Physics & Astronomy at St Andrews

Physics and Astronomy are key subjects for understanding the universe around us. There is a fascination and a challenge here. Why is the sky blue? What is the difference between metals and semiconductors? How are matter and energy related? What happens near a black hole? How did the universe begin? Answers to these and similar questions can then lead to investigation and understanding of related phenomena, and to the development of new technologies.

We can use physics to understand aspects of systems ranging from the smallest parts of our bodies to the vast collections of galaxies. Physics is relevant in almost every human endeavour. Our teaching emphasises an understanding of these ideas. Our courses are interesting, current, relevant, and thought-provoking.

- Students at the University of St Andrews have voted themselves the most satisfied in the UK for the quality of their higher education experience, according to the National Student Survey 2019. This is the eleventh time in the past 13 years that St Andrews has been ranked at the top of universities across the UK in this survey.
- Students enjoy a wide range of activities in a student-focused community within a historic coastal town.
- Guaranteed University accommodation, in first year.
- Our School is large enough to have major research strengths, but small enough that there is good student-staff interaction, and some small class sizes.
- Programmes are flexible, with a choice of entry and exit points and degree intention as a student proceeds.
- Well-qualified entrants may complete an Honours BSc degree in three years, or an MPhys degree in four.
- The University Observatory contains the largest operational optical telescope in the UK.
- The 2018 formal review of our teaching programme commended the School for “its strong sense of community. Students perceive staff as welcoming, approachable and supportive.”
- Internationally recognised research in astrophysics, biophotonics, lasers and optoelectronics, mm-waves, magnetism, semiconductors, solid-state and theoretical physics informs our teaching.
- In the Guardian University Guide 2020, and the Sunday Times 2020 League tables, Physics in St Andrews was rated top in the UK.
- UK University of the Year 2020 (The Times and Sunday Times).
- Research in quantum materials
- Traditional student pierwalk

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Note also the alternative entry route: Physics and Astronomy (Gateway) BSc (FH31) and MPhys (FH3C)

(See page 8 for Entry Requirements)
The School
Along with several other science Schools, Physics & Astronomy lies on a pleasant modern site close to the town centre, as pictured on the back cover of this leaflet. Teaching, research, library and computing facilities are in our building, and the well-equipped University Observatory nearby has the largest operational optical telescope in the British Isles.

Having about 40 members of teaching staff and around 150 research staff and students, the School is large enough to provide a wide coverage of physics and astronomy at undergraduate level and lively enough to produce significant research. However, the School is small enough for staff and students to get to know each other in a way that is not possible at much larger universities. Some 60-100 students per year graduate from the School. The comparatively small size of the University as a whole facilitates the ready mixing of those studying different subjects. There is a cosmopolitan feel to St Andrews, with students from all over the UK, and indeed from around the world.

BSc and Integrated Masters Programme Details
A five-level structure is used in order to provide suitable entry and exit points tailored for students with different backgrounds and desires. These levels, which usually last an academic year each, are shown in the table on pages 8 and 9. There can be a choice of entry level depending on school qualifications and how broad you wish your entry year to be.

First year entry has been designed for those entering straight from Scottish Highers, those wishing to experience the traditional broad-based first year at university, and students on some joint programmes. If you have good Advanced Highers or A-Levels, and you are sure that you wish to study for a degree in physics and/or astronomy, you are invited to enter directly into second year. Currently around one third of our entrant students take this accelerated route entry.

There is an alternative first year entry called the Physics and Astronomy (Gateway) designed for students with high academic potential who have experienced disadvantage. Slightly lower qualifications (e.g. ABBB at Higher) are needed for entry. About half the entry year is with the traditional entry students, about half is on strongly tutored modules in academic skills relevant to physics and mathematics. Successful completion of this year allows progression to our second year physics, astrophysics, and mathematics modules. www.st-andrews.ac.uk/subjects/physics/gateway-to-physics

There is a choice of exit levels with the BSc Honours degree taking three or four years and the more advanced MPhys and MSci Honours degree taking four or five years, depending on the point of entry. The Integrated Masters degree is particularly appropriate if you wish to go on to pursue a research or development career in physics or astronomy. Your final decision on the BSc or Integrated Masters degree need not be made until third year.

“To study Astrophysics here is a true privilege. The staff all care deeply about their students and are always on hand to help, which I have found greatly reassuring. The flexibility offered is amazing- I was able to study French and Astrobiology in my 1st year along with all the required maths and physics courses. Studying here may be challenging but it’s never boring!”

Ishbel
In third and fourth year you take some or all of the mainstream modules in quantum mechanics, nuclear and particle physics, thermal and statistical physics, electromagnetism, computational physics, and condensed matter physics, as well as choosing additional modules in specialist areas. Depending on the degree programme these might include extragalactic astronomy, computational astrophysics, special relativity and fields, fluids, laboratory modules and many others. All final year students undertake a major research project, which is often carried out within one of the School’s research groups.

