



Physics
Undergraduate Degrees 2024

Welcome

I am proud to be head of one of the top physics departments both for physics education and for research in the UK.

Based on our broad range of world-leading research, we provide flexible and engaging degrees that allow our students to experience the full fascination of the subject. Through project work, extracurricular activities and an open-door policy, we offer a unique and inclusive study experience with degree programmes and pathways that are constantly evolving along with the frontiers of the discipline. Our Department plays a significant positive role in science and society and has contributed to Nobel prize winning research with colleagues at international facilities such as CERN, the Laser Interferometer Gravitational-wave Observatory and the Sudbury Neutrino Observatory, discovering new galaxies, setting low temperature records, or by creating new materials and quantum devices. We go beyond traditional research to apply physics in an impactful manner, for example, we repurposed our software to prevent forest fires, apply identification techniques to aid disaster relief, and regularly provide outreach events for the community. In all these activities, our students have many opportunities to be involved.

I hope that this subject brochure will be the beginning of your own rewarding journey leading to a deeper understanding of our world.



Professor Roger Jones
Head of Department

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Disclaimer

The information in this brochure relates primarily to 2024/25 entry to the University and every effort has been taken to ensure the information is correct at the time of printing in June 2023. The University will use all reasonable effort to deliver the course as described but the University reserves the right to make changes after going to print. You are advised to consult our website at lancaster.ac.uk/study for up-to-date information before you submit your application. Please see lancaster.ac.uk/compliance/legalnotice for further information.

What can we offer you?

What to expect from our highly ranked department.

Flexible degrees

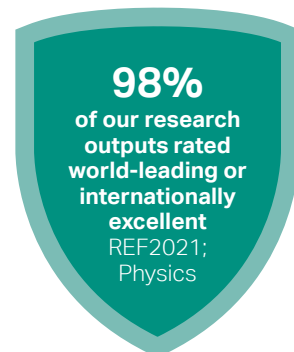
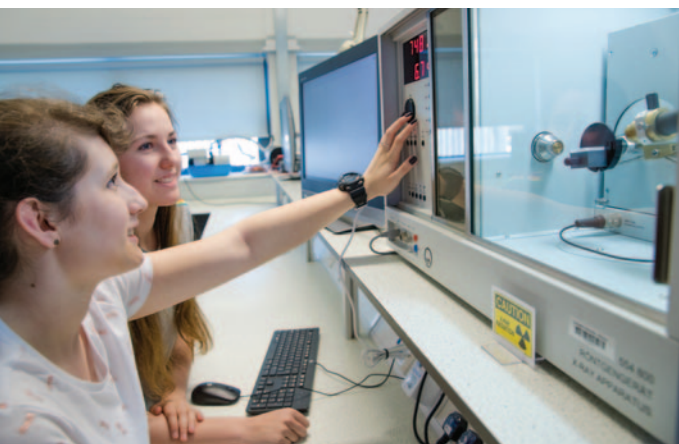
All our single honours subjects have a common first year, meaning you will benefit from exploring all areas of physics, and you can change your degree specialism up until the end of your first year.

Research-led teaching

Teaching is directly informed by our world-leading, experimental and theoretical research. You will benefit from expert lecturers, engaging projects and access to state-of-the-art facilities.

Supportive department

We build a diverse and supportive community, with dedicated academic advisors, disabilities officers and an open-door policy. This means there is always someone to support you through your studies.



A supportive environment



First of all, thank you for taking the time to learn about Physics at Lancaster. My name is Jon Prance and I am the Director of Teaching. I also do research in Low Temperature Physics and Quantum Nanotechnology. My goal is to cool tiny electronic circuits to the lowest possible temperatures and build devices that use quantum mechanics to do otherwise impossible things. I love sharing my research with students through project work and lectures, and this is something we do throughout our degrees.

We strive to provide a supportive and friendly learning environment for all students. Approachable lecturers and dedicated academic advisors help to guide you through your studies. We also know that regular, helpful feedback is essential in developing your understanding and confidence. All of our degrees include regular coursework assessments as well as practical work and projects. These encourage you to put what you have learned into practice and gain feedback on how to improve.

Deciding where to study is obviously an important choice and also a very personal one. If you do apply to Lancaster, I think you will find a welcoming environment and staff who are committed to supporting you through your degree and onwards into your future career.



Dr Jonathan Prance
Director of Teaching



Open-door policy

Our open-door policy means that help is never far away. Have a question about your coursework? Just ask.

