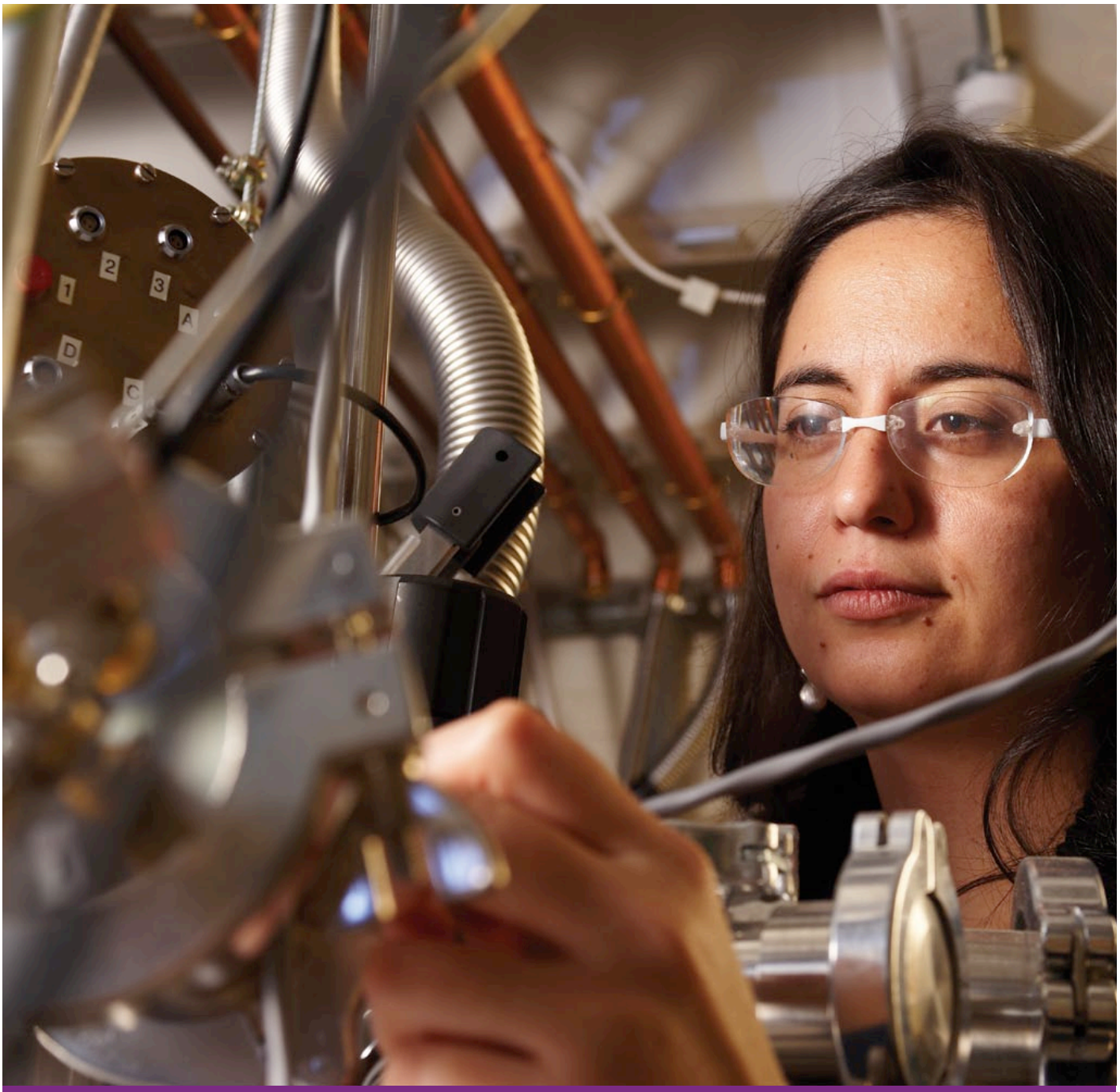


Department of Physics
Undergraduate Studies

Royal Holloway
University of London

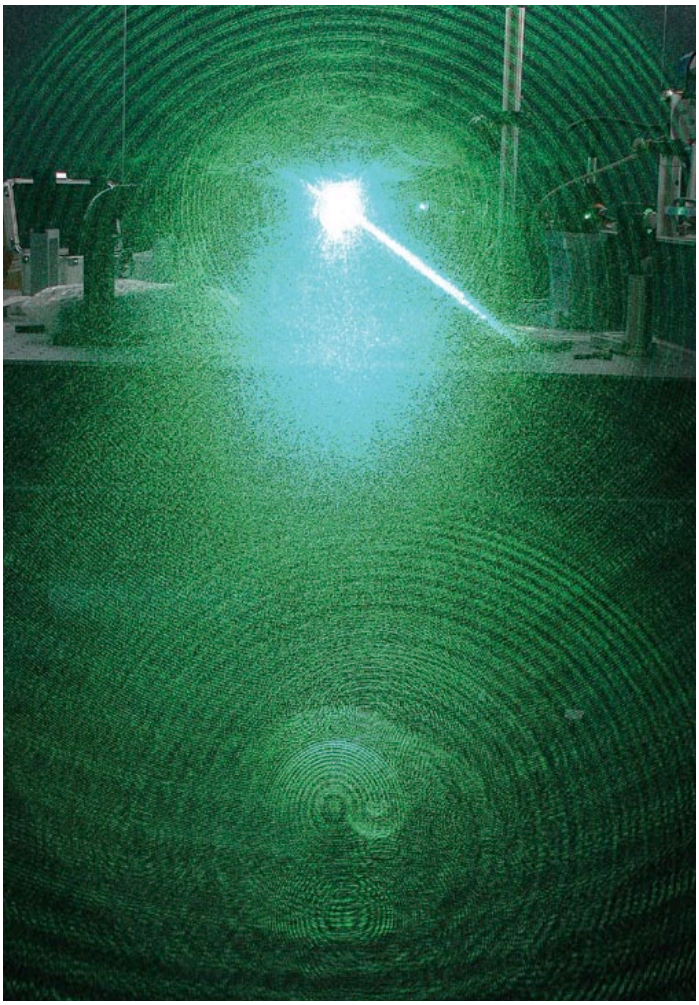
Royal Holloway
University of London

Royal Holloway is widely recognised on the world stage as one of the UK's leading teaching and research universities. One of the larger colleges of the University of London, we are strong across the sciences, social sciences, arts and humanities. Our 8,500 students work with internationally renowned scholars in 20 academic departments. The University of London degree gained by our talented, high-achieving graduates is valued the world over.

As a cosmopolitan community, with students from 130 countries, we focus on the support and development of the individual. Our friendly campus, just 19 miles west of central London, provides a unique environment for university study. Campus life revolves around the Students' Union, which runs over 100 societies and sports clubs, and we are recognised as London's best sporting college.

Physics

Royal Holloway is a major centre for Physics study and research. We pride ourselves on creating a vibrant, friendly and cultured atmosphere, allowing students to progress from the founding concepts of Physics to working side by side with internationally respected scientists. The Department has an outstanding international reputation for its research and an excellent record of teaching from its origins in the late 1800s.



Contents

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This brochure is designed to complement Royal Holloway's Undergraduate Prospectus and information on the Department's website at **www.rhul.ac.uk/physics/**

It is also available as a PDF at:
www.rhul.ac.uk/studyhere/prospectus/brochures

Why study Physics?

Our students often explain that their enthusiasm to study Physics stems from a yearning to learn about the Higgs particle, dark matter, nanotechnology or just a wide ranging curiosity about how things really work. Other motivations arise simply from a desire to emerge with one of the most respected qualifications available. You will no doubt have your own reasons for wishing to study Physics, but whatever your motivation, our aim is to inform and delight in the study of Physics, the most fundamental of the sciences.

While studying Physics at university you will come to understand new concepts and paradigms. You will develop the deep conceptual framework that enables a profound understanding and appreciation of nature. You will also discover that Physics is a multi-faceted subject, acquiring experimental and mathematical skills that underpin a wide and deep knowledge of natural phenomena. A logical knowledge structure and a deep appreciation of nature are perhaps the key features of Physics and physicists, pervading the subject from first principles to research level.

This array of knowledge and skills provides a secure base for solving Physical problems, founded on understanding and evaluating experimental evidence through to making logical inferences and testing your deductions. Together with strong foundations in mathematics, computing, practical skills, theoretical understanding and critical appraisal, a degree in Physics provides the strongest and most general scientific education.

Knowledge and understanding are not the only results of a degree in Physics; it is a degree qualification that employers find extremely attractive. The training in logical thinking, the ability to analyse a problem from first principles in an abstract, logical and coherent way, and to define a problem and then solve it, are critically important skills. These skills transcend your particular knowledge of physical phenomena and are the reason why Physics graduates go on to excel in all types of employment, including those only loosely related to Physics such as management and finance, as well as scientific, technical, engineering and teaching careers. In this way, a degree in Physics helps keep your future employment options both bright and open.

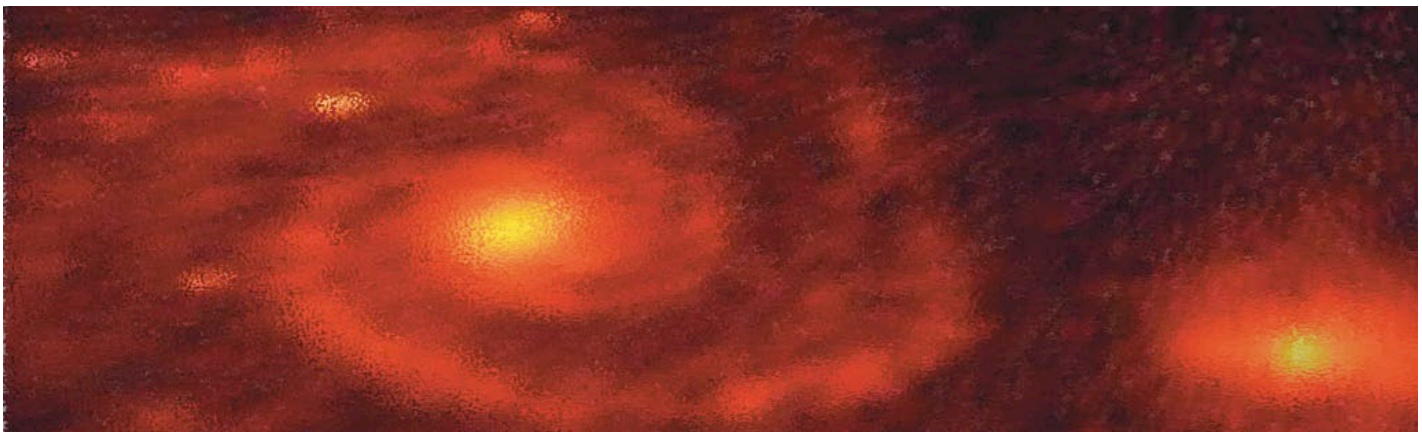
Student profile
Affelia Wibisono – 1st Year

Friendly, approachable lecturers, a shining reputation and excellent facilities. These are some of the things I looked for whilst choosing my shortlist of Universities and all can be found at Royal Holloway.

As soon as I stepped into the department on my first visit, I knew that I wanted to be part of the group of students who were passionate about studying Physics and were also having a good time whilst doing so. When I came back in September all of the staff and students made me feel very welcome and I fitted in almost immediately. I soon found out that because of the moderate size of the department, it is a very close-knit community where everyone is welcomed.

As students, we have a good rapport with the lecturers. They know us as individuals and by name instead of as a group and a face among a sea of others. They genuinely care about our progress and well-being and teach us to become physicists rather than to pass exams. The open-door policy means that I can ask lecturers for help as soon as I have any problems.

Coming to Royal Holloway has helped me grow as a person and as a physicist and I recommend it to anyone considering studying Physics at university.