The MPhys additional year contains a choice of advanced lecture modules in areas such as biophotonics, group theory, Monte Carlo radiation transport techniques, applications of quantum physics, magnetofluids and space plasmas, and contemporary astrophysics, as well as a major research project. All our BSc, MPhys and MSci degrees are accredited by the UK Institute of Physics.

In all modules, lectures are supplemented by tutorials. At second and third year these tutorials may be in groups comprising only four or five students. Tutorials provide the opportunity for in-depth discussions of issues arising from lectures, as well as broader topics in physics and astronomy.

Appropriate laboratory periods introduce you to a wide range of equipment and techniques. Third and fourth year physics lab modules, for example, contain work with scanning tunnelling microscopes, X-ray crystallography, cryogenics, and optical tweezers. Astronomy students have the use of telescopes at the Observatory.

In your final year you can participate in the extensive research activity of the School by undertaking a project which extends over a large part of the academic year. This is a great way to learn and experience the development of physics at first hand. Some projects result in scientific publications, and may include travel to international facilities. Recent projects have included the investigation of extra-solar planets, the use of our cleanroom to explore novel liquid micro-optics, the use of terahertz radiation for drug detection, and the theoretical physics of invisibility cloaks.

For Single Honours students in the School, advanced communication and other skills are developed in the 3000-level Transferable Skills for Physicists module, which includes an informal weekend spent away from St Andrews, giving a talk on a chosen topic in physics or astrophysics.

Depending on the modules you have chosen to take, it is possible to postpone the final choice of degree title at least until you reach 3000-level. Many students make use of this flexibility.

**Teaching and Research Quality**

In the latest Research Excellence Framework (REF) our research in physics and astrophysics was ranked third in the UK for quality. The submission to REF was joint with the physics and astronomy research programme at Edinburgh University, both Schools being part of the Scottish Universities Physics Alliance.

The formal review of our teaching programme in 2018 commented on the “attractive, balanced and modern presentation of Physics and Astronomy” and “a well-functioning School with a healthy student-staff relationship”.

Our students also hold our teaching and their experience in high regards, with the School of Physics and Astronomy and the University coming first in the UK for student satisfaction (National Student Survey 2019).

“I felt incredibly welcome when I arrived in St Andrews, and quickly noticed how the staff and students seemed to bounce off each other in a very unique way. One of the highlights of my time here has been working with a condensed matter physics research group: this has given me an even deeper passion for my subject and, like many things in physics, was a lot of fun!”

Martin

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Martin
This information is for guidance only. For Joint Honours degrees the subject with the higher entrance requirements determines the likely minimum grades. Admissions Officers consider all aspects of every application, particularly the Personal Statement. Remember that you must also meet the Faculty Entry Requirements: www.st-andrews.ac.uk/subjects/physics

St Andrews uses contextual data to assess UK applications. Our indicator will tell you whether you are likely to need to achieve the ‘standard’, ‘minimum’, or ‘Gateway’ entry requirements. www.st-andrews.ac.uk/subjects/entry/indicator

*Direct entry to second year of the joint degrees with Mathematics is also possible. Typically required grades in Advanced Highers and IB as for Single Honours, A-Level qualified applicants also need A in Further Mathematics.
Scholarships
The School offers a number of scholarships of £1,000 or more to selected students. Details are on the School website: www.st-andrews.ac.uk/physics/pandaweb/admiss/bursaries

The University has a variety of other scholarships on offer: www.st-andrews.ac.uk/study/fees-and-funding/scholarships

Visits to the University
The University organises Visiting Days for prospective students to visit the University and see for themselves the Schools in which they are interested. These take place on a number of Wednesdays through the year. They include an introduction to the University and town, as well as visits to relevant Schools. The School runs a special Visiting Day on one Saturday in February each year. Please see the School’s web pages or contact us for details. On request, visits may be organised at other times as well. Please see the back cover for contact details for arranging such visits.

International links
We are pleased to welcome a number of overseas students to our School for a semester, a year, or the full degree programme. Our University has exchange links with a number of overseas universities. Students may apply to be considered to spend third or fourth year at one of these institutions.

The School’s Student-Staff Council organises summer placements for selected students at international facilities such as the High Magnetic Field Facility in Grenoble.

Research links are maintained with scientists in many countries.

Career Opportunities
Degrees in physics and related subjects are welcomed by employers, and St Andrews graduates do well at finding employment in areas of their choice. A significant number of graduates go into some form of research or development in industry or in Government agencies, either immediately after graduation or following a higher degree. Examples of high technology industries in which physicists work include optoelectronics, computing, telecommunications, aerospace, and semiconductors. In our degree programmes we work with students to develop relevant skills such as problem solving, mathematical modelling, and the ability to communicate complicated ideas. These skills also make for graduates who are well-suited for more general careers in management, banking, and related areas. A good physics training opens the door to many different careers. We have a number of graduate profiles on our School website. These include graduates who have entered careers in research (various universities and companies), software consultancy (QAS, London), intellectual property law (Bristows, London), accountancy (Deloitte), and a pair of graduates who started up a small business in scientific displays (FifeX, Tayport). www.st-andrews.ac.uk/careers/exploring-your-future/destinations

“Joining St Andrews for astrophysics, I was elated to witness such a strong sense of community between the physics department students and staff. Being encouraged to discuss captivating topics with lecturers outside of teaching hours is one of the many things that has enhanced my university experience. I’ve particularly enjoyed applying my astronomy knowledge at the Astronomical Society’s observatory based public stargazing nights each week.”