Continuous feedback

We continually provide academic feedback and keep you informed of your results. A very large part of your lab, project and coursework counts towards your final degree mark – this allows us to make the assessment meaningful, in recognition of the fact that in-depth scientific research requires time.

As a rough guide, 40-50% of your degree marks will be based on this continuous assessment, with the remainder based on exams.

High-quality contact time

In a typical week during your first year, you will have 8-12 hours of lectures and workshops, 3 hours of seminars and 3 hours in a lab. In later years, the balance between lectures, seminars and lab work will change depending on your chosen degree specialism.

You will work closely with other students and staff in laboratories, have the opportunity to have solutions explained and receive any support you may need. You will participate in demonstrations of the physical phenomena described in lectures, learn to use scientific equipment and develop skills in taking measurements, drawing conclusions and writing reports.

You will also carry out extensive research projects, first in groups and then under individual supervision, where you apply your knowledge and actively contribute to the development of the field.



For more information please visit lancaster.ac.uk/physics

A community for you

In the Physics Department we foster an inclusive and friendly community and are proud to get you involved to make sure you can get the most out of your time here. Here are just a few ways you can become involved outside of your degree.

Societies

The Physics Department has two societies that you can get involved in.

The Physics Society (LUPhys)

You'll be welcomed into an inclusive society that focuses on our Physics Department family. From annual events such as our Christmas dinner and summer BBQ, to games nights, evenings out, academic talks and our football team, there's something for everyone to get involved in.

The Lancaster University Astronomy Society (LUAstroSoc)

For keen astronomers and beginners alike, this society provides you with the opportunity to use our telescopes when the weather is clear, weekly group meetings with seminars given by students and space themed social events.



Student reps

You can become a student rep for a number of committees, such as the Staff and Student Consultative Committee and the Safety Health & Welfare Committee. By doing so you are becoming the voice for your peers and helping shape the Department for you and the generations to come.

Inclusivity

We proudly promote inclusivity within the Physics Department and have both the Athena SWAN Silver Award and the IoP Juno Champion status. We also have an Inclusion in Physics group which meets regularly, arranging informative talks and providing a forum for members to share their experiences and discuss career and research options.

Student Ambassadors

We regularly recruit Student Ambassadors to provide support to the Department with recruitment events such as Open Days and Interview Days and work with outreach and engagement to encourage others to learn about physics. This is a great way of sharing your passion and experience, and developing your skills whilst earning money.



Scan to hear Maya's experience of life in the Physics Department



When did you know Physics at Lancaster University was the place for you?

When I came for my interview. I was so nervous about it, hoping I'd know enough physics to impress the interviewer. Everyone was so nice, and the campus was so pretty, I knew straight away that this was the university I wanted to go to.

What makes the facilities so great?

How open everything is. I never felt shy to go to one of the many study spaces and work on some questions or go to an academic's office to ask for some help (or even just for a chat). I think it's important for students to feel comfortable where they work and the Physics Building excels at creating that atmosphere.

What is your favourite aspect of your course?

The fact that there are so many different aspects of my course. There's Coding and Astrophysics; Mathematics and Theoretical Physics, I like the idea of waking up every day almost doing something completely new but that I still find really fascinating. Also, I really enjoy the collaborative aspects, me and my friends working on the coursework together have created some of my most fond memories of my time here.

What are you going to do after your degree?

I hope to continue in the line of physics, something hands on that I find equally as exciting as my current course if not more. Physics at Lancaster has shaped me to be able to go on and effectively do whatever I want so the sky's the limit really.

What do you like about Physics at Lancaster?

Overall, I like how much fun it is to work here. The coursework is challenging yet manageable, the people are delightful, and the scenery and atmosphere of Lancaster are just divine. I feel like I'm genuinely friends with some of my lecturers which makes life in the Department for me just that bit more enjoyable. We also learn some absolutely fascinating things in our lectures from the tiniest quark to the most massive of stars, it makes physics feel like the study of everything for everyone.



April Dalby



MPhys Physics, Astrophysics and Cosmology

Equipped to achieve excellence

You will benefit from our unique and world-leading research facilities. This includes specialist equipment and materials in our Quantum Technology Centre, IsoLab and Ultra-Low Temperature Lab. You will also have access to a wide range of learning resources, from our own computer suites and new teaching laboratories to the 365mm Schmidt-Cassegrain reflecting telescope.

