: <http://oxfordsu.org/>

University Surveys: <https://www.ox.ac.uk/students/life/student-surveys>

5.3 Complaints and Appeals

The University, the Mathematical, Physical and Life Sciences Division, the Department of Physics and the Mathematical Institute all hope that provision made for students at all stages of their course of study will result in no need for complaints (about that provision) or appeals (against the outcomes of any form of assessment).

Where such a need arises, an informal discussion with the person immediately responsible for the issue that you wish to complain about (and who may not be one of the individuals identified below) is often the simplest way to achieve a satisfactory resolution.

Many sources of advice are available from colleges, faculties/departments and bodies like the Counselling Service or the OUSU Student Advice Service, which have extensive experience in advising students. You may wish to take advice from one of those sources before pursuing your complaint.

General areas of concern about provision affecting students as a whole should be raised through Joint Consultative Committees or via student representation on the faculty/department's committees.

Complaints

If your concern or complaint relates to teaching or other provision made by the faculty/department, then you should raise it with Director of Undergraduate Studies (Dr Richard Earl (Maths), Prof Jonathan Jones (Physics)) or with the Director of Graduate Studies (Prof Christoph Reisinger (Maths)) as appropriate. If your concern relates to the course as a whole, rather than to teaching or other provision made by one of the faculties/departments, you should raise it with Prof Caroline Terquem, Chair of the Joint Supervisory Committee for the Master of Mathematical and Theoretical Physics/MSc in Mathematical and Theoretical Physics. Complaints about departmental facilities should be made to the Head of Administration/Head of Physical Resources (Dr Jocasta Gardner (Maths), Mr. Simon Probert (Physics)). If you feel unable to approach one of those individuals, you may contact the Head of Department Prof James Sparks (Maths). The officer concerned will attempt to resolve your concern/complaint informally.

If you are dissatisfied with the outcome, you may take your concern further by making a formal complaint to the Proctors under the University Student Complaints Procedure <https://www.ox.ac.uk/students/academic/complaints>.

If your concern or complaint relates to teaching or other provision made by your college, you should raise it either with your tutor or with one of the college officers, Senior Tutor, Tutor for Graduates (as appropriate). Your college will also be able to explain how to take your complaint further if you are dissatisfied with the outcome of its consideration.

Academic Appeals

An academic appeal is an appeal against the decision of an academic body (e.g. boards of examiners, transfer and confirmation decisions etc.), on grounds such as procedural error or evidence of bias. There is no right of appeal against academic judgement. If you have any concerns about your assessment process or outcome it is advisable to discuss these first informally with your subject or college tutor, Senior Tutor, course director, director of studies, supervisor or college or departmental administrator as appropriate. They will be able to explain the assessment process that was undertaken and may be able to address your concerns. Queries must not be raised directly with the examiners. If you still have concerns you can make a formal appeal to the Proctors who will consider appeals under the University Academic Appeals Procedure (<https://www.ox.ac.uk/students/academic/complaints>).

5.4 Careers Service

Careers guidance is provided by the Careers Service (<http://www.careers.ox.ac.uk/>), which also provides training in writing applications, interview techniques and analysis of transferable skills. The Careers Service provides information about occupations and employers, and advertises work experience opportunities.

In addition to its general programme, the Careers Service runs an annual 'Jobs for Mathematicians' half-day, in collaboration with the Mathematical Institute. At this event there are talks from alumni working in various industries and a talk for those interesting in continuing on to further postgraduate study. Further information about postgraduate study opportunities at the Mathematical Institute and Physics respectively can be found here:

<https://www.maths.ox.ac.uk/study-here/postgraduate-study>

<https://www.physics.ox.ac.uk/study/postgraduates>

5.5 Volunteering Opportunities

Maths Outreach

The Department has an active Outreach programme <https://www.maths.ox.ac.uk/outreach> which runs throughout the year, with events and programmes for school students aged 5-18. You can take a look at what's currently happening on the website. Keep an eye out throughout the year for e-mails asking for volunteers for various events and other ways to get involved. Contact outreach@maths.ox.ac.uk if you would like to get involved.

Physics Outreach

The Physics department similarly has an outreach programme with events for primary and secondary schools. See <https://www.physics.ox.ac.uk/engage/schools> for more information and email engage@physics.ox.ac.uk if you would like to get involved.

5.6 Societies

There are number of Mathematics and Physics student societies which you may like to join. Details of the main societies are given below. In addition, there are also over 200 clubs and societies covering a wide range of interest which you may join or attend. A full list is available at <http://www.ox.ac.uk/students/life/clubs/list>.

Invariants

The Oxford University's student society for Mathematics. The society promotes Maths and hosts informal lectures, often given by leading mathematicians. Website: <http://www.invariants.org.uk/>.

LGBTI^3

LGBTI^3 is the student group for all LGBTQ+ identifying students in Maths, Stats and Computer Science.
Contact: oxlgbtqubed@gmail.com.

Mirzakhani Society

The Mirzakhani Society is a society aimed at supporting women and non-binary students in Oxford who are studying maths.
Contact: mirzakhanisociety@gmail.com.