Welcome

Thank you for considering studying Physics at Royal Holloway. In choosing Physics you may have in mind your interest in the subject, your desire to be challenged or simply your wish to understand this, the most fundamental of all sciences. Or perhaps you are thinking of your possible contribution to the challenges that our civilisation faces in the 21st century. Whatever motivates you, we pride ourselves in being an enthusiastic and highly respected department and a champion of the subject of Physics.

World experts in our department are trying to answer some of the most fundamental and important questions; Does Quantum Mechanics really apply to cats? What are the consequences flowing from the discovery of the Higgs Boson? Can we detect the so-called 'dark matter' that forms most of our universe? Can we build a quantum computer or discover better energy storing materials? These same experts form our teaching staff and all have international reputations in their field. Our aim is to convey a deep understanding and the excitement we feel for the subject of Physics.

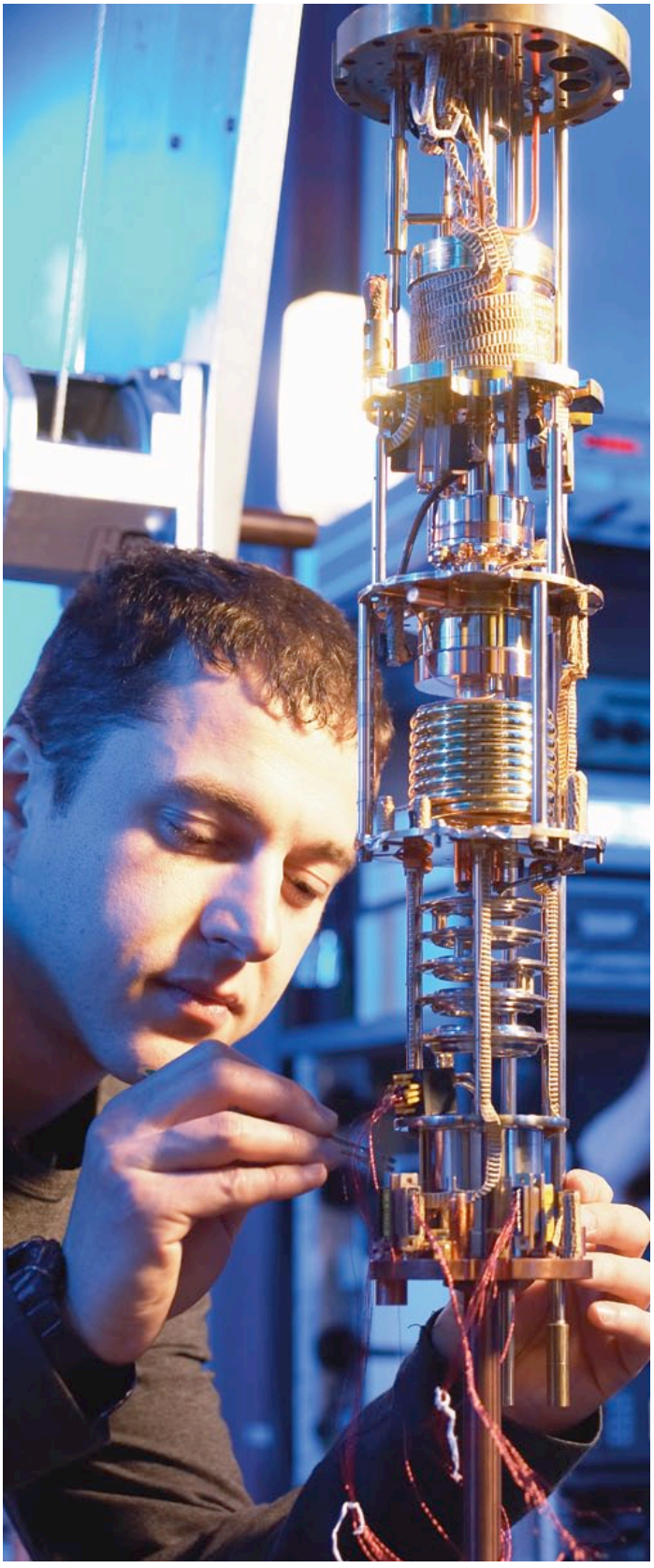
University is also a place for development in other ways; you will emerge after three or four years with first-class skills, lifelong friends and a degree that commands great respect and excellent prospects. Your choice of subject and institution will have an enduring influence on both your personal and professional lives. Royal Holloway provides a very special educational experience: a choice of options worthy of one of the UK's largest teaching departments, smaller class sizes, small group teaching and a beautiful, safe, green campus within easy reach of central London.

All suitable applicants (and their parents) are offered the chance to visit us before making a final choice and we would recommend that you do so. We hope that you find everything in this brochure that you need to make a well-informed decision, but a personal visit informs in a way that a brochure cannot.

Whatever your choice, I wish you every success.

Professor Brian Cowan
Head of Department

Physics at Royal Holloway
continued



We pride ourselves on providing the very highest quality of teaching and learning. Our overall aim is to allow students to develop as well-rounded, enthusiastic and highly capable physicists in an environment that emphasises fundamental understanding, achievement, the development of specific and transferable skills and caters for the individual interests of the student. Royal Holloway is a medium sized Department of Physics in UK terms. Our desire not to grow too large is based principally on our aim of delivering the very high quality education that arises from a favourable staff-student ratio and sensible class sizes. Our ability to maintain a department of this size arises in part from our excellent record of research funding. This approach has a number of benefits for our students:

- an emphasis on the most up to date and interesting modern physics taught in an understandable and rigorous style;
- a wide range of effective teaching and learning methods including small group tutorials, problem classes, lectures, laboratory and computing assignments, teamwork, and one-to-one teaching in laboratories;
- an 'open-door' approach that ensures that access to help from lecturers and tutors is readily available;
- appropriate lecture class sizes – questions during lectures are not only possible, but encouraged. You won't need to watch your lecturer on a screen in an overflow room;
- final year projects based on one-to-one supervision in our research laboratories;
- a full range of Physics degree programmes, including three-year (BSc) and four-year (MSci) degrees, with flexibility to transfer between programmes;
- degree programmes based on a modular system that maximises choice of options;
- well-equipped and modern teaching and research laboratories, computing, library and lecturing facilities;
- lecturers who are all internationally recognised experts in their fields;
- access to employment, sponsorship and award schemes in partnership with industry and academia;
- opportunities to participate in extensive outreach activities, including the long running annual Science Festival;
- a comprehensive system of prestigious summer internships.

"Since arriving here I have been very impressed by the high quality of the teaching and the approachability of my lecturers. The department also provides its students with many valuable opportunities that I have found very useful, such as funded work placements inside and outside the department."

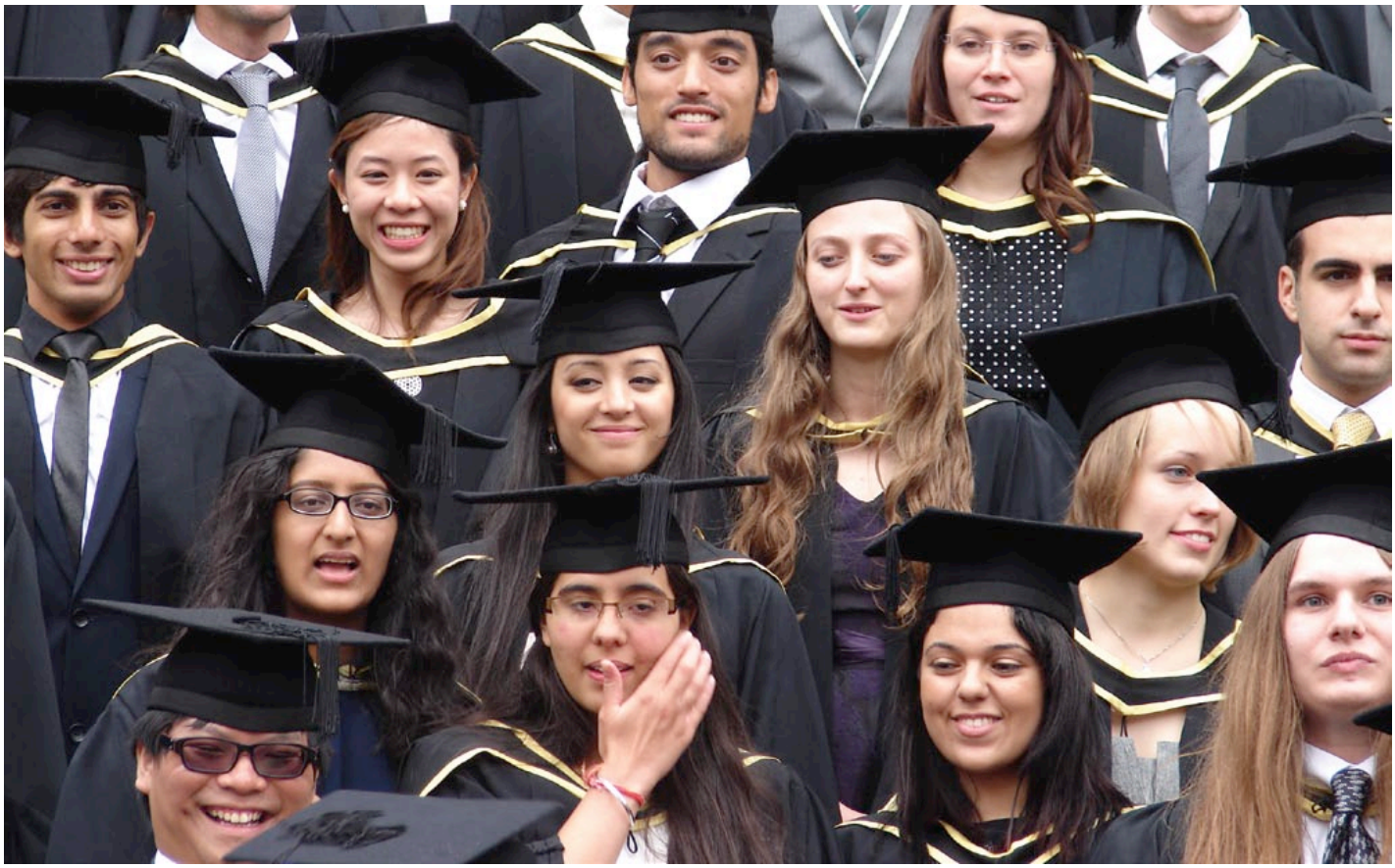
Katie Porsch, 4th year MSci

- an emphasis on transferable skills, such as communication and presentation, teamwork, self-reliance and critical thinking: skills highly valued by prospective employers as well as being important for scientists;
- access to seminars and special lectures– activities intended to raise awareness of the most interesting and current aspects of Physics not normally covered in an undergraduate curriculum;
- the Physics Society: PhysSoc is the students' own society. They organise days and nights out, social and scientific interest events and provide one of the mechanisms by which the 'student voice' is heard. It is one of the first points of contact on arrival, allowing students to immediately help each other out;
- Quality. We are enormously proud of our record and our students. *The Guardian's* 2012 university guide ranks the department 5th out of all UK Physics institutions. We are consistently rated very highly by the National Student Survey, an independent and anonymous survey of all recent UK graduates in all institutions and disciplines – a wonderful independent endorsement of our approach by our own students.
- our students have won a wide array of Departmental, College and University of London top achievement prizes and scholarships, year by year and for overall undergraduate excellence.

Royal Holloway is a constituent college of the world-respected University of London and your degree will be awarded from the University of London. Educational standards are not only guaranteed by our own QAA audited standards, but also by compliance with University of London regulations. Our degree programmes are also fully accredited by the Institute of Physics (leading eventually to professional status for our students) and subject to scrutiny by External Examiners.