We also have direct involvement in international collaborations such as the Large Hadron Collider at CERN, T2K in Japan, space science experiments inside the Arctic and Antarctic circles, ESA's JUICE mission en-route to Jupiter, the James Webb Space Telescope COSMOS and JELS collaborations, and the Vera C. Rubin Observatory.

These provisions significantly enhance your research projects, allowing you to use cutting-edge equipment on-site and providing research data from international facilities.

$$B = \frac{A}{(R^2 + z^2)^{3/2}}$$

$$N = \frac{2BR}{\mu_0 I}$$

$$\alpha_N = N \sqrt{\left(\frac{\mu_0 I}{I}\right)^2 + \left(\frac{\mu_0 B}{B}\right)^2}$$



What attracted you to study Physics at Lancaster University?

Lancaster's strong position in university league tables, particularly in the student satisfaction area, really stood out to me when looking at universities. The research-led teaching and flexible degrees schemes also stood out to me as I was still unsure at the time on what part of physics to specialise in.

When did you know it was right for you?

I knew Lancaster was the place for me after speaking to Student Ambassadors and academics at the Interview Day. Everyone I spoke to was really welcoming and friendly, which left me comfortable and excited about coming here. The emphasis on supporting students, shown by the open-door policy and continuous academic feedback, was also a big factor in me choosing Lancaster.

Did you visit the Department? What were your thoughts?

I was really impressed by the amount of study spaces available for students in the Department. I also liked how close the study spaces were to the staff offices, meaning that help was only down the corridor if I had any questions.

What has been your favourite aspect of your course so far?

My favourite module has been the Industrial Group Project, where I worked in a team tasked with solving a problem for a company. My team had to test the motion and temperature sensors of a robot to determine if it was suitable for Martian exploration in the future. The experience has taught me many transferrable skills, and I enjoyed working with three others towards the same goal.

What do you do in your spare time?

I'm part of the ABACUS society, where I socialise and do fun activities with other British-born Asian students at the University. I also like to play pool at the college bars and in town. On Wednesdays, I take part in "physics football" which is a huge game of football comprised of physicists and friends. The level is not too high which suits me very well!



Ben Cheung



BSc Physics

The place for the researcher

Our world-leading research

We are active in a wide range of research areas and teaching on our degrees is directly informed by our experimental and theoretical research. Our staff include many leading authorities and work with world-leading facilities.

Research in our Department is structured into four major research areas:

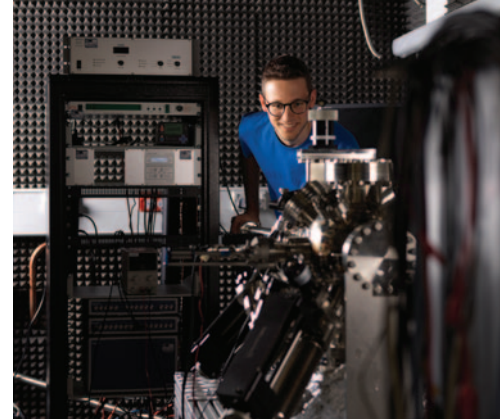
Astrophysics

Particle and Accelerator Physics

Experimental Condensed Matter Physics

Theory

For more information please visit lancaster.ac.uk/physics



Astrophysics

We use space- and ground-based observations and experiments, as well as theory and modelling, to tackle important open questions in Astrophysics, Cosmology, Space Physics and Planetary Physics. Our research spans topics from space weather in the solar system through to galaxy formation and the evolution of the Universe from the earliest times to the present day.

Particle and Accelerator Physics

We study the forces and interactions that shape our Universe, conduct searches for new particles, and build the technologies and mathematical models that will be needed for future generations of particle accelerators. We are striving to answer fundamental questions such as why particles have different masses and why the Universe is made of matter and not anti-matter?

Experimental Condensed Matter

We perform experiments at temperatures close to absolute zero, build and operate nanometer-scale electronic, optical and mechanical devices, study new materials, and seek to understand the dynamic behaviour of biological systems. By working with industrial partners and startup companies, we are developing new technologies for imaging, sensing and information security.

Theory

Our research concerns the theoretical properties of condensed matter systems and molecular-scale devices, and the development of new mathematical techniques to predict the classical and quantum behaviour of light and matter. By studying systems ranging from artificial materials to ultra-intense plasmas, we seek to advance the mathematical descriptions that underpin our understanding of the physical world.