The Oxford University Physics Society

The Oxford University Physics Society (PhysSoc) is a student society that exists to promote and encourage an interest in Physics in and around Oxford University. PhysSoc hosts talks most weeks during term time in the Physics Department, often by leading experts and also holds social events which are a great opportunity to get to know others with an interest in all things Physics. Website: <https://oxfordphyssoc.wordpress.com/>

Appendices

- Appendix 1 - Course Curriculum
- Appendix 2 - Specialized Pathways
- Appendix 3 - Dissertation Proposals

A - Dissertation Topics

Subject to Joint Supervisory Committee approval

Supervisor: Prof Alexander Schekochihin

(alex.schekochihin@physics.ox.ac.uk)

Title: Thermodynamics, Statistical Physics, and Effective Collision Integrals for Collisionless Plasma

Abstract:

Ordinary gases and plasmas where binary collisions between particles occur on time scales that are shorter than the time scales of collective dynamics usually hover close to Maxwellian equilibria — an expression of the thermodynamical inevitability ubiquitous in nature. What, however, happens if the collisions are infrequent, like they are in many astrophysical plasmas (and also in most gravitating kinetic systems)? The question has been on the agenda since the 1960s but in recent years, there have been a number of interesting developments that suggest a path forward, previously obscure. It turns out that the principle of maximum entropy can be applied to such systems if one treats the particle distribution function (phase-space density) itself as a random field and asks how its coarse-grained (averaged) version evolves subject to constraints imposed by (approximate) incompressibility of the phase space (encoded in a continuum of Casimir invariants). Universal equilibria emerge — they can be derived by the methods of statistical mechanics (maximising entropy), but a further challenge is to do to the resulting equilibria what Boltzmann did to Maxwell's distribution and work out how (and why) they are achieved dynamically. This means deriving, essentially, an effective field theory for the evolution of non-Maxwellian plasmas — "collisionless collision integrals". Under some rather restrictive assumptions, this has been done for Vlasov-Poisson (electrostatic plasmas). The student's first task would be to learn the necessary theory that leads one to that point. From there, they will be looking over the research frontier into terra incognita. A useful research-level task would be to work out how (and whether) the existing theory can be generalised to Vlasov-Maxwell (electromagnetic) plasmas. Another would be to try some new approaches to deriving collision integrals beyond the quasilinear approximation. It is also possible that, in the course of their exploration of the subject, the student might tread onto a third path, which cannot as yet be predicted.

Reading:

D. Lynden-Bell, "Statistical mechanics of violent relaxation in stellar systems," Mon. Not. R. Astron. Soc. 136, 101 (1967)
T. H. Dupree, "Theory of phase space density granulation in plasma," Phys. Fluids 15, 334 (1972)
R. J. Ewart et al., "Collisionless relaxation of a Lynden-Bell plasma," J. Plasma Phys. 88, 925880501 (2022)
R. J. Ewart et al., "Non-thermal particle acceleration and power-law tails via relaxation to universal Lynden-Bell equilibria," J. Plasma Phys. 89, 905890516 (2023)
A. A. Schekochihin, "Lectures on Kinetic Theory and Magnetohydrodynamics of Plasmas", secs 10-11 and references therein, <https://www-thphys.physics.ox.ac.uk/people/AlexanderSchekochihin/KT/2015/KTLectureNotes.pdf>

Title: Phase-Space Structures and Strong Langmuir Turbulence

Abstract:

This dissertation is related to the previous one: the relaxation of collisionless plasmas towards universal non-Maxwellian equilibria occurs because the plasma is in a turbulent state that is very different from thermal (particle) noise that underlies the relaxation of collisional systems to the local Maxwellian equilibrium. This turbulence occurs in a 6D phase space and has only recently started to be understood theoretically and probed numerically. An especially fascinating (and, it seems, highly consequential) feature of it appears to be that, due to the phenomenon of particle trapping in electric fluctuations, long-lived coherent structures can form and then engage in vigorous dynamics, interacting with each other, growing to ever-larger size at each other's expense, and in the process stirring the plasma in a manner that pushes it towards non-Maxwellian states. In this dissertation, the student will first study the fundamental theory underlying our understanding of these structures and then, if they (the student) have sufficient energy and gain sufficient momentum while there is still time, they can attempt to construct a theory of turbulence of phase-space structures. A promising lead is that it will turn out to be linked to the theories of strong Langmuir turbulence developed in the 1970s-80s, but never finished due to impossibility at that time of testing ideas on large computers (which are now available and have yielded some intriguing new data).

Reading:

I. B. Bernstein et al., "Exact nonlinear plasma oscillations," Phys. Rev. 108, 546 (1957)
 T. O'Neil, "Collisionless damping of nonlinear plasma oscillations," Phys. Fluids 8, 2255 (1965)
 I. H. Hutchinson, "Kinetic solitary electrostatic structures in collisionless plasma: phase-space holes," arXiv:2407.08539 (2024)
 M. L. Nastac et al., "Phase-space entropy cascade and irreversibility of stochastic heating in nearly collisionless plasma turbulence," Phys. Rev. E 109, 065210 (2024)
 A. A. Schekochihin, "Lectures on Kinetic Theory and Magnetohydrodynamics of Plasmas", secs 8, 12 and references therein (on strong Langmuir turbulence, see references in sec. 8.6.2), <https://www-thphys.physics.ox.ac.uk/people/AlexanderSchekochihin/KT/2015/KTLectureNotes.pdf>