Uniquely, our MSci final year is taught in collaboration with the other Departments of Physics in the University of London (King's College, Queen Mary, University of London, and University College, London). At intercollegiate lecture courses you will meet and interact with students from the other colleges in the consortium and take the same exams, typically travelling twice per week during term-time to the central London base (expenses paid). Intercollegiate collaboration provides a more extensive choice of study options than any you will find at the largest Physics teaching departments in the UK, and by studying at Royal Holloway, you will at the same time enjoy the excellent personalised teaching that our staff–student ratio enables.

We are a friendly, professional department where students and staff mix daily over tea and coffee, discussing everything from the surprises of quantum mechanics to planning nights out in London. By the end of your studies, you will most likely be on first name terms with several members of staff.



Physics at Royal Holloway
continued

Our Location

Royal Holloway is based near the town of Egham in Surrey, about 40 minutes from London Waterloo by train. Access to central London is both easy for social activities and necessary for our final-year intercollegiate teaching. London's Heathrow airport is a short drive (10 minutes to Terminal 5) and there is excellent access to other airports, London underground, UK motorways (we are five minutes from the M25) and mainline rail, making national and international travel very easy indeed.

Travel links to London and elsewhere are excellent, so you might be surprised to discover that we are based on a beautiful, peaceful and safe semi-rural campus, five minutes walk from Windsor Great Park, surrounded by country pubs, history (Magna Carta was signed at Runnymede; Windsor Castle is close by), national landmarks such as Wentworth and Sunningdale Golf Clubs, Ascot Racecourse, Chobham Common National Nature Reserve, the shopping centres of both London and Reading and even Thorpe Park theme park and Legoland!

There is a wide variety of student accommodation available including extensive recently built halls of residence on campus and newly renovated rooms in the glorious Founder's Building. Undergraduate students who firmly accept an offer by the UCAS deadlines are prioritised for a place in hall for their first year.

The Department

Underpinning the academic achievements, the scholarly research and the friendly and supportive nature of our staff and students, the heart of the Department is the Physics Resource Centre. The PRC acts not only as a common room, but also as a centre for the entire department, hosting everything from staff and student meetings and study facilities to games tournaments and end of term parties.

Although the Bedford Library, just 50m away from the Department, contains a large collection of Physics texts, the PRC provides ready access to a mini library of course texts and other study materials. There is also a small kitchen for self-service tea, coffee and the occasional microwave meal, supplementing the nearby cafés. Everyone from senior professors to first year undergraduates mingle in the PRC, where an informal atmosphere promotes discussion, joint study, and a chance to relax.

On the roof of the department one can find the astronomical dome. Our location, well away from the light pollution of the big city, allows our telescopes to provide the best observational astronomy in the University of London, housed in a dome dedicated to undergraduate study. Elsewhere, a new video-conferencing facility has recently been constructed. Intended primarily for research use, it is also used for participating in seminars and lectures at other institutions within the SEPNet consortium and supplementing the University of London intercollegiate teaching.

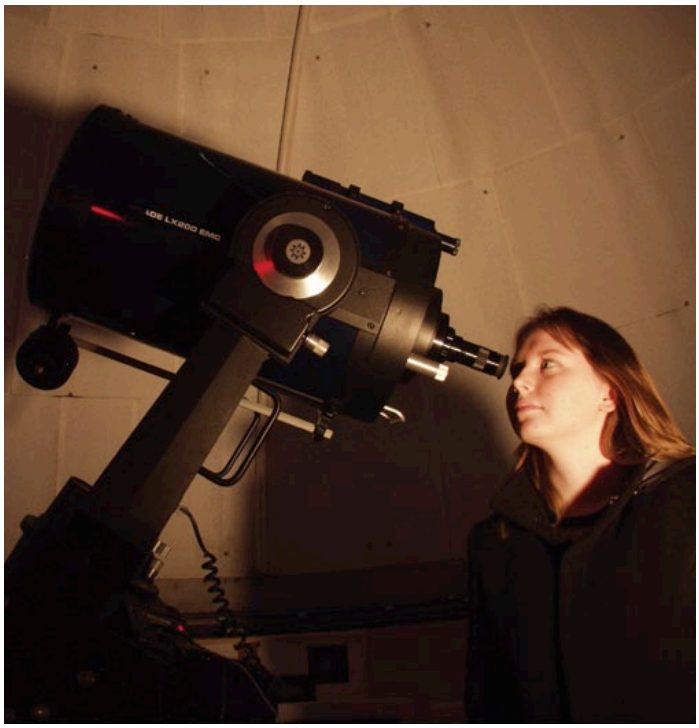
Our Teaching Labs are a key element of the undergraduate programmes. Located on the top floor, they provide a light and pleasant environment in which to discover the pioneering experiments of the great masters of Physics and to learn the measurement skills and data analysis techniques that are the foundation of modern Physics. Together with dedicated technical help, the teaching laboratory is usually very busy with students doing experiments and academic staff and postgraduate demonstrators teaching.

In later years of the degree programme, you will often be based in one of our extensive and well-funded research labs. Final year projects are usually undertaken on an aspect of one of the department's major research activities. You may find yourself using the GRID computers to analyse real data from a particle physics experiment, attempting to guide a beam of fundamental particles in a High Energy Particle Physics collider, fabricating a nano-device in our extensive suite of nanofabrication clean rooms, or cooling a piece of metal to within a fraction of a degree Kelvin above the absolute zero to explore sophisticated quantum properties of superconductors, electron liquids or superfluids.

Near the Department, Royal Holloway's extensive and recently refurbished library, The Bedford Library, provides all of the facilities expected of a modern university library, especially comfortable reader spaces, easy access to book and journal stocks and a vast range of information technology. Students also have access to other University of London libraries, including Senate House Library in central London.

Several PC labs exist with full student access across campus, including a suite of PCs within the Physics teaching laboratory that house specialist physics hardware and software.

Last but not least, campus life is considerably enriched by the activities of the Students' Union, which provides a forum for sport, community action, music, relaxation, social events and groups and societies offering a starting point for every conceivable interest, complete with a building to host all of this right next to the Department of Physics. Wednesday afternoons are kept free of teaching commitments so that sports or other interests may be pursued.



Dr James Nicholls
Director of Undergraduate Studies

Teaching:

As Director of Undergraduate Studies I have overall responsibility for the structure and the smooth running of teaching in the department. I also teach on two third year courses, both of which have a strong overlap with my own research in semiconductors. In one of these courses, the students write a short dissertation on a topic in condensed matter physics – the students very much enjoy this independent study of the latest research literature. It is enjoyable and sometimes very challenging, for the lecturer as well!

Research:

My research interests lie in the exotic properties of 'low-dimensional systems'; in practice this means looking at planes (2D), wires (1D) or small dots (0D) of a metal or semiconductor. The Physics in these systems can be astonishingly different from the usual 3D world, particularly in small devices where the quantum wave-like properties of electrons can be explored at low temperatures.

Admissions and entry requirements

The Department admits about 70 students per year. We look for the most talented and enthusiastic candidates and we encourage applications from students from a diverse range of backgrounds.

All applications, including international applications, take place via the Universities and Colleges Admissions Service (UCAS) and are made online at **www.ucas.ac.uk** where searches for particular courses and institutions may be also be performed and applications tracked.

All suitable applicants are invited to visit the Department for an interview, usually on an Open Day dedicated to applicants. This also provides an opportunity to talk to members of staff and students, view our teaching and research facilities, explore the College and find out more about studying at Royal Holloway. We also hold regular Open Days for prospective students still considering or reviewing their application.

Generally, applications are considered on the basis of predicted grades, previous achievements, references and performance at interview. Typical offers ask for three grade A's at A2 level and must include Mathematics and Physics. Additionally, an A* is required in Mathematics for entry to the Mathematics & Physics degree programmes. Any subject may be chosen as the third A level, but preference in final decisions will be given to those studying Further Mathematics, science and other intellectually demanding subjects. We admit students to both MSci and BSc degree programmes on equal terms. Offers of a place for study are usually conditional on the outcome of the A-level examinations, unconditional offers may be made to candidates who are already qualified. Equivalent qualifications are also welcome, for applicants studying for the International Baccalaureate, typical offers are 36 points overall, with scores in Mathematics and Physics of 6 at higher level. For further information or advice about your own specific qualifications, circumstances or application, or about any other aspect of becoming a student, please contact the Admissions Tutor.

International students

Applications from overseas students are welcome; Physics is, in essence, universal. We draw many of our academic and research staff from across the globe and the presence of international undergraduates enriches the student experience for all. Each year a number of non-UK students are admitted to our full degree programmes and many other international students study for limited times through Erasmus or other exchange programmes. Our proximity to London, superior UK and international travel links, the University of London degree and our excellent reputation are all attractions. For entry we seek qualifications that demonstrate skills that are broadly equivalent to the UK A levels, in particular in mathematics. For a decision on whether your qualifications are suitable for entry, please send copies of your Physics and Mathematics syllabus to: physics@rhul.ac.uk.

Female applicants

In the interests of parity, and in light of our institutional history, we very strongly encourage and support female applicants. Royal Holloway, University of London was formed by a merger of Royal Holloway College and Bedford College. Both of these institutions had their origins as pioneering women-only educational establishments in the 19th century, though both institutions had been admitting male scholars for many decades at the time of the merger. The Department of Physics has received a number of awards for our efforts to promote both equality and women in science, including the "Juno Champion" award from the Institute of Physics and the prestigious "Athena SWAN Silver" Award (the highest level achieved by any Physics department in the UK). Within the Department of Physics the female admission rate compares well with the national average in Physics and ensures that each year a large cohort of female students are studying physics. We also find that male and female students perform equally well in their studies of physics.

Mature Students

Each year we accept a number of mature students. In such cases we look favourably at existing qualifications. The principal consideration is to ensure that applicants can cope with the level of mathematics encountered in the first year, but enthusiasm and commitment to study are also key considerations. Mature applicants are strongly encouraged to explore their options directly with the Admissions Tutor.

Science Foundation Year

Our Science Foundation Year is a one-year course designed for successful students who, for one reason or another, find themselves with inappropriate qualifications. For example, applicants who have become interested in studying Physics at degree level only after choosing their A level subjects. A number of students progress from our Science Foundation Year to the degree programmes each year. Students progressing via the Science Foundation Year have generally shown themselves to be very well prepared and go on to be highly successful in their degree level studies.

Deferred entry

Applications from candidates who wish to take a gap year between leaving school and entering university are welcomed. UCAS operates an application route especially to cater for such students, ensuring that your place at university the following year is guaranteed whatever you plan to do with your time.

Formal applications are made online via **www.ucas.ac.uk**. An email to enquiries@ucas.ac.uk will generate an automatic response with general information and guidance on UCAS procedures.

Those without web access should contact:
Customer Contact Centre, UCAS, P.O.Box 28, Cheltenham, Gloucester GL52 3LZ, UK T: +44 (0)871 468 0468
Mon – Fri 8:30am to 6pm UK time

The UCAS code for Royal Holloway, University of London is R72. The relevant course codes for Physics degree programmes are shown in the table on page 12.

Dr Phil Meeson
Admissions Tutor

Teaching:

I teach all levels of undergraduate and postgraduate students from 1st year classical mechanics and relativity (the Physics of Einstein) to final year PhD students. My final year project students may explore macroscopic quantum effects, fabricate nano-devices or make use of refrigerators capable of cooling to the milliKelvin regime. At all levels I try to bring a deep appreciation and understanding of fundamental physics and I find I learn as much from students as they learn from me. A particular interest of mine is a collaboration with the National Physical Laboratory where, because of our overlapping research interests, we place a number of students for summer internships each year. I also run a placement scheme for students to visit local schools to develop their science communication skills and to gain some experience of the subtlety of teaching. I have been both deeply pleased and amazed at the skill and satisfaction that our students display as ambassadors for the College.