Becoming the researcher

Our degrees are designed to link strongly to our research - providing an up-to-date physics education that is engaging and inspiring to our students and contributes to excellent student-staff relations. As a Lancaster student you will benefit from this, not only through the wide choice of optional modules and research projects, but also from the enthusiasm and expertise of our staff in these subjects.

Throughout your degree you will have the opportunity to undertake exciting research projects, solving a real problem on a topic of your choice whilst being supervised by expert researchers.

You will complete a succession of projects, commencing with a computer project in second year and progressing to open-ended research projects of increasing complexity in the following years. This includes a group project on a current research topic in third year, and an extensive, individually supervised research project in the final year of the MPhys/ MSci programmes.

The topics are closely connected to our broad portfolio of world-leading research, and provide you with an opportunity to make an active contribution to actual research.

Research specialisms

Observational Astrophysics
Theoretical Particle Cosmology
Space and Planetary Physics
Experimental Particle Physics
Accelerator Physics
Low Temperature Physics
Quantum Nanotechnology
Nonlinear and Biomedical Physics
Condensed Matter Theory
Mathematical Physics
Theory of Molecular-Scale Transport



Exciting research projects

Recent third year group projects include:

- **Particle physics:** studies of cosmic-ray particles from outer space, measurements of trace gamma radiation from a range of rock samples, studies of exotic baryons detected by bubble chambers
- **Industrial projects:** working with external organisations to build a demonstration of a community solar panel scheme, compare simulations of radio signal strength to real-world results, and analyse conductive nonwovens for resistive heating of wind turbine blades
- **Cosmology:** solving the Age of the Universe problem using the Cosmological Constant or Dark Energy and using satellite data to pinpoint the characteristics of Dark Energy
- **Theoretical physics:** cellular automata for modelling the spread of covid-19, machine learning, simulating quantum computers, chaos and topology
- **Astrophysics:** working with data collected from the Hubble Space Telescope and the Cassini-Huygens mission to explore outstanding questions in galaxy evolution, active galactic nuclei, moon-planet interactions, and planetary aurorae
- **Quantum technology (New for 2023/2024):** explore topics like the dynamics of electron spins and conduct experiments into quantum optics

Recent MPhys/MSci projects include:

- Physics for healthcare
- Novel nanoscale detectors
- Modelling of stellar winds
- Studies of the Earth's aurora
- Studies of Saturn's ring current and aurora
- Topological defects in rhombohedral graphite
- Quantum effects in curved spacetime
- Model-building cosmic inflation
- Thermodynamic costs of entanglement dynamics and transition
- Neutrino interactions in the T2K near detector
- Development of future neutrino experiments
- Studies of exotic atoms using quantum Monte Carlo simulations
- Galaxies and dark matter
- Superfluid wind tunnel
- Galaxy formation and evolution across cosmic time

Opportunities for you

Third and fourth year students take part in The Physics at Lancaster Annual Conference and Exhibition (The PLACE). It is a relaxed and fun event, held near the end of summer term after final year exams so you can fully embrace the conference experience.

Following your project, you write up your results, create a poster and present your work to your fellow students and staff. To help with this, you are taught research and communication skills, including poster design, in the final year project module. It offers you a chance to develop presentation and communication skills in a friendly atmosphere and get a feel for presenting to a large group of people, something you may well need to do when you enter the workplace.

Embedding employability in the curriculum is a key aim of the Department. As part of The PLACE we run an employer exhibition, where we invite industry partners and local companies to join us at the conference. This provides a great opportunity for you to present your work to companies, hear talks from the employers, and talk with them about opportunities after your degree. Employers join us from a wide range of areas from energy and education to healthcare and navigation.



For more information please visit lancaster.ac.uk/physics



Emma's PLACE Experience

Emma Marshall
PhD student ATLAS, CERN

“

The PLACE was one of the highlights of my undergraduate degree at Lancaster University. As someone who came to university very shy it was something I was a bit worried about, but having spent time working on the projects I presented about I ended up really excited to talk about them! The work you do throughout the year prepares you well to present your results, and often I found I had to make sure I wasn't talking about it for too long!

The Physics Department did a really good job of emulating a conference environment for The PLACE without being it too intimidating. Being in a familiar lecture theatre helped put me at ease while presenting to 100+ people about my research. It really gave me a flavour of what it would be like to present results in an academic environment and extra confidence that I could do this in a PhD! It was also really interesting going to my friends' presentations and learning more in depth about what they had been doing in their projects, as well as looking at the Master's project posters and chatting to people about their poster and research.