Supervisor: Prof Andre Henriques

(henriques@maths.ox.ac.uk)

Title: The Virasoro Algebra

Abstract:

The Virasoro algebra is an important infinite dimensional Lie algebra, with a rich and fascinating representation theory. It is the universal central extension of the Lie algebra of vector fields on the circle, and plays a central important role in two-dimensional conformal field theory. The proposal will start with an investigation of Lie algebra cohomology, specifically the relation between H^2 and Lie algebra central extensions. Then, a specific construction called the Segal-Sugawara construction will be investigated: every representation of a so-called affine Lie algebra is automatically also a representation of the Virasoro algebra. At last, we will aim for a classification of the irreducible representations of the Virasoro algebra. An ambitious (optional) goal would be to study the so-called fusion product of representations of the Virasoro algebra, which equips the category of representations of the Virasoro algebra with the structure of a modular tensor category. (Note: initial supervision for this project may be held in groups.)

Pre-requisites:

B2.3 Lie Algebras

Recommended:

C2.2 Homological Algebra

C2.3 Representation Theory of Semisimple Lie Algebras

Reading:

Course notes: <http://andreghenriques.com/Teaching/CFT-2020.pdf>

A Mathematical Introduction to Conformal Field Theory, by M. Schottenloher.

V. G. Kac. Infinite-dimensional Lie algebras. Cambridge University Press.

Unitary representations of the Virasoro and super-Virasoro algebras, by P. Goddard, A. Kent, and D. Olive

Conformal Field Theory, by David Sénéchal, Philippe Francesco, and Pierre Mathieu

Representation Theory of the Virasoro Algebra, by Kenji Iohara, and Yoshiyuki Koga.

Friedan, D., Qiu, Z.A. and Shenker, S.H., 1984. Conformal invariance, unitarity and two-dimensional critical exponents. Physical Review Letters, 52, p.1575.

Wang, W., 1993. Rationality of Virasoro vertex operator algebras. International Mathematics Research Notices, 1993(7), pp.197-211.

Supervisor: Prof Andrew Dancer

(dancer@maths.ox.ac.uk)

Title: Symplectic Geometry and Quantisation

Abstract:

This project would explore aspects of symplectic geometry, especially those related to group actions on symplectic manifolds. The project would start with a review of the basic theory of symplectic manifolds, Hamiltonian group actions and moment maps. Further topics could include all or some of the following: (i) Abelian actions, toric varieties and Delzant's theorem. (ii) moment maps and symplectic reduction (iii) Duistermaat-Heckman theorem (iii) geometric quantisation of symplectic manifolds, in particular a detailed treatment of the case of Delzant spaces There are many examples in toric

geometry that could be worked out, and quite a few details that the candidate could fill in during an exploration of the literature. There are extensive links with convex geometry, combinatorics and even some parts of number theory.

Prerequisites:

It would be helpful to take Differentiable Manifolds and C3.5 Lie Groups

Reading:

V. Guillemin. Moment Maps and Combinatorial Invariants of Hamiltonian Tⁿ Spaces (Birkhauser). M. Audin.

The Topology of Torus Actions on Symplectic Manifolds (Birkhauser).

Supervisor: Dr Anton Sokolov

(anton.sokolov@physics.ox.ac.uk)

Title: Astrophysical probes of dual axion-photon coupling

Abstract:

Hypothetical particles called axions are one of the most popular candidates for the role of the cold dark matter, moreover axions can explain the absence of the electric dipole moment of the neutron. Possible electromagnetic signatures of axions are actively searched for in laboratory experiments and astrophysical observations. Recently, a new form of axion electrodynamics was proposed which evades many of the existing experimental searches. The goal is to study the implications of this new form of axion electrodynamics for astrophysical observations, and possibly predict novel axion signals from stars.

Prerequisites:

Electrodynamics and Field Theory, Basics of Astrophysics.

Reading:

G. Raffelt, "Stars as Laboratories for Fundamental Physics", 2) A. Caputo and G. Raffelt, "Astrophysical Axion Bounds: The 2024 Edition".

Supervisor: Prof Ard Louis

(ard.louis@physics.ox.ac.uk)

Title: Biological Evolution and a Bias towards Simplicity?

Abstract:

Evolution proceeds by mutations to genotypes that in turn change phenotypes (the organism). But since the number of genotypes is much larger than the number of phenotypes, concepts of genetic entropy must enter into the equations, which means methods from statistical mechanics become relevant. In this project you will study some recent advances that use algorithmic information theory to argue for a bias towards simplicity in biology. See, for example, the papers below: Symmetry and simplicity spontaneously emerge from the algorithmic nature of evolution, Iain G Johnston, Kamaludin Dingle, Sam F. Greenbury, Chico Q. Camargo, Jonathan P. K. Doye, Sebastian E. Ahnert, Ard A. Louis PNAS 119, e2113883119 (2022). Bias in the arrival of variation can dominate over natural selection in Richard Dawkins' biomorphs View ORCID Profile, Nora S. Martin, Chico Q. Camargo, Ard A. Louis doi: <https://doi.org/10.1101/2023.05.24.542053>

Title: Sloppy Systems

Abstract:

Many models in biology, engineering and physics have a very large number of parameters. Often many of these are only known approximately. Moreover, in John von Neuman's famous quip "with four parameters I can fit an elephant, and with five I can make him wiggle his trunk." suggests that only a small set of these parameters are actually relevant? Could there be a fundamental theory of these complex systems that allows us to work out what the key parameters are?