Research:

I am interested in the foundations and applications of quantum mechanics. In our extensive nanofabrication facilities we are able to manufacture tiny electronic devices made of superconductor. In these materials electrons can flow without resistance, much as the electrons circulate in an atom. We are therefore able to build artificial atoms that obey all of the rules of quantum mechanics but some 10,000 times bigger! Man-made atoms allow us to test many of the assumptions of our most fundamental physical theory, quantum mechanics, including a direct attack on the issue of whether or not it only applies to small atom sized objects! A key application of this technology is to the construction of a computer that operates on quantum principles – a quantum computer. Many of us in the department have engaged with this global Physics challenge with much success.

Degree structure

Degree Programme Options and Course Codes

Single Honours Programmes	
4 year degree programmes	**3 year degree programmes**
Physics MSci (F303)	Physics BSc (F300)
Theoretical Physics MSci (F321)	Theoretical Physics BSc (F340)
Physics with Particle Physics MSci (F372)	Physics with Particle Physics BSc (F370)
Astrophysics MSci (F313)	Astrophysics BSc (F511)
Experimental Physics MSci (F313)	Experimental Physics BSc (Fxxx)
Joint Honours Programmes	
Mathematics & Physics MSci (GFC3)	Mathematics & Physics BSc (GF13)
Physics as a Major Subject	
	Physics with Music BSc (F3W3)
	Physics with Philosophy BSc (F3V5)
Foundation Programme	
Science Foundation Option Physics (F308)	

All degree programmes in Physics are accredited by the Institute of Physics.

Royal Holloway offers a range of degree programmes in Physics, including the possibility of studying other subjects in addition to Physics. Physics itself may be studied with an emphasis on pure, experimental or theoretical physics and in three or four year formats.

The most important choices are between:

- the MSci, a four-year programme and the BSc, a three-year programme
- a straight Physics programme or one with an emphasis on a particular theme or topic in Physics
- a full Physics degree, or a programme incorporating another subject

Your choice of degree programme depends on your interests as well as your career aspirations. The information below will help you identify the most appropriate programme. However, we do understand that after submitting your application, or after arrival, your interests may change and so we try to ensure that it is possible to switch between degree subject programmes and between BSc and MSci programmes, as late as the end of the second year of study.

MSci or BSc?

The choice of a four-year MSci or three-year BSc degree is a personal one. However, we find that our students generally fall into one of two classes: those who plan to use their Physics degree in a professional capacity, either in science based employment or through further study at PhD level, and those who will use their degree in Physics as a platform to gain employment in a non-scientific area. The latter group generally choose the shorter BSc, preferring to use the time released to gain professional qualifications or for employer training schemes, for instance, in law, finance or management. But these are generalisations, and the choice is yours.

The MSci degree provides for the study of Physics at a substantially deeper level than the BSc and this is the degree of choice, not only for those intending to remain in science, but also for those that simply wish to continue their studies a little longer. The fourth year of the MSci degrees, while based at Royal Holloway, also offers a wide variety of 4th year intercollegiate options that may be taken at partner institutions (UCL, KCL and QMUL) in central London. At intercollegiate lecture courses you will meet and interact with students from the other colleges in the consortium and take the same exams. Intercollegiate collaboration creates in effect the largest department of Physics in the UK with an extensive choice of study options. By studying at Royal Holloway, you will at the same time enjoy the excellent personalised teaching that our staff–student ratio enables. All MSci programme studies culminate in a final year Major Project that builds on and consolidates experimental, theoretical and other research skills. The project is usually undertaken in the research laboratories embedded within a research group and lasts throughout the two teaching terms. A literature review of a selected topic of research level Physics is also undertaken in the final fourth year. The emphasis on research level activity through individual tuition is a feature of our excellent staff-student ratio and brings a level of experience and competence to our graduates that we are particularly proud of.

"The department has a strong community feel and allows you to develop a friendly relationship with both the staff and students. I greatly appreciate the opportunities I have had to develop as a scientist through meeting lecturers who are active researchers at the forefront of their fields and my time here has helped me gain the skills and the confidence I needed to pursue a career in physics."

David Bowman, 3rd year MSci

The BSc degree programme, like the MSci degree, provides an excellent and thorough grounding in all the core topics that a graduate in Physics would be expected to have encountered. The BSc is the degree of choice for those wishing to obtain a highly respected qualification embodying mathematical, experimental, conceptual and computing skills, and wishing to use that qualification as a springboard to a career. The third and final year facilitates the study of a range of specialist and advanced topics through a wide choice of optional courses and incorporates a final year project taken over a single term that allows access to some research level experience.

For those applicants who are uncertain of their choice between BSc and MSci, we advise choosing the MSci on entry, since it is usually simpler to switch to the BSc at a later date than to have to find the extra funding when switching from BSc to MSci. That said, many students who initially choose the BSc do switch to the MSci when they discover how much they are enjoying their studies. Students entering the BSc programme may transfer to the MSci programme at the end of the first or second year of study, provided certain standards of attainment are achieved. We require MSci students to maintain a certain minimum level of achievement for progression on the MSci programmes.

The MSci forms an integrated four-year degree. It is known by different names (often MPhys) at different universities. The MSci should not be confused with the MSc, which is usually a one-year stand alone course that may be chosen following a BSc or MSci degree and which generally focuses on some specialisation or skill set conversion.

Applicants considering choosing between the Single Honours degree programmes should note that the straight Physics MSci and BSc programmes (UCAS codes F303 and F300) allow you to choose options later in the course that can make the content of your degree very similar to or even equivalent to the specialised degree, except in name. For those not certain of their interest in a particular Physics specialisation, we would recommend choosing the straight Physics MSci or BSc programmes, thus retaining more flexibility to choose optional courses that reflect your interests later. This approach is not appropriate for degree programmes with a non-Physics element; in these cases, the non-Physics courses are taught in the companion department and applicants with these interests should choose these degree programmes directly.

Dr Veronique Boisvert
Senior Tutor

Teaching:

My responsibilities as Senior Tutor mean that I get to know all of the students in the department rather well. Along with your personal tutors, I am the first port-of-call for students needing advice of just about any sort. I see my job as being there mainly to ensure fair play.

I truly enjoy interacting with students from each year of study. I take tutorials with first years, where we sometimes get to talk about my research in particle physics. I also teach Mathematics to second years, and while this is quite a challenging course for students, they know it is necessary and useful to have this mathematical background for the more advanced Physics courses of later years. With third and fourth year students, I supervise Major Projects, which give them a taste of what cutting edge research is all about.

Research:

My research is in particle physics and involves the ATLAS detector located at CERN in Switzerland.

I am interested in the big questions: What are the constituents of matter? What happened a few seconds after the Big Bang? Why do particles have mass? Royal Holloway has a large and very active particle physics research group and many of us are working on the Large Hadron Collider at CERN.

I hope that out of the remnants of proton collisions inside the LHC, I will find some of my answers! Particle physics is a very collaborative area of Physics. I love meeting physicists from all over the world and sometimes I even get to speak my native language, French!

Degree programmes

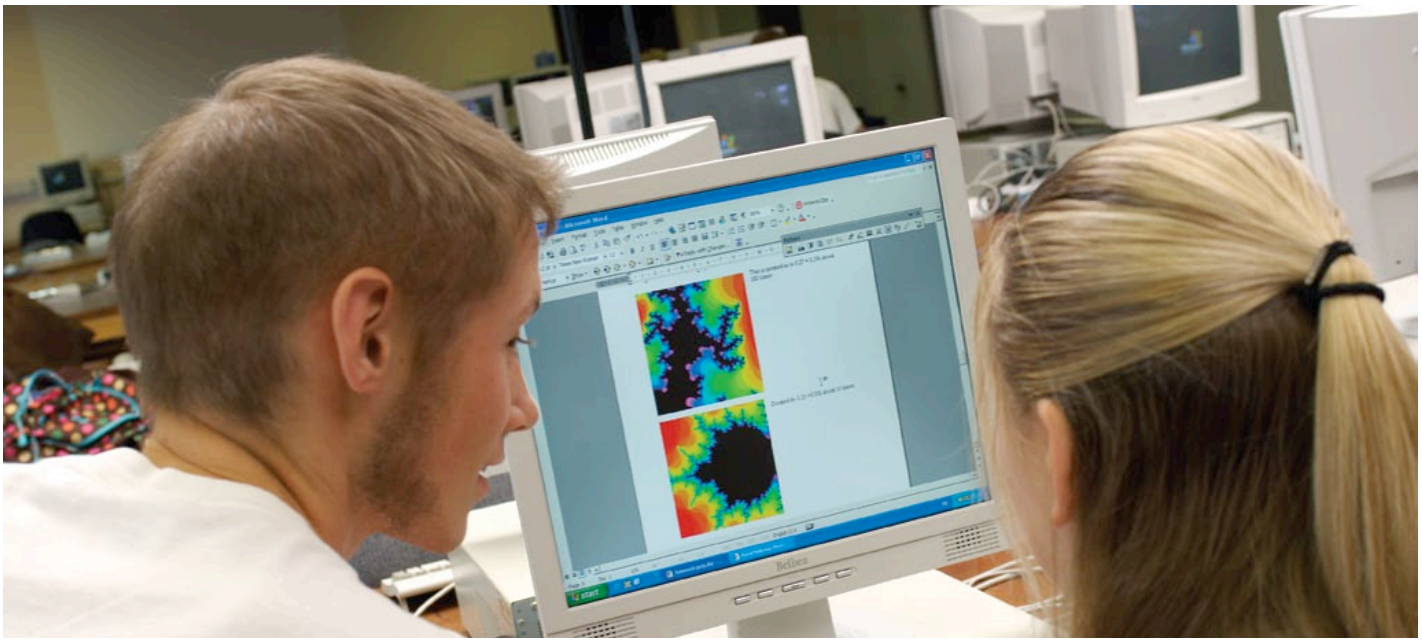
Single Honours Programmes

Physics MSci (F303)