Manraj
Student experience

St Andrews offers you a student experience like no other, currently voted the best in the UK in the National Student Survey (2019). There are societies, sports clubs, traditions and events throughout the year, so whether you have existing activities you want to continue or want to explore whole areas, you will always find something to get involved in.

The School’s students run AstroSoc and PhySoc with social and academic events associated with astronomy and physics respectively. The School’s Student-Staff Council also plays an active role in academic and other events, including a dinner-dance for students and staff.

“My love of numbers and equations drew me towards studying physics. The highly modern and well-equipped labs make studying experimental physics a great experience at St Andrews. The staff in the School of Physics & Astronomy make studying at such a world-class university easier. My advisor told me exactly what to expect and gave me guidance throughout the year. There is always someone in the School to speak to, whether for a chat about quantum mechanics or a motivational pick-me-up during a tough week. You can be guaranteed that you’ll get to know your lecturers well and feel supported throughout all your years at St Andrews.

Settling into St Andrews and the School is an enjoyable process, with many events held during Orientation Week, including the Physics Society brunch and Astrophysics Society BBQ. The vast number of societies and sports clubs ensures you can find something that suits your interests and meet some great new friends. I have been in the handball club for almost four years and have made some of my best friends from all around the world.

St Andrews has a very strong community amongst the students, supported by the wider university. It’s a welcoming and supportive place to be.”

Andie
The School has a successful research programme exploring a range of fundamental and applied areas of physics and astronomy. The latest Research Excellence Framework ranked the quality of our research (joint with Edinburgh) third across UK physics departments.

With most teaching staff directly involved in research you can expect to find classes that are informed by the latest research in astronomy and physics, and taught in many instances by internationally-recognised experts in their fields. Through their research many staff also have useful links with companies and organisations. The links between teaching and research are probably strongest for students in their final-year project, which they often undertake within one of the research groups and with access where appropriate to specialised equipment, some of which is unique within the UK. Our Centre for Designer Quantum Materials, for example, includes apparatus for growing new materials one layer of atoms at a time, and for exploring these designer materials using techniques that can image its electrons and measure their properties with atomic resolution.

The main research activities of the School are in the areas of: Astronomy and Astrophysics, Laser Physics and Optoelectronics, Biophotonics, Quantum Optics, Magnetism and Superconductivity, Quantum Materials, Millimetre-wave Techniques, and Theoretical Physics. The School is a member of the Scottish Universities Physics Alliance, which is a major collaborative project enhancing physics research in Scotland.

Research and Students
Our undergraduate students have various opportunities to interact with the research work of the School. The most obvious is the final year project, which sees most students working with one of the research teams.

The School’s research informs our teaching generally. In some of our first year labs students carry out a research-style investigation, followed by a visit to a relevant research lab. Third year students can explore topics of local research and present this to the class in the Transferable Skills for Physicists module. Final year lectures can take students to the current research frontiers. There are opportunities for funded summer internships with our research groups, and astronomers can, after suitable training, have access to some of the Observatory’s telescopes to carry out their own investigations.

Recent research contributions to science from our School include:
- The discovery of the nearest yet seen rocky planet outside our own solar system.
- Exploring black hole physics in a special optical fibre.
- The development of light emitting polymers to sniff for landmines.
- Using optical forces to create the fastest man-made rotating object.
- Wide-field high-resolution imaging for neuroscience and developmental biology.
- Tracking biological cells through feeding them microlasers.
- Imaging of magnetism at the atomic scale in quantum materials.
- Controlling novel electronic states in atomically-thin materials.
- Theory of how to build quantum materials that absorb light at a super-fast rate.
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“Since graduation, I have built on skills developed in St Andrews to work as a Graduate Research Assistant at KP Technology, conducting research in collaboration with scientists worldwide and studying for a PhD. Our specialism is the measurement of the energy levels of materials, with applications including semiconductors, solar cells and forensics. An enjoyable and exciting future is just beginning!”

Susanna
Curriculum Development
As a research intensive institution, the University ensures that its teaching references the research interests of its staff, which may change from time to time. As a result, programmes are regularly reviewed with the aim of enhancing students’ learning experience. Our approach to course revision is described at:
www.st-andrews.ac.uk/media/teaching-and-learning/policies/course-revision-protocol.pdf

Photographs (unless noted in captions) by: Peter Adamson, broad daylight, Christopher Davy, Guthrie Aerial Photography, A Robotham, Rhona Rutherford, Laurence Winram, and others. Produced by Print & Design, University of St Andrews, September 2019.

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