References:

1. Transtrum, Mark K., Machta Benjamin, Brown Kevin, Daniels Bryan C., Myers Christopher R., and Sethna James P. , Perspective: Sloppiness and Emergent Theories in Physics, Biology, and Beyond, J. Chem. Phys., Volume 143, Issue 1, (2015)
2. Machta, Benjamin B., Chachra Ricky, Transtrum Mark K., and Sethna James P. , Parameter Space Compression Underlies Emergent Theories and Predictive Models, Science, Volume 342, p.604-607, (2013)
3. Gutenkunst, R. N., Waterfall J. J., Casey F. P., Brown K. S., Myers C. R., and Sethna J. P., Universally sloppy parameter sensitivities in systems biology models, PLoS Computational Biology, Volume 3, p.1871-1878, (2007)
4. Waterfall, J. J., Casey F. P., Gutenkunst R. N., Brown K. S., Myers C. R., Brouwer P. W., Elser V., and Sethna J. P. , Sloppy-model universality class and the Vandermonde matrix, Physical Review Letters, Volume 97, p.150601, (2006)

Title: Theory of Deep Learning

Abstract:

Deep neural networks (DNNs) have revolutionised machine learning. In spite of their great success, many questions remain about why they work so well. One key issue is why they generalise so well in the overparameterised regime, where classical learning theory predicts that they should heavily overfit. We have recently used concepts from Algorithmic Information Theory (AIT) to argue that that DNNs are exponentially biased towards functions with low Kolmogorov complexity. If this inductive bias reflects patterns seen in nature, then this may explain the conundrum of good generalisation in the overparameterised regime. But many questions remain, and in this project you would use a combination of theory and simulations to peer into the DNN black box, and to hopefully understand what makes them so special.

See <http://www.physicsmeetsml.org/posts/sem> 2020 06 03/ for some more background.

Title: Effects of Mass Vaccination on the Dynamics of SIRS Systems with Seasonal Variation in Transmissibility

Abstract:

For many pathogens, infection-blocking immunity is transient even though immunity against severe disease (whether acquired through natural infection or vaccination) may be lifelong. The interplay between seasonal changes in HIT and loss of infection blocking immunity is therefore a critical determinant of dynamics of pandemic spread and of the characteristics of endemic equilibrium of any emerging pathogen. This project will focus on:

- i. how the time of arrival of the pathogen within the seasonal cycle of transmissibility affects the initial dynamics of infection and subsequent establishment of an endemic equilibrium;
- ii. how these dynamics are affected by pre-existing immunity (for example, due to exposure to related pathogens);
- iii. how mass vaccination can alter these dynamics.

We will refer to available data on SARS-CoV-2 in various settings to test and refine the hypotheses generated by these exercises.

Supervisor: Dr Christopher Couzens

(couzens@maths.ox.ac.uk)

Title: Equivariant Localization and supergravity

Abstract: Equivariant localisation is a powerful mathematical result which allows for the evaluation of integrals on a space with a symmetry using topological data of the space. It has recently been used in supergravity to compute various observables such as the on-shell action and anomalies. This thesis will review this recent topic before applying it to a new setup.

Pre-requisites: The topic uses Riemannian geometry and supersymmetry/supergravity. The student should be familiar with the basics of Riemannian geometry (metric, curvature, forms) or taking the GR1 C7.5 course and/or the Differentiable manifolds (C3.3) course. Supersymmetry and Supergravity will be learnt as a byproduct of the dissertation.

Title: Classifying supersymmetric solutions in supergravity

Abstract: Finding solutions to the Einstein equations is very difficult, they are second order non-linear equations. One method for finding solutions is to impose additional symmetries, one such symmetry is supersymmetry. Imposing that the solution preserves supersymmetry typically allows us to replace the second order PDEs with first order PDEs. We will review how this is done using G-structures and Generalised complex geometry before applying this to a new class of solutions.

Pre-requisites: The topic uses Riemannian geometry and supersymmetry/supergravity. The student should be familiar with the basics of Riemannian geometry (metric, curvature, forms) or taking the GR1 (C7.5) course and/or the Differentiable manifolds (C3.3) course. Supersymmetry and Supergravity will be learnt as a byproduct of the dissertation.

Supervisor: Prof Ed Hardy

(edward.hardy@physics.ox.ac.uk)

Title: The Strong CP Problem and Axions

Abstract:

One of the outstanding mysteries of the Standard Model of particle physics is the absence of CP violation in the strong sector. This project involves first reviewing the origin of CP violation in gauge theories, which has a fascinating connection to non-perturbative dynamics. Possible solutions to the strong CP problem will also be studied. A two-unit project could extend to analysing a recent paper that claims (possibly erroneously) that there is in fact no strong CP problem.