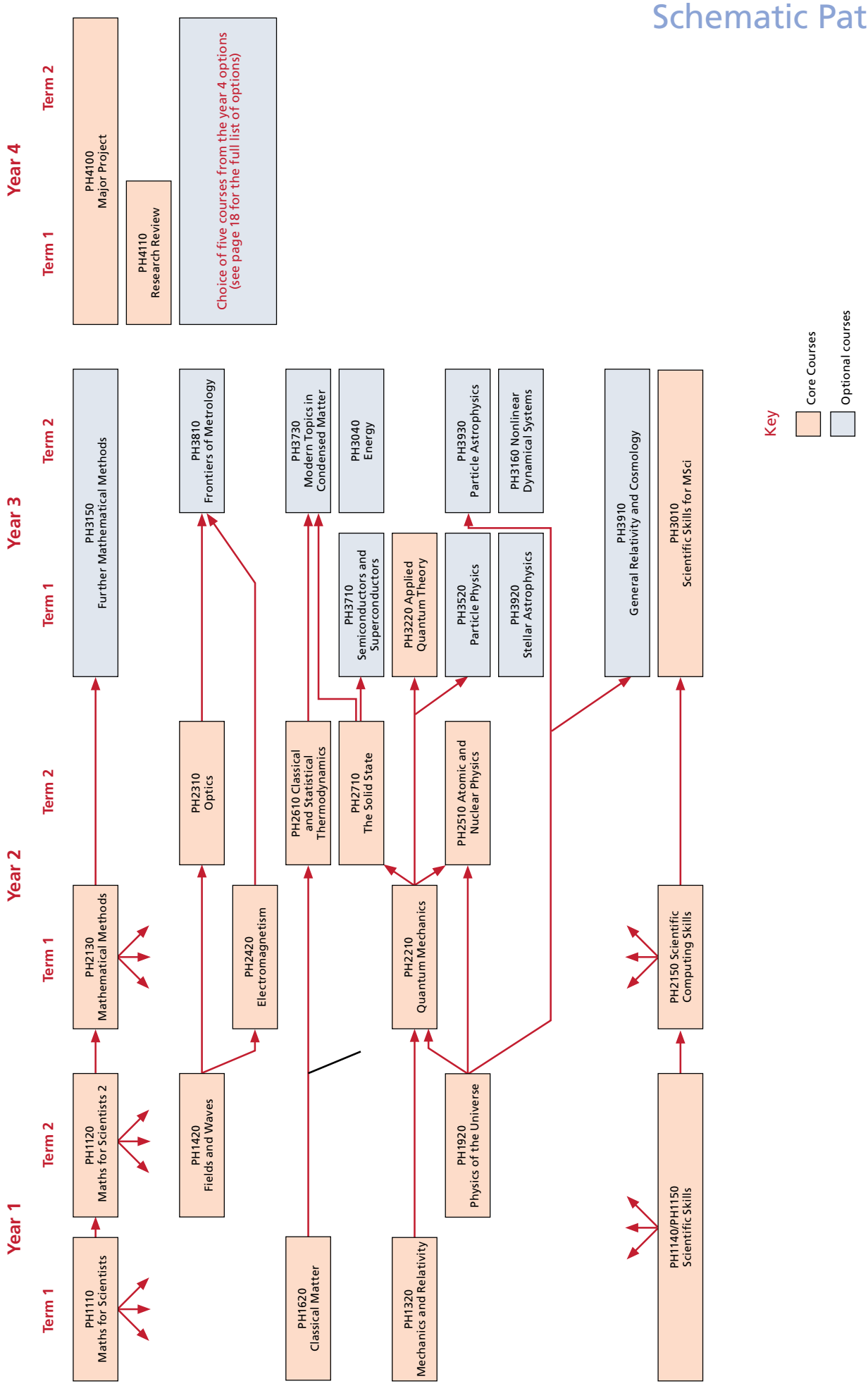
The MSci Physics programme is the most popular and flexible undergraduate degree programme in Physics. In four years of study, the programme takes you through a thorough grounding in the basic concepts and theories of modern and classical Physics, to a level close to that of current research. The programme offers the opportunity to consolidate and then develop your quantitative and conceptual understanding of Physics. The foundations of Physics are based on three pillars; the conceptual understanding, the mathematical description and the experimental evidence. Approximately half of the degree course is based on lecture courses in physics, such as classical and quantum mechanics, relativity, electromagnetism, classical and statistical thermodynamics, the structure of matter and the solid state, these are core units that provide you with a full knowledge of all of the most fundamental theories, concepts and methods of modern physics in a systematic and logical way. About a quarter of the course is focussed on mathematics. Mathematics is often said, correctly, to be the language of physics. In the first year key pure maths skills such as vector analysis and differential equations are developed moving on in the second year to an introduction to those areas of maths most important to physics such as Fourier techniques, integral transforms and probability. The remaining quarter of the course is spent in the laboratory, in the first year experiments are performed that allow you to see for yourself some of the most important discoveries that changed the history of Physics and to hone your skills as an experimental physicist. In the second and third year experiments tend to be linked more directly to concepts discussed in lectures and new and more advanced techniques and skills are introduced. As you progress, you will have the opportunity to take optional courses which will first introduce you to advanced topics and then progress to current research interests such as semiconductors and superconductors, particle physics, applications of quantum theory, and chaotic systems. The diagram opposite shows the typical degree course pathway for MSci Physics (F303). The full current list of core and optional course units is shown on page 18. The final year incorporates both the Major Project, a six month hands-on opportunity to gain research level experience, working within some of the most advanced research groups in the world, and the Research Review, a chance to study the current state-of-the-art of a research topic from original recent research papers. The wide variety of core and optional courses on offer within the degree programme will train you in everything necessary to be recognised as a highly qualified graduate physicist, from basic experimental techniques to esoteric theoretical reasoning and a good understanding of the concepts. The MSci in Physics leads directly to opportunities for postgraduate study in all areas of physics and the course also embeds skills important to employers and future research supervisors, such as the enhancement of computational, experimental and communication skills.

Physics BSc (F300)

The BSc Physics programme is the most popular three-year undergraduate programme. The first two years are similar to the MSci degree and cover all of the core material that a graduate physicist would be expected to know, including quantum mechanics, electromagnetism, statistical physics and thermodynamics, Einstein's relativistic physics and the study of the fundamental structure of matter and the universe. All of the mathematical, experimental and conceptual knowledge and skills necessary in a graduate physicist are developed. In maintaining the similarity between the MSci and BSc courses for the first two years, we can allow flexibility for the final choice between these two courses to be taken as late as the end of the second year. In the third and final year an individual project allows the development of a deeper understanding of a selected area of Physics. This is studied together with a range of optional courses,



Physics MSci Degree Programme
Schematic Pathway



Degree programmes
continued

providing insight into specialist or advanced subjects chosen from the Year 3 modules listed on page 18. The overall aim is the development of a sound quantitative and conceptual understanding of Physics, though necessarily to lesser depth than the MSci programme. There is a further emphasis on the development of transferable skills such as teamwork, communication, computing and independent working which are important for employers and career progression both inside and outside of science.

Theoretical Physics MSci (F321) and BSc (F340)

The Theoretical Physics courses cover all of the core skills, concepts and advantages of the Physics degrees (F303/F300), but in addition they allow you to develop an enhanced mathematical and a deeper conceptual understanding of classical and modern physics. There is a reduced laboratory component in later years relative to the Physics programmes (F303/F300) while the availability of compulsory and optional courses in, for example, Quantum Theory, Further Mathematical Methods, Atomic and Nuclear Physics, Stellar Astrophysics, General Relativity & Cosmology and Non-Linear & Chaotic Systems provide an emphasis on advanced theoretical topics in Physics. The final year of each programme also provides the opportunity to study a selected area of Physics at a deeper level through an individual theoretical project. The emphasis on theoretical concepts and foundations provides a greater appreciation of the beauty and surprises of Physics while requiring a higher aptitude for the applications of mathematics.

Experimental Physics MSci (F313) and BSc (Fxxx)

The degree programmes in Experimental Physics emphasise the development and techniques of the subject from a more practical point of view. The very foundation of the scientific method lies in the ability of anyone to reproduce experimental evidence by simply observing and measuring the world around them. From Galileo to Faraday, J.J.Thomson to the Large Hadron Collider, provided experiments are performed correctly, the most long standing, elegant and profound theories may be rendered utterly obsolete by one simple experimental fact. Perhaps even more importantly, unexpected experimental discovery and the verification of theoretical predictions have been the prime methods by which Physics has been driven forward for centuries. The courses in Experimental Physics cover all of the core skills and concepts of the Physics degrees (F303/F300) in the first two years including the mathematical and conceptual, but provide an additional focus on the experimental techniques and methods through which modern Physics is driven. Courses such as Frontiers of Metrology, Semiconductors & Superconductors and specialist laboratory teaching emphasise the experimental components of the degree. The final fourth year is taught at intercollegiate level, with a full choice of options including Quantum Computation, Nanoscale Physics and others. The Major Project usually specialises in an application of Physics within an experimental research group.

Astrophysics MSci (F510) and BSc (F511)

The Astrophysics programmes allow for the full development of core Physics concepts, mathematical and experimental skills with a particular emphasis on phenomena encountered in astrophysics and cosmology. The course structure in the first two years is similar to the Physics courses F303/F300 except that Astronomy is introduced in favour of delayed study of solid state physics. In later years the courses cover topics such as Stellar Astrophysics and Atomic & Nuclear Physics. As you progress, modules in Particle Astrophysics, Planetary Geology and Geophysics, General Relativity & Cosmology and Optics provide the introduction to research level topics. Experimental and observational skills are also developed through an astrophysics or astronomy based individual research project in the third year of the BSc or a Major Project in the MSci final year, usually based in our astronomical observatory or in an astro-particle physics related research area.

Physics with Particle Physics MSci (F372) and BSc (F370)

The degree programmes in Physics with Particle Physics provide the opportunity to study Physics with a special emphasis on the underlying Physics of fundamental particles, high-energy particle detectors and accelerator physics. The subject is highly topical following the discovery of the Higgs Boson as the search for Physics beyond the Standard Model commences at the Large Hadron Collider at CERN. The courses develop all of the elements found in the Physics courses (F303/F300) but additionally cover the methods of particle detection and acceleration at an earlier stage, while delaying the study of less relevant material. Advanced third year courses in Particle Physics and Particle Astrophysics are given following courses in the first and second year necessary to understand this field properly. Final year projects provide an appreciation of research methodologies in an area of particle physics. The MSci, as the standard undergraduate programme in this area, leads directly to opportunities for postgraduate research study, with both the MSci and BSc offering a comprehensive knowledge of topics at the forefront of particle physics research. These programmes incorporate a field trip to CERN.

Joint Honours Programmes

Mathematics & Physics MSci (GFC3) and BSc (GF13)

Since the time of Newton, Mathematics has gone hand in glove with Physics. While the study of Physics necessarily incorporates the study of Mathematics, the joint honours programmes in Mathematics & Physics provide the opportunity to study mathematics from a purer and more rigorous point of view and to a deeper level than would be normal in a Physics degree alone. These programmes split the students time equally between the Departments of Mathematics and Physics at Royal Holloway. In order to make way for the teaching of Mathematics some of the laboratory study components are reduced and some of the core Physics material is delayed until future years though

all of the core topics of a degree in Physics are still covered. The courses in Mathematics strongly complement and provide a deeper understanding of the theoretical aspects of the Physics courses. For the MSci, the third year offers the flexibility to choose more Physics-based or more Mathematics-based pathways, according to preference. Studies culminate with fourth year intercollegiate courses and the opportunity for an area of mathematical Physics to be studied at a deeper level through the Major Project and Research Review. For the BSc, two distinct pathways are available depending on whether your interests lie more in the Physics or Astrophysics areas. The joint degrees are significantly more challenging than a single honours degree and are suitable only for well qualified mathematicians wishing to study Physics.

Physics with Music BSc (F3W3) and Physics with Philosophy BSc (F3V5)

These programmes provide for the study of the essential core topics of Physics together with a non-physics component of about 25% spread across all three years of study. The major subject, Physics, includes all of the mathematical, conceptual and experimental skills expected of a graduate physicist. Courses in Quantum Physics, Special Relativity, Electromagnetism, Classical and Statistical Thermodynamics as well as more foundational subjects are studied. In order to provide the time for the non-physics component the study of some core material is delayed and the study of the experimental skills is reduced. A wide range of transferable skills are developed and practised. MSci versions of these degree programmes are not available and students deciding to pursue a scientific career should transfer to the MSci Physics programme no later than the end of the second year.

The Music component of the Physics with Music degree covers music composition, theory and analysis, and historical musicology. "Techniques of composition" is a recommended module. In the third year, an individual project in an area of Physics related to music brings an appreciation and understanding of the role of Physics in music.

In the first-year of Physics with Philosophy, a broad range of texts is studied, from ancient Greek to modern philosophy, tackling fundamental questions in philosophy. In the second and third years a choice is made from a range of courses in ancient and modern philosophy, depending on interests. In addition to the core Physics study, the programme adds philosophical, critical and interpretive skills.

Foundation Year

Science Foundation – Option Physics (F308)

The Science Foundation Year provides all of the necessary pre-requisite study for entry to our degree programmes. Essentially compressing the study of the most relevant and important elements of A level Physics and Mathematics into one full time year the SFY provides a fast track solution for students who find themselves wishing to study Physics but without the right qualifications to do so. The SFY is taught in collaboration with Strodes College in Egham. There are strong links between the Department of Physics and Strodes College and students may benefit from the facilities of Royal Holloway, including accommodation. The course is not usually suitable for students who have previously studied A level Physics and Mathematics.