References:

Advanced Topics in Quantum Field Theory, Shifman (widely available in libraries)

<https://inspirehep.net/literature/1707528>

Title: Hamiltonian Truncation and Machine Learning

Abstract: Hamiltonian truncation is an approach to analysing quantum field theories in the strongly coupled regime, in which the full Hilbert space of the theory is truncated and the resulting system is studied numerically. This project will involve reviewing the existing literature and attempting to exploit machine learning techniques to obtain an optimized truncated subspace.

Reading:

<https://inspirehep.net/literature/1333856>

Supervisor: Prof Fabian Essler

(fabian.essler@physics.ox.ac.uk)

Title: Heating rates in Floquet circuits

Abstract: In recent years there has been a lot of interest in simulating interacting many-particle quantum systems using superconducting circuits. Brickwall circuits naturally give rise to periodically driven ("Floquet") circuits. These are known to heat under time evolution [1,2] and approach an infinite temperature (completely mixed) state at late times. Circuits that have a globally conserved charge are then expected to exhibit hydrodynamic behaviour. In order to study the latter using numerical methods it is necessary to have a circuit that heats fast, so that the accessible time scales suffice to detect it. The objective of the project is to investigate a simple class of two-Qbit brick wall circuits with a single conserved charge, and use the diagnostic proposed in [3] to find which circuits heat fastest.

Reading list:

[1] A. Lazarides, A. Das and R. Moessner, Phys. Rev. E90, 012110 (2014).

[2] L. D'Alessio and M. Rigol, Phys. Rev. X 4, 041048 (2014).

[3] A. Rakcheev and A.M. Lauchli, Phys. Rev. Research 4, 043174 (2022).

Supervisor: Dr Gianmarco Spera

(gianmarco.spera@physics.ox.ac.uk)

Title: Continuum description of living systems

Abstract:

Living systems are an emblematic example of active matter as they convert energy from the environment into work. As a consequence, such systems are inherently out of equilibrium, resulting in a wealth of large-scale behaviours[1-3]. To account for it, a key requirement is the ability to predict how different ingredients or symmetries of the models affect the emerging phenomenology[4-5]. Possible directions could be: the study of microscopic theories (and the associated field theories) to capture the emergent behaviour of biological systems; the study of continuum models with different symmetries, e.g. polar and/or nematic; or the role of domain topology in collective motion.

- [1] Marchetti, M. Cristina, et al. "Hydrodynamics of soft active matter." *Reviews of modern physics* 85.3 (2013): 1143-1189.
- [2] Chat  , Hugues. "Dry aligning dilute active matter." *Annual Review of Condensed Matter Physics* 11.1 (2020): 189-212.
- [3] Bechinger, Clemens, et al. "Active particles in complex and crowded environments." *Reviews of modern physics* 88.4 (2016): 045006.
- [4] Doostmohammadi, Amin, et al. "Active nematics." *Nature Communications* 9.1 (2018): 3246.
- [5] J  licher, Frank, Stephan W. Grill, and Guillaume Salbreux. "Hydrodynamic theory of active matter." *Reports on Progress in Physics* 81.7 (2018): 076601.

Supervisor: Dr Harini Desiraju and Prof Jon Keating

(harini.desiraju@maths.ox.ac.uk)

Title: Semi-classical limits of Selberg integrals

Abstract: Special functions play a central role in describing physical phenomena. Some examples you may have encountered are Gamma functions, and Euler beta functions, which appear in the description of partition functions in statistical mechanics or computation of Feynman integrals. This project will focus on the multi-dimensional analogue of the Euler beta function, known as the Selberg integral.

Selberg integrals appear across diverse fields such as combinatorics, conformal field theory, and random matrix theory to name a few. You may begin by exploring the role of the Selberg integral in either random matrix theory or conformal field theory, where these integrals are commonly parameterized by beta, a parameter that encodes the underlying symmetry class of the system. As a concrete question, you will study these integrals in the (semi-classical) regime $\beta \rightarrow \infty$, which is expected to give rise to interesting sets of equations with rich geometry.

References:

1. Chapter 17, Random matrices by M.L Mehta (available in the library)
2. The importance of the Selberg integral (<https://arxiv.org/abs/0710.3981>)
3. Random Matrix Theory and $\zeta(1/2 + it)$ (<https://link.springer.com/article/10.1007/s002200000261>)
4. Conformal blocks as Dotsenko-Fateev Integral Discriminants (<https://arxiv.org/abs/1001.0563>)

Supervisor: Prof Jason Lotay

(lotay@maths.ox.ac.uk)

Title: Minimal surfaces, mean curvature flow and applications

Abstract: Minimal surfaces provide the mathematical description of soap films, locally minimizing their surface area, and thus are important from the point of view of physical sciences (including relations to black holes) as well as geometry and topology. The mean curvature flow is a geometric evolution equation which takes a surface and tries to make it minimal.

Again, besides the applications of mean curvature flow to geometry and topology, it also has connections to image processing, and the (inverse) mean curvature flow is used to prove the Penrose inequality inspired by the study of gravity. The aim of this project will be to look at some of the recent developments in theory of minimal surfaces and mean curvature flow of surfaces, using geometry, topology and analysis, as well as applications within or outside mathematics, such as in theoretical physics.

Prerequisites: Essential: Basic geometry (e.g. material equivalent to B3.2 Geometry of surfaces) and basic topology (e.g. material equivalent to A5 Topology); Recommended: It would be good to learn alongside this dissertation the following topics - Differentiable Manifolds (C3.3), Riemannian Geometry (C3.11); Useful: Again, alongside this dissertation it might be helpful to learn Partial Differential Equations (e.g. C4.3).

Reading list:

T. Colding and W. Minicozzi, A Course in Minimal Surfaces, 2011

C. Mantegazza, Lecture Notes on Mean Curvature Flow, 2012

Supervisor: Prof Joseph Conlon

(joseph.conlon@physics.ox.ac.uk)

Title: Cosmic Strings

Abstract: Cosmic strings are extended 1-dimensional topological defects that have long been considered a possible element of the universe. Such strings can arise either in field theory through symmetry breaking phase transitions or as fundamental cosmic superstrings. Although cosmic strings were originally considered as a candidate for structure formation in the universe, this possibility did not survive contact with data on large-scale structure and the distribution of galaxies. However, low-tension cosmic string networks still exist as a possibility and are a speculative explanation for the origin of the ultra-low frequency gravitational waves recently observed by pulsar timing arrays. The dissertation will review the physics of cosmic strings and explore some aspect of their physics in more depth. It can be offered as either a 1- or 2-unit dissertation.

Pre-requisites: While no course is an absolute pre-requisite, a familiarity with field theory and cosmology would be very helpful.

Reading list:

As starter references,

Cosmic Strings and Other Topological Defects, (Vilenkin + Shellard, CUP, 2000)

Cosmic Strings and Superstrings, E. Copeland and T. Kibble, arXiv:0911.1345

These should then be used as a base from which to explore the literature.

Supervisor: Prof Julia Yeomans

(julia.yeomans@physics.ox.ac.uk)

Title: Active Matter

Abstract:

Active systems take energy from their surroundings on a single particle level and use it to do work. This means that they naturally operate out of thermodynamic equilibrium and provide examples of non-equilibrium statistical physics. Dense active matter has many surprising properties such as active turbulence and motile topological defects, motility induced phase separation, odd viscosities and the breakdown of detailed balance. The dissertation will probe more deeply into an aspect of active materials; possible examples are spontaneous flow in confined active systems, swimming at low Reynolds number, active wetting or forces in confluent cell layers.

Reading:

G Gompper et al, The 2020 motile active matter roadmap, J. Phys.: Condens. Matter 32 193001

(lots of short articles introducing active matter)

A. Doostmohammadi, J. Ignés-Mullol, J.M. Yeomans, and F. Sagués, Active nematics. Nat. Commun. 9, 3246 (2018) (for a review of active nematics)

Supervisor: Prof Lionel Mason

(lionel.mason@maths.ox.ac.uk)

Title: Twistor theory and applications

Abstract: Twistor theory is a geometrical framework for the formulation of physical theories introduced by Roger Penrose in the 1960s. It provides a more primitive geometry from which space-time itself emerges together with physical fields thereon using ideas from algebraic geometry and complex analysis. It traces its origins to the Klein correspondence from classical projective geometry in which the space of lines in three dimensional projective space form a four-dimensional quadric which in twistor theory is re-interpreted as Minkowski space-time. This framework has had many applications to mathematical physics over the years, any one of which might form the basis for a dissertation of one or two units.

1. The classification of integrable systems of nonlinear equations of Mathematical Physics and construction of exact solutions, see Mason & Woodhouse, Integrability, Self-Duality and Twistor Theory, OUP Monograph, 1996. This could be reviewed in the light of recent Chern-Simons approaches due to Costello, Witten and Yamazaki, Gauge Theory and Integrability, ICCM Not. 06, arxiv:1709.09993.
2. Applications to the construction of scattering amplitudes and correlation functions for 4d gauge and gravity theories. A prerequisite is QFT and a general introduction to scattering amplitudes can be found in the CUP book by Elvang and Huang book available at <https://arxiv.org/abs/1308.1697>. From here one could study more recent developments such as ambitwistor strings and the scattering equations, Geyer and Mason The SAGEX Review: Ambitwistor strings and amplitudes from the worldsheet, J.Phys.A 55 2022, arxiv:2203.13017 or more recent applications to the construction of cosmological and AdS correlators A new twist on spinning (A)dS correlators <https://arxiv.org/abs/2408.02727>. Another approach is via twistor actions which more ambitiously connects to celestial holography, see Kmec, Mason, Ruzziconi and Sharma, S-algebra in Gauge Theory: Twistor, Spacetime and Holographic Perspectives, arxiv:2506.01888.

Supervisor: Dr Nick Jones

(nick.jones@maths.ox.ac.uk)

Title: Symmetry-resolved entanglement in quantum chains

Abstract:

Entanglement entropy (EE) is of fundamental importance to our understanding of ground states of quantum many-body systems. The aim of this dissertation is to review some recent developments in the area of symmetry-resolved EE - the EE of a particular symmetry sector of the ground state. Directions one can take include calculations in exactly-solvable lattice models, and numerical investigation of the ground states of different symmetric Hamiltonians.

Prerequisites:

Part B Further Quantum Theory (or equivalent)

Relevant courses:

Quantum Field Theory, Random Matrix Theory.