Programme modules

Year 1

These modules focus on the foundations of Mathematics and Physics, consolidating and extending your knowledge from A-level.

- Mathematics for Scientists 1 and 2
- Scientific Skills 1 and 2 (taught in the laboratory)
- Mechanics and Relativity
- Fields and Waves
- Classical Matter
- Physics of the Universe

Year 2

These modules allow in depth study of the most important components of Physics.

- Mathematical Methods
- Scientific Computing Skills
- Quantum Mechanics
- Optics
- Electromagnetism
- Atomic and Nuclear Physics
- Particle Detectors and Accelerators
- Classical and Statistical Thermodynamics
- The Solid State
- Astronomy

Year 3

These modules generally form an introduction to subjects that are the focus of current research.

- Scientific Skills (Laboratory based)
- Energy
- Experimental or Theoretical Project
- Further Mathematical Methods
- Nonlinear Dynamical Systems – Chaos
- Applications of Quantum Theory
- Frontiers of Metrology
- Particle Physics
- Semiconductors and Superconductors
- Modern Topics in Condensed Matter
- General Relativity and Cosmology
- Stellar Astrophysics
- Particle Astrophysics
- Planetary Geology and Geophysics
- Science Communication

Year 4

The study of advanced material.

- Major Project
- Research Review
- Lie Groups and Lie Algebras
- Statistical Mechanics
- Advanced Quantum Theory
- Relativistic Waves and Quantum Fields
- Electromagnetic Theory
- Galaxy and Cluster Dynamics
- Atom and Photon Physics
- Quantum Computation and Communication
- Molecular Physics
- Particle Physics
- Particle Accelerator Physics
- Order and Excitations in Condensed Matter
- Theoretical Treatments of Nano-Systems
- Physics at the Nanoscale
- Superfluids, Condensates and Superconductors
- Standard Model Physics and Beyond
- Nuclear Magnetic Resonance
- Computing and Statistical Data Analysis
- String Theory and Branes
- Supersymmetry and Gauge Symmetry
- Stellar Structure and Evolution
- Advanced Cosmology
- Relativity and Gravitation
- Astrophysical Fluid Dynamics
- Planetary Atmospheres
- Solar Physics
- The Solar System
- The Galaxy
- Astrophysical Plasmas
- Space Plasma and Magnetospheric Physics
- Extrasolar Planets and Astrophysical Discs
- Molecular Biophysics
- Mathematical Methods for Theoretical Physics

Degree Programmes are studied in modules, usually eight per year. The list of modules available within the Department of Physics, or through intercollegiate options at MSci level, is shown here, although it may change slightly from year to year. In certain degree programmes, some modules are made available in years other than those noted. Some advanced modules require other modules as prerequisites; the specialised degree programmes are arranged to fulfil these conditions in a natural way. With exceptions, approximately four modules of the expected eight modules may be chosen from the options listed in the third year. In the fourth year, approximately five modules are chosen from the list. The remaining three modules comprise the Major Project and Research Review, in which the content is chosen, so far as is possible, from the research portfolio of the Department.

Teaching and assessment

Physics combines experimental work with conceptual thinking and mathematical analysis. Each of these demands its own teaching and assessment techniques. The teaching of Physics at Royal Holloway assumes that the motivation to study exists within the student. Our task as teachers is to introduce, explain, challenge and excite. A year's worth of study is normally broken down into eight modules, each of a nominal 150 hours of study. This study can take a variety of forms.

Lecture-based courses

These usually comprise 50-minute lectures conveying material essential to the study of the subject. Lectures are usually supplemented by question sheets that are worked at in the student's own time. The related answer sheets and solutions classes provide some of the necessary feedback.

Problem classes

Problem classes provide an environment for working through selected problems in the presence of academic or graduate teaching staff. The teaching technique allows gaps in students' understanding of the topic to come to the fore and to be remedied in an informal, helpful and immediate way.

Tutorials

In your first two years, small group teaching is undertaken with three or four students and a member of academic staff, typically providing informal help with academic problems, practice at short presentations or discussions of current scientific discoveries. Often the topics to be discussed are chosen by students. Tutorials are useful in building confidence, filling gaps in understanding and providing a route for discussion of topics not covered elsewhere.

Experimental work

Typically, this takes up around 20 percent of study time. Experimental work can vary from exploring classic experiments two afternoons a week in your first-year, in our well equipped and modern teaching laboratories, to working alongside academic staff in six month long research-related projects in your final year.

PC-based classes

These develop computer skills. You will work with software packages such as those for mathematics, numerical modelling, presentation, data acquisition and data analysis. You will also have the opportunity to learn programming languages such as C++, Python, Java and LabView.

Presentational modules

Typically these comprise reviews of research papers or a specialised topic of Physics. The subject matter is often chosen and researched by a student for presentation to other students. Group study is also used, with shared tasks and a speaker being selected from the group to present.

Assessment

For lecture courses, assessment is usually by two-hour examination at the end of the year in which the module is studied. In many modules, coursework and in-class tests also contribute to the assessment. Experimental work is generally assessed by the production of written reports of the experiment or by oral presentation. A minimum of six of the eight modules must be passed with a minimum score of 40 percent each year.

Scholarships and bursaries

Future Leaders Scholarship Programme

Full three year fee waiver to the value of Home/EU tuition fees.

Available to all undergraduate students on a competitive basis. Considered on merits of motivation, leadership skills, sense of future ambition, social responsibility and academic achievement.

Bedford Scholarships

£1000 for the first year.

Available to all undergraduate students achieving a minimum of AAB at GCE A2 level or equivalent.

National Scholarships

£3000 for the first year of study (as Royal Holloway Bursary in later years)

For undergraduate students from England with a family income below £25,000.

Royal Holloway Bursaries

£750 (to £2,500) per year for each year of undergraduate study.

Awarded to all full-time students from England and Wales with a household income of £42,600 (£25,000) per year or less.

Eliahou Dangoor Scholarships

£1000 in the first year of study

Awarded on a competitive basis to students of science and mathematics. Students must be predicted a minimum of ABB grades at GCE A2 level or equivalent.

Conditions may apply to these scholarships and bursaries. For full details and application forms visit:
www.rhul.ac.uk/studyhere/undergraduate/feesandfunding/bursariesandscholarships

Department of Physics Excellence Awards

Up to three awards of £1000 on a competitive and discretionary basis to candidates providing exceptional evidence of excellence and not in receipt of any other scholarship.

Head of Department Undergraduate Hardship Fund

A discretionary fund used to alleviate hardship where there is documentary evidence of need.

Dr Stewart Boogert
Curriculum Development

Teaching:

My teaching spans all levels, from first year undergraduates to PhD students. I very much enjoy giving my second year courses in Astronomy, Stellar Astrophysics and Particle Physics and I find 3rd and 4th year projects most rewarding as we (a student and I) get to work on an aspect of my own research. Working in this way on a topical research problem, is usually an enjoyable first experience of research for students. Some students also continue their research with me as summer interns within the department.

Research:

My research is focused on developing higher energy and better performing accelerators for particle physics and applied science. A happy consequence of my research is that I am able to enjoy working at all the major particle accelerator laboratories around the world, including Japan, Switzerland, USA, Germany and of course the UK. I am interested in the next generation of particle colliders – beyond the LHC! This involves a satisfying blend of almost all undergraduate Physics, including electromagnetism, optics, lasers and dynamical systems, combined with electrical and mechanical engineering. A particular speciality, is making precision measurements of the position and size of electron beams. We recently measured the width of a high energy electron beam, travelling at the speed of light, that was much smaller than a human cell!

Accelerator technology is now becoming more and more relevant to other scientific disciplines, and to society in general, in applications such as medical imaging.

Research

"NPL is the UK's National Physics lab. We keep the most precise clocks and develop many kinds of measurement standards, such as the Volt and the Ampere. We have strong links with Royal Holloway, including teaching the Frontiers of Metrology advanced course. Royal Holloway undergraduate students take part in some of our most advanced research programmes, both as paid summer interns and on final year projects. We have found that the quality of the College's students is exceptionally high"

Thomas Byrne, Head – Quantum Metrology, National Physical Laboratory

As an undergraduate at Royal Holloway, your education will be enriched by the international quality of the research environment within the Department.

Exposure to the cutting edge of international research is an important element of your undergraduate student experience; the courses you take are enhanced by our research expertise. Importantly, as an MSci student, your final year project will be undertaken as a member of one of our research groups. As an illustration, undergraduates have made state-of-the art nanostructures in our in-house nano-fabrication suite or contributed to the analysis of data from CERN. Such activity provides key exposure to, and training in, all the skills (practical, analytical, theoretical, presentational) that both research and many other jobs require. Final-year BSc students have similar opportunities. Undergraduate summer studentships (with stipend) are also awarded on a competitive basis for students to work in research groups over the summer vacation, usually at the end of year 2 or year 3. These placements may be either at Royal Holloway, at a SEPNet partner, a national laboratory or in industry.

Research projects at Royal Holloway reflect the activity of our research groups. The majority of these have a strong internationally collaborative dimension, involving other world-leading groups. Frequently, these projects involve exploring new research directions, and often students are motivated to continue onto PhD research in a similar area.

Our research ranges from exploring key questions in fundamental science, both experimentally and theoretically, to applied instrumentation development. Topics include: understanding quantum matter in all its forms – from the Higgs boson to dark matter to superfluids; the quest for new materials with new functionality; making, understanding and applying new nano-scale electronic/optical devices; developing new instrumentation and technology for healthcare and; developing accelerator technology for future particle accelerators.

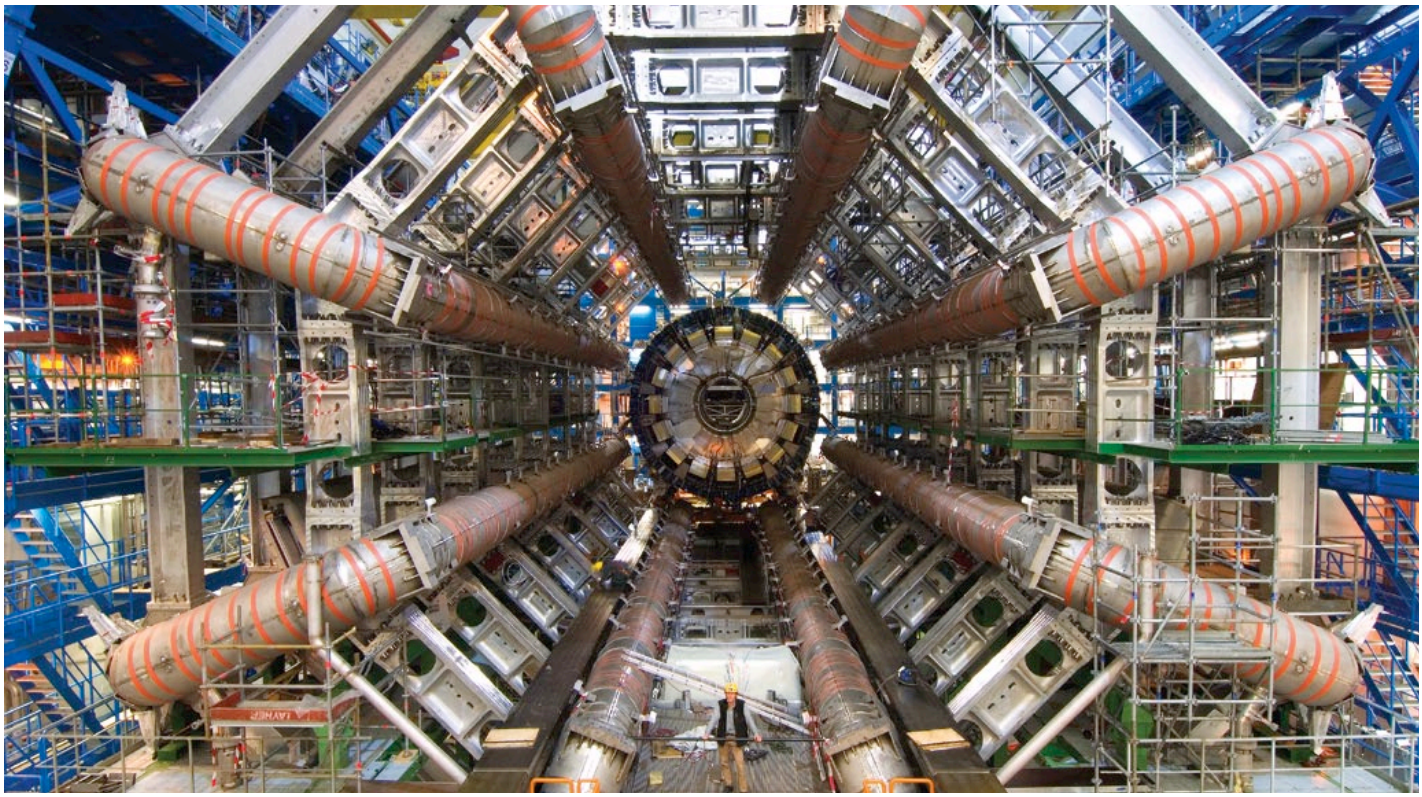
Research activity locations range from in-house state-of-the-art laboratories, to major national and international facilities ... and more.