Reading:

P. Calabrese and J. Cardy 2009 J. Phys. A: Math. Theor. 42 504005

M. Goldstein and E. Sela 2018 Phys. Rev. Lett. 120, 200602

R. Bonsignori, P. Ruggiero and P. Calabrese 2019 J. Phys. A: Math. Theor. 52 475302

S. Fraenkel and M. Goldstein J. Stat. Mech. (2020) 033106

N. G. Jones J. Stat. Phys., 188, 28 (2022)

Supervisor: Prof Renaud Lambiotte

(renaud.lambiotte@maths.ox.ac.uk)

Title: How Directed Are Directed Networks?

Abstract:

Many real-world networks are composed of directed edges that are not necessarily reciprocated. While several algorithms have been generalised to the case of directed networks, conceptual challenges, i.e. to quantify the level of hierarchy (and its impact on dynamics). In this project, we will investigate the notion of hierarchy in directed networks from different, possibly complementary viewpoints. The two main challenges will be to design embedding techniques allowing to rank nodes according to their importance, while grouping "similar nodes", and to investigate how hierarchies impact on linear dynamics, more specifically via the non-normality of the coupling matrices.

Prerequisites:

Taking the course C5.4. Networks is recommended.

Reading list:

MacKay, Robert S., Samuel Johnson, and Benedict Sansom. "How directed is a directed network?" Royal Society open science 7.9 (2020): 201138.

Lambiotte, Renaud, and Michael T. Schaub. Modularity and Dynamics on Complex Networks. Cambridge University Press, 2021.

Title: Dynamics and structure of complex-weighted networks

Abstract: Complex numbers define the relationship between entities in many situations. A canonical example would be the off-diagonal terms in a Hamiltonian matrix in quantum physics. Recent years have seen an increasing interest to extend the tools of network science when the weight of edges are complex numbers. The purpose of this project will be to explore further the structure and dynamics of such complex-weighted networks. We will consider linear processes such as consensus dynamics and random walks, from which build algorithms to extract information from the systems. Relatedly, the student may consider problems where edges are equipped by linear transformation, thus going beyond rotations in two dimensions.

Reading list:

Tian, Yu, and Renaud Lambiotte. "Structural balance and random walks on complex networks with complex weights." SIAM Journal on Mathematics of Data Science 6.2 (2024): 372-399.

Tian, Yu, et al. "Matrix-weighted networks for modeling multidimensional dynamics." arXiv preprint arXiv:2410.05188 (2024).

Supervisor: Dr Seyed Moosavian

(farooqh.moosavian@maths.ox.ac.uk)

Title: Quantum Theory of Gravity

Abstract: Quantum gravity has remained elusive for nearly a century, dating back to the earliest attempts by Pauli, Heisenberg, Rosenfeld, Bronstein, and others in the 1930s. Despite numerous efforts on many fronts, this arguably most profound challenge at the foundation of theoretical and mathematical physics has not yet yielded. In fact, it is fair to say that all existing approaches have not even managed bending this very thick rod, let alone cracking it [1, 2].

This project aims to delve into one of the most important series of papers in the history of the subject: the trilogy Quantum Theory of Gravity I, II, and III by Bryce DeWitt, a (if not the) principal architect of modern research in the field [3, 4, 5]. These papers encompass the canonical and covariant approaches to the quantization of gravitational interactions, applications of these methods, the derivation of the famous Wheeler–DeWitt equation, the problem of time, the many-worlds interpretation of quantum mechanics, the principal challenges that remain in completing the program, and much more.

Among DeWitt's many contributions, which can be read about in [6], two stand out for their foundational importance in quantum field theory and quantum gravity alike: the development of the background-field method, and the systematic formulation of gauge-fixing in the path integral formalism. The background-field method allows one to maintain manifest gauge (and diffeomorphism) invariance while quantizing fluctuations around a fixed classical background—crucial for any sensible approach to perturbative quantum gravity. Closely related, DeWitt's elegant and general approach to gauge fixing—

via what would become known as the Faddeev–Popov procedure—originates from the very ideas developed in these papers. Unlike most modern literature on the subject, this series is highly technical: there are no random or vague assumptions made to simplify or obscure the main challenges. The attempt is to build everything for the quantization of gravity in four spacetime dimensions from scratch. As such, the project is correspondingly demanding—certainly not for the faint of heart. Anyone interested is strongly encouraged to browse the papers in advance to get a sense of their scope and depth. If you remain interested after that, please contact me for further discussion.

For a Master's student, the goal will be to absorb as much as possible—not necessarily by reading the entire trilogy, but by seriously engaging with its core ideas and reflecting on potential questions that might be addressed using these methods. The dissertation should include:

1. A detailed review of one of the main topics or methods from the trilogy;
2. An exploration of one question that can be pursued using that reviewed topic or method—this could either be a question that has already appeared in the literature, or, if the student is ambitious, something entirely new.

The choice in (2) depends on whether the student would like to complete a one-unit or two-unit dissertation.

Please Notice: If your main goal is to perform quick computations, publish a paper immediately, or engage with the latest hot and mainstream developments, then this project may not align with your interests. Its purpose is to build a strong and lasting foundation in the subject, one that you can draw upon in your future studies, if you are inclined to pursue it further. For clarity, there is no supersymmetric content in this project.

Reading list:

- [1] R. P. Feynman, F. B. Morinigo, W. G. Wagner, B. Hatfield, J. Preskill and K. S. Thorne, Feynman Lectures on Gravitation. Addison–Wesley, Jun, 1995. 1
- [2] R. P. Woodard, How Far Are We from the Quantum Theory of Gravity?, Rept. Prog. Phys. 72 (Jul, 2009) 126002, [0907.4238]. 1
- [3] B. S. DeWitt, Quantum Theory of Gravity. I. The Canonical Theory, Phys. Rev. 160 (Aug, 1967) 1113–1148. 1
- [4] B. S. DeWitt, Quantum Theory of Gravity. II. The Manifestly Covariant Theory, Phys. Rev. 162 (Oct, 1967) 1195–1239. 1
- [5] B. S. DeWitt, Quantum Theory of Gravity. III. Applications of the Covariant Theory, Phys. Rev. 162 (Oct, 1967) 1239–1256. 1
- [6] S. M. Christensen, ed., Quantum Theory of Gravity, Essays in Honor of the 60th Birthday of Bryce C DeWitt. CRC Press, 1984. 1

Supervisor: Dr Thomas Spieksma

(thomas.spieksma@physics.ox.ac.uk)

Title: Interactions of black holes crossing through active galactic nuclei

Abstract: Extreme-mass-ratio inspirals (EMRIs) are expected to be key sources for the future space-based gravitational-wave observatory LISA, yet their formation channels are poorly understood. One promising scenario involves stellar-mass black holes being captured by active galactic nuclei (AGN). These captures occur at large distances from the central black hole, and their subsequent evolution must be modelled to predict when and how they enter the LISA sensitivity band. In this project, the student will study the interaction of the captured black hole with the AGN, and determine the expected orbital parameters (such as inclination and eccentricity) by the time the system reaches the relativistic regime.

<https://arxiv.org/abs/astro-ph/9910401>

<https://arxiv.org/abs/2212.11301>

<https://arxiv.org/pdf/2308.09129>

<https://arxiv.org/abs/2504.08033>

B - Course Calendar

MICHAELMAS TERM	
0th week	Induction Class sign-up for Part C Maths open on Moodle
Week 1	Michaelmas term lectures begin Friday (17th October): Deadline to request approval for non-curriculum subject
Week 2	Part C Maths classes start Class sign-up for Physics classes open on TMS Friday (24th October): Deadline for MMathPhys students to request transfer back to their original degree programme (MMath/Mphys/MMathPhil)
Week 3	Thursday (30th October): Exam entry for Hilary exams open
Week 4	Dissertation application form open Thursday (6th November): Deadline to complete exam entry for Hilary exams Friday (7th November): Deadline to request exam adjustments in time for Hilary exams Deadline to change class times for both Maths (Moodle) and Physics (TMS)
Week 5	
Week 6	Monday (17th November): Deadline to apply for a dissertation
	Tuesday (18th November): Jobs for Mathematicians Fair, 4-6pm Mathematical Institute
Week 7	
Week 8	Approval for dissertations sent out
Christmas Vac	
HILARY TERM	
0th week	Exams Class sign-up for Part C and bespoke MTP Maths courses open on Moodle
Week 1	Hilary term lectures begin
	Thursday (22nd January): Exam entry for Michaelmas homework, Hilary submissions and Trinity exams open
Week 2	Class sign-up for Physics classes open on TMS
	Thursday (29th January): Deadline to complete exam entry for Michaelmas homework, Hilary submissions and Trinity exams
Week 3	
Week 4	Friday (13th February): Advanced Philosophy of Physics mini-project titles released Deadline to change class times for both Maths (Moodle) and Physics (TMS) Deadline to make new exam adjustments requests in time for Trinity exams
Week 5	Results of Hilary term exams released
Week 6	
Week 7	
Week 8	Friday (13th March): Mini-projects and take-home exam released

Easter Vac	Wednesday (18th March): Collisionless Plasma Physics take-home exam submission deadline Friday (3rd April): Galactic and Planetary dynamics mini-project submission deadline Friday (17th April): C5.4 Networks mini-project submission deadline
TRINITY TERM	
0th week	Trinity exams Class sign-up for bespoke MTP Maths courses open on Moodle
Week 1	Trinity term lectures begin
Week 2	Class sign-up for Physics classes open on TMS
Week 3	
Week 4	Friday (22nd May): Adv. Phil. of Physics mini-project submission deadline Deadline to change class times for both Maths (Moodle) and Physics (TMS)
Week 5	
Week 6	Monday (1st June): Dissertation submission deadline
Week 7	Part C Maths and Physics exams and some bespoke MTP exams
Week 8	
Long Vac	The provisional date for the Final Exam Board meeting is 17th July. Your college must submit an MCE by noon the previous day if you wish it to be considered by the Examiners at the meeting. Your college may submit an MCE up to 1 month after the Final Exam Board meeting. It will be at the Proctors' discretion whether or not they forward it to the Examiners for consideration.
	Final exam results and classifications will be released towards the end of July. DO NOT BOOK A GRADUATION CEREMONY UNTIL YOU HAVE RECEIVED YOUR EXAM RESULTS