Visit **www.rhul.ac.uk/Physics/Research/** to find out more.

Higgs boson, quarks and dark matter

Centre for Particle Physics

What is the origin of the mass of elementary particles? Why is there more matter than anti-matter in the Universe? What is Dark Matter? To address these questions, Royal Holloway physicists are collaborating in new experiments (ATLAS) at the Large Hadron Collider (LHC), CERN, particularly understanding the properties of the Higgs boson and other more exotic particles, and studies of the top quark. A key question is: what lies beyond the standard model? The group has strong involvement in GRID-computing, and plays leading roles in the statistical analysis of data. Theorists at Royal Holloway, part of the NExT Institute for Particle Physics Phenomenology, work in close collaboration with the experimentalists. Can the LHC provide evidence for supersymmetry, for extra spatial dimensions or dark matter?



Research

John Adams Institute for Accelerator Science (joint with University of Oxford)

The techniques for accelerating particles to high energies are relevant to a wide range of problems: developing the next generation of accelerators for particle physics; new therapies for cancer, and developing improved synchrotron-based sources of x-rays for the study of physical, chemical, biological and geological materials. New beam diagnostic methods are being developed in our dedicated Accelerator Science laboratory at Royal Holloway and applied at international facilities at CERN, KEK (Japan) and DIAMOND (UK).

Fabricating "artificial atoms" for quantum computation

Quantum Information Processing Group

Exploiting new techniques of nano-fabrication to create structures, 'giant atoms', governed by the laws of quantum mechanics, is a challenge attracting huge international interest. Our researchers are exploring a number of new approaches to non-invasively probe superconducting 'qu-bits', and using such devices as single photon detectors in the microwave regime.

Developing a new electronics based on metals rather than semiconductors

Nanophysics and Nanotechnology Group

As semiconductor devices are shrunk to meet the demands of increased computing power and data storage, we will soon hit a barrier where devices simply have too few electrons for reliable operation. Our researchers are pioneering novel nano-devices made out of combinations of different metals, which have much higher electron density than semiconductors. 70 percent of the elements in the periodic table are metals, and they can also be alloyed. Combining metals, superconductors and ferromagnetics offers huge possibilities for 'hybrid metallic nanostructures.'

New instrumentation for medical diagnostics

Biodiagnostics Group

Can we develop new Magnetic Resonance Imaging methods in low magnetic fields (e.g. Earth's field) widening access to this diagnostic technique? Our researchers have developed new magnetic resonance detectors based on superconducting devices for this purpose. We hope such detectors can be applied to pin-point the flow of neural currents in the brain. They can also potentially be used as a reliable histopathological technique to detect cancer. We have also developed new devices for detecting single photons in the far infra-red (THz) regime. The current target is a THz imager with high spectral sensitivity for health screening.

Materials discovery: fundamental understanding and applications

Quantum Matter Group

The quest for new materials has been an abiding strand of human activity for millenia. To achieve room temperature superconductivity is one current dream, of huge impact if realised. Our researchers are investigating the new class of iron-based superconductors. We hope to understand both these materials and high Tc superconductors, which cannot be explained by the 'standard model' of metallic systems. High pressure is used to tune materials; seeing how superconductivity emerges from magnetism will help us develop theories beyond the standard model, and guide our choice of which materials to make and investigate. Another important strand involves the development of new thermoelectric materials, with applications in energy saving devices, and potentially as local on-chip coolants on semiconductor devices. This research makes use of in-house crystal growth facilities and exploits nanofabrication techniques to construct new devices. Understanding these materials involves making use of international synchrotron x-ray and neutron scattering facilities, as well as in-house low temperature and high pressure facilities.

Theory of strongly correlated quantum matter

Theoretical Condensed Matter Physics Group

We are establishing the Hubbard Theory Institute in partnership with the Harwell Science and Innovation Campus. This will provide a framework for our theorists to work in close partnership with experimentalists in the area of materials discovery. Our researchers are also developing theories of cold atom systems, trapped at nanoKelvin temperatures on optical lattices, which are models for quantum many body physics. The nexus of cold atoms and strongly correlated electron materials is a new one; understanding simple systems should lead to new insights into more complex materials.

Helium, at ultralow temperatures, as a simple model system for quantum matter

Quantum Matter

This research takes place in the in-house London Low Temperature Laboratory, a leading international centre for low temperature physics and member of the new European Microkelvin Collaboration. Here we explore matter close to absolute zero. 3He is a fermion and 4He is a boson, and the relatively simple systems available show remarkably rich behaviour, offering a window into more complex materials. We study helium in two and one dimensions, by looking at helium on surfaces or confined within nanotubes. We confine superfluid 3He on the nano-scale inside the tiniest microfluidic sample chambers to induce new superfluid states. Recently it has been proposed that this system should host Majorana fermions, particles which are their own anti-particle and hitherto undetected in Nature! Our researchers are also investigating the recent claim that solid 4He is a supersolid, and have found evidence for supersolidity in two dimensions. This research is underpinned by a strong strand of instrumentation development, and an effective network of international collaboration.

Other information

Study Abroad

Royal Holloway operates a scheme called the Study Abroad Programme. Typically, within this scheme the second or third year (but not the final year) of your degree programme may be exchanged for equivalent study in a partner university in North America, Europe (the Socrates Erasmus Programme), Asia or other locations. Alternatively, your studies may be extended by a year to accommodate additional study abroad. The Study Abroad Programme adds an international dimension to your degree, allows you to experience another culture and style of education, perhaps practice your languages and it enhances your CV. Applications for a place on the exchange programme are made after admission to your degree programme at Royal Holloway. For more details, please visit:
www.rhul.ac.uk/international/

College Open Days

An Open Day at Royal Holloway offers a unique opportunity to come and see the College for yourself. You will have the chance to meet our students and teaching staff, and get a taste of what university life is really like. Parents and friends are very welcome to come with you. College Open Days are a great opportunity to decide if you wish to apply, but please bear in mind that all suitable applicants will also be invited to the Department Open Days for interview on receipt of their application.

Dates of Open Days and bookings can be obtained from the Department, or from our website:
www.rhul.ac.uk/studyhere/opendays/

For further information please contact: physics@rhul.ac.uk

Student Welfare and Support

When you join us, you will be immediately assigned to a member of staff who is your Personal Adviser. They can advise on your choice of courses and offer personal support during your degree, referring you to the wider range of College welfare services where necessary. Departmental staff are renowned for being friendly and approachable.

The College has excellent provision for helping students with queries and problems through the Student Advisory Service, which includes the Student Administration Centre, the Student Counselling Service, the Students' Union welfare officers, the Chaplains and the Wardens in the halls of residence.

Royal Holloway is committed to supporting students with disabilities or special educational needs. This support is offered primarily through the Educational Support Office (ESO).

Your future career

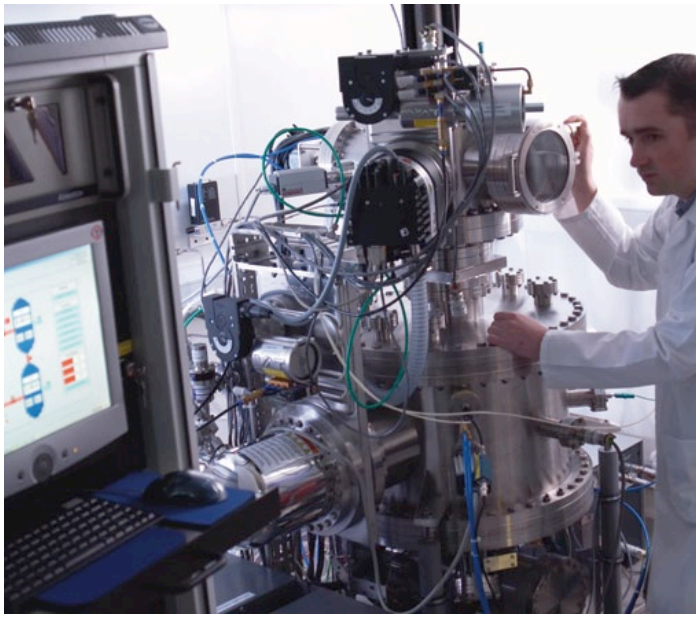
A degree in Physics is one of the most sought after qualifications available, national figures for employment of recent physics graduates show employment levels amongst the highest of any subject. Physics graduates from Royal Holloway are no different, with 92% of recent graduates in full time employment or further study within six months of graduation. According to the Institute of Physics, in the UK alone Physics-based industry employs more than 1.79 million people, while UK graduates in Physics earn more than those in most other disciplines.

The fundamental reason for the high employability of physics graduates is their possession of rare and valuable qualities. Quite apart from the specialist knowledge of, say Einstein's relativity or Schrödinger's quantum mechanics a degree in physics provides graduates with a range of skills that are directly transferrable to problems outside of physics or science. Chief among these, and far from a complete list, are the mathematical literacy and modelling skills; practical, experimental, mathematical and conceptual problem solving skills; creativity; logical thinking; computer literacy, numerical modelling and data analysis skills; and communication skills. Such skills are equally as useful in solving problems in social science, finance, engineering or business as they are at the Large Hadron Collider and they are highly prized by employers, including those not needing Physics-specific knowledge and skills. For these reasons, a degree in Physics is one of the most respected qualifications available.

Because it is a training in fundamental science rather than a vocational qualification a degree in physics can lead to many different career paths. About one third of physics graduates go on to study for a higher degree or enter research. Our recent graduates have accepted offers to study at doctoral level from the University of Cambridge, Imperial College, the University of St Andrews, the Institute of Cancer Research, Lund University (Sweden) and many others, as well as Royal Holloway. Graduates entering employment are often no longer called physicists, but enter professions with titles such as aeronautical engineer, computer analyst, programmer, software engineer, satellite engineer, meteorologist, finance analyst and investment analyst, to mention just a few examples from our recent graduates, plus many others. Much more information on career paths for physicists can be found at: **www.iop.org/careers/**

Recent employers of our graduates include:

- National Physical Laboratory
- MSSL (Mullard Space Science Laboratory)
- SSTL (Surrey Satellite Technology Ltd)
- The Meteorological Office
- ECMWF
- Qinetiq
- Smith Aerospace
- Lockheed Martin
- Gama Aviation
- St George's Hospital
- ONR Office for Nuclear Regulation
- Oxford Instruments
- Ministry of Justice
- Metropolitan Police
- Bank of New York
- Deutsche Bank.
- Morgan Stanley
- KPMG
- Societe Generale
- St James Place
- Experian



Internships and Industry Links

We operate a wide range of summer placements explicitly designed to enable students gain valuable work experience, taste a selection of different career paths, prepare more deeply for a wide range of careers and provide opportunities to develop contacts and networks. These include extensive paid summer research placements within the department, external placements sponsored by international and UK national laboratories such as the National Physical Laboratory, CERN, DIAMOND and ISIS and a wide range of placements at other universities, high technology companies, local schools and other employers. These are usually sponsored either directly from the department or through our partners in the South-East Physics Network (SEPNet) or from a wide variety of other sources. Placements and internships are generally taken in the summer and occasionally dispersed through the teaching terms in order to ensure that the gaining of transferrable skills and the development of personal career preferences is as efficient and compact as possible. The demand for graduate physicists is so high, even in the present economic climate, that the need for an entire year in industry is debatable, most students finding that it is better to gain permanent paid employment or a place on a higher degree course as early as possible by graduating sooner.

Careers Support

At Royal Holloway the acquisition of transferrable skills so valued by employers is embedded within each degree programme and course unit that the Department of Physics offers, so that personal development proceeds in a natural fashion. The Department also helps students to recognise their own strengths, skills and abilities so that they can make the strongest possible applications for their chosen job or training course. It is also possible to have extracurricular activity formally recognised through the 'Passport' scheme, verifying to future employers the ways in which you have picked up other valuable skills or contributed. Participating in outreach activities, for example, not only promotes the subject of physics but also allows you to hone your communications and presentational skills. The department's annual 'Physics Careers Week' provides an insight into the wide variety of career routes open to you, with advice from careers specialists from the Institute of Physics and SEPNet and returning Physics alumni sharing their experiences, building connections and networking opportunities and providing invaluable advice to students.

The College Careers Service, which is part of the University of London Careers Advisory Service, provides a wide variety of services including advice on choice of careers and help with CV writing, completing application forms and preparing for an interview. One-to-one advice with a Careers Consultant is available each term. The Careers Service also brings many important employers onto the campus throughout the year but especially during the 'Careers Fair', an event dedicated to enabling students to talk directly to the employment managers of major companies. The Careers Service can also help with part time jobs, allowing you not only to earn some cash during your studies but also providing another way to develop your career aspirations. You can explore the Careers Service website at **www.rhul.ac.uk/careers/**

Graduate Profile

Alumnus: Michael Cheesman

Subject: Physics

Graduated: 2010

Place of Work: QinetiQ

Position: Acoustic Signature Analyst

My degree has been vital in both being offered my job and for the skills I use on a daily basis. As an acoustic engineer, the knowledge I gained from my degree is used every day. During my degree I was fortunate enough to be accepted on to an eight week internship with QinetiQ, which gave me fantastic industry experience and was ultimately very important in helping me get on QinetiQ's graduate scheme.

My degree has set me up perfectly for my current role and my future career. And it's not just the technical skills I learnt during lectures, but also the transferable skills that I wasn't always necessarily aware of. A lot of the things I find myself doing regularly, which are vital to my role, were learnt during my degree, such as: writing technical reports to a professional standard, giving presentations to both expert and non expert audiences, conducting practical experiments, leading project teams, acoustics, materials science, a fair bit of maths, some signal processing and a pinch of computer programming.

Academic staff and their research

A full list of staff in the department and their research interests can be found at **www.rhul.ac.uk/physics/for-staff/**

Dr Vladimir Antonov, Reader in Nanophysics

Specialising in Nanoelectronics, Dr Antonov's research is concerned with the study of low-dimensional structures, including research on quantum bit devices, TeraHertz detectors and novel nanodevices.

Dr Tracey Berry, Lecturer in Particle Physics

Dr Berry's research interests are in searching for new Physics, especially extra dimensions, at the highest energies possible. She has worked at the Tevatron Collider at FermiLab (Illinois, USA) and is preparing for the analysis of new results from the ATLAS detector, at the Large Hadron Collider at CERN. Dr Berry is also the Deputy Admissions Tutor.

Professor Grahame Blair, Professor of Particle Physics

Professor Blair is the Deputy Director of the John Adams Institute for Accelerator Science. His research areas include Physics at the ATLAS detector at the LHC and the Physics potential of a future electron-positron linear collider. He is also developing simulations and beam diagnostic instruments for the linear collider and the LHC upgrade.

Dr Veronique Boisvert, Reader in Particle Physics

Dr Boisvert's principal areas of research are in quark physics, the question of why there is more matter than antimatter in the universe and the physics that may link the top quark with the Higgs Boson (the probable mechanism for the fundamental particles to have mass). She has worked at Fermilab and CERN.

Dr Stewart Boogert Reader in Particle Physics

Dr Boogert's interests include the aspects of the design of a linear accelerator that affect its important physics goals. These include measurement of the Luminosity spectrum and the effect on the measurement of the top mass from threshold scans. He has close research links with the University of Oxford through the John Adams Institute and with collaborators in Japan.

Dr Andrew Casey, Lecturer in Low Temperature Physics

Dr Casey is presently an EPSRC Advanced Research Fellow, a prestigious appointment allowing time for pure research. His research interests involve the study of fundamental quantum effects in superfluids and the development of nuclear magnetic spectroscopy for BioDiagnostic uses, including developing a new generation of MRI machines.

Professor Brian Cowan, Professor of Low Temperature Physics and Head of Department

Prof Cowan's special interest is in Nuclear Magnetic Resonance and Low Temperature Physics and concerns the properties of both solid and liquid helium. His work involves the study of 2-dimensional and 3-dimensional properties, the development of high sensitivity electronic instrumentation and the theory of magnetic relaxation.

Professor Glen Cowan, Professor of Particle Physics

Dr Cowan has worked on the BaBar experiment at the Stanford Linear Accelerator (SLAC) and is now involved in the ATLAS experiment at CERN. His interests include hadron production in electron-positron collisions as well as developing advanced methods of statistical data analysis.

Professor Matthias Eschrig, Professor of Theoretical Physics

Dr Eschrig is a member of the Hubbard Theory Consortium and a SEPnet fellow. He is active in bringing together experimental and theoretical efforts in the department and partner institutions, including the Rutherford Appleton Laboratory and the London Centre of Nanotechnology. His principal interests are in the fields of quantum many-body physics, emergent topological excitations, mesoscopic transport phenomena, and superconducting nano-devices.

Dr Stuart Flockton, Senior Lecturer in Physics

Dr Flockton's research interests are in adaptive systems, including the design of electrical circuits using artificial evolution and the development of sophisticated methods to extract overlapping signals from mixtures.

Professor Jon Goff, Professor of Quantum Matter

Professor Goff's main interests are in the use of neutron and synchrotron x-ray beams to study how quantum behaviour underpins the physics of novel metals, frustrated magnetism, fabricated multilayer materials and other condensed states of matter. His research takes him to the new world-class UK ISIS and Diamond facilities, as well as a number of other international laboratories.

Dr John Hargreaves, Senior Lecturer in Astrophysics

Dr Hargreaves is investigating cosmological models with extra dimensions. He is also interested in non-minimal models of the universe.

Dr Andrew Ho, Lecturer in Theoretical Physics.

An EPSRC Advanced Research Fellow, his principal interests are in the study of quantum many-body Physics and especially mechanisms that destabilise the standard 'Fermi liquid' picture of a metal. He has also focused more recently on theories of strong correlation in cold atom traps.

Dr Grégoire Ithier, Lecturer in Quantum Information

Dr Ithier joined the department in 2006 as a postdoctoral researcher, became a Leverhulme Research Fellow in 2009 and joined the academic staff in 2011. As a member of the Quantum Devices group, his research exploits quantum mechanics in the development of the world's best amplifiers and detectors. Through the use of nanofabricated devices, cryogenics and superconducting materials, he is also testing the use of quantum mechanics in hitherto unexplored regimes.

Dr Pavel Karataev, Lecturer in Particle Physics

Dr Karataev has worked in Tomsk, Russia and Tokyo, Japan before recently joining Royal Holloway. His principal research interests are in the development of charged particle beam diagnostic techniques for future particle physics experiments, including the LaserWire project at the KEK Accelerator test facility (Japan).

Dr Nikolas Kauer, Lecturer in Particle Physics

A SEPnet-NExT Fellow, Dr Kauer has worked at the Universities of Edinburgh, RWTH Aachen and Würzburg. Interested in particle physics phenomenology, he helps the search for new physics beyond the Standard Model at the Large Hadron Collider by making theoretical predictions of higher order corrections.

Dr Chris Lusher, Senior Lecturer in Low Temperature Physics

Dr Lusher's major interest is in the use of DC SQUIDs (superconducting devices – the most sensitive detectors of magnetic field available) for Nuclear Magnetic Resonance on systems with very weak magnetic fields. Examples include exotic metallic samples and 3He films in low magnetic fields.

Dr Phil Meeson, Reader and Admissions Tutor, Quantum Devices Group

Dr Meeson's research uses superconductivity, nanophysics and cryogenics to answer questions such as: Can we exploit quantum mechanics to build a quantum computer? Does quantum mechanics apply to large objects on the human scale? (The answer is yes.) Are there other devices and sensors that quantum mechanics might make possible?

Dr Jocelyn Monroe, Lecturer in Particle Physics

Dr Monroe's research is on experimental Dark Matter detection. Her group builds experiments to search for evidence of Dark Matter particle interactions in terrestrial detectors, at the cutting edge of particle detection technology. She works with two international collaborations: the DEAP/CLEAN experiment at SNOLAB, in Sudbury, Ontario, CA, and the DMTPC project at WIPP, in Carlsbad, NM, USA.

Dr James Nicholls, Senior Lecturer in Nanophysics

Dr Nicholls has a particular interest in the electronic and thermal properties of mesoscopic semiconductor-based systems. Recent experiments have focused on electron thermometry and whether there is a spontaneous spin-polarisation in quantum wires.

Dr Philipp Niklowitz, Lecturer, Quantum Matter and Low Temperature Groups

Dr Niklowitz experiments on and seeks to understand novel and exotic forms of condensed matter, especially where they can be tuned towards quantum phase transitions and the regime of Fermi liquid breakdown.

Professor Victor Petrashov, Professor of Nanophysics Specialising in Nanoelectronic

Professor Petrashov's research is concerned with the study of quantum phenomena in condensed matter having dimensions approaching the de Broglie wavelength of conduction electrons. He develops nanofabrication processes enabling the control of device geometry in all three dimensions, with a precision of 1–10 nm, with a view to electron band structure (or wavefunction) engineering.

Professor John Saunders, Professor of Low Temperature Physics

Professor Saunders studies Helium at ultra-low temperatures as a simple model system for understanding strongly correlated quantum matter and unusual superconducting states. Current interests include the investigation of two-dimensional anti-ferromagnetism and ferromagnetism and the search for superfluidity in thin liquid 3He films.

Dr Pedro Teixeira-Dias, Senior Lecturer in Particle Physics and Associate Dean (Science Faculty)

Dr Teixeira-Dias has worked on the OPAL and ALEPH experiments at the Large Electron Positron collider. He is now a member of the ATLAS experiment, which is being commissioned in the Large Hadron Collider. His major research interest is the search for the Higgs particle, which is believed to explain the origin of mass of all fundamental particles.

Dr Stephen West, Lecturer in Particle Physics

Dr West is a particle physics phenomenologist in the NExT Institute and a SEPNET Fellow. His research focuses on investigating models of Dark Matter and how they can be tested at current and future experiments such as those at the Large Hadron Collider.

The Department of Physics also contains approximately 20 postgraduate research students, 20 postdoctoral researchers and 12 technical staff involved in both teaching and research.

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