”



Hello Future

Preparing you for your next step and helping you achieve good employment prospects is paramount for the Physics Department. Our graduates find employment in high-technology industries, medical and telecommunication businesses, computer programming, public health and teaching programmes, as well as in consulting, finance and accountancy and further research.

Transferable skills

Our degree schemes will develop your transferable skills such as critical thinking, problem solving, numeracy, computational skills, communication skills, and team working, which are all highly valued by both employers and academia.

Employability Champion

Our dedicated Employability Champion provides individual support, organises trips to careers fairs and runs the Employability Booster programme. This is designed to help you achieve the career you want and prepare you for your future.

Internships

Each year we offer a number of internships for our students, which will give you a relevant work experience and the opportunity to apply your academic knowledge in real-world situations.

Industry and placements

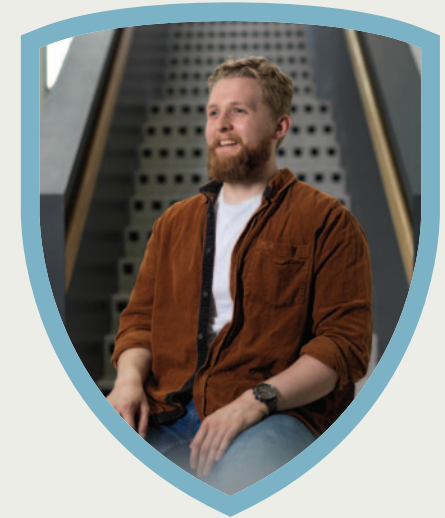
You will benefit from our direct links with industry and outside agencies, which contribute to the range of our third and fourth year projects and fund departmental research.

What else?

You will have ample opportunity to further enhance your CV, for example, acting as a Student Ambassador, taking part in outreach activities, or by joining student societies and participating in the University's Lancaster Award. You will also take part in The Physics at Lancaster Annual Conference and Exhibition (PLACE) which gives you the valuable experience of presenting work to an audience.



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Ben Frondigoun
MPhys Theoretical Physics

When did you know Physics at Lancaster University was the place for you?

I remember leaving my Interview Day and feeling a huge sense of community within the Department which I hadn't seen elsewhere, and I knew that was something I wanted to be a part of with my studies.

What makes the facilities so great?

The Department has a huge amount of space for students to work, from the atrium to the breakout rooms to specialist spaces like the Astro lab. As a theorist who spends very little time in labs, it's nice to be able to come and work in such an open environment.

What is your favourite aspect of your course?

The huge amount of project work in the degree from second year and beyond is something I've enjoyed massively. Be it working individually or in a group, I've had many opportunities to produce exciting original work throughout the degree.

What are you going to do after your degree?

In September, I will be starting a graduate scheme as a software engineer with an international company.

What do you like about Physics at Lancaster?

For me, the community is the biggest appeal of Physics at Lancaster. On top of the incredibly high quality of education and facilities, I feel like I've got to know a huge number of great people through the Department, with everyone always looking to help each other.

”

The right degree for you?

Accredited by the Institute of Physics (IoP), all of our degrees provide you with a comprehensive education, and cover all the general and specialist skills valued for further study and employment in the private and public sectors.

3 or 4 years?

We offer a choice of 4 year MPhys Hons degrees and 3 year BSc Hons degrees. Providing you are meeting academic requirements you can easily transfer from 3 to 4 years up until term 2 of your third year. The additional year in the MPhys degrees contains an extended research project, which is ideal if you are considering studying for a PhD in the future or aiming at a research-based career outside academia.

More maths?

We also offer a BSc/MSci degree in Theoretical Physics with Mathematics, taught jointly with the Department of Mathematics and Statistics. This means that there is extra maths content, and you will also receive extra support from the Department of Mathematics and Statistics.

Single honours

All our single honours courses share a common first year, meaning you can switch degree schemes up until the end of your first year. As a result, you only need to submit one application to the course that interests you most, confident that you can change whilst at Lancaster.

Entry criteria

For all degree schemes, the A-level entry requirements are AAA, including A in Physics and A in Maths (or equivalent grades for those with alternative qualifications). For those doing an Extended Project Qualification (EPQ), the entry requirement is AAB, including A in Physics and A in Maths, plus B or higher in your EPQ. See our website for more details.

For more information please visit lancaster.ac.uk/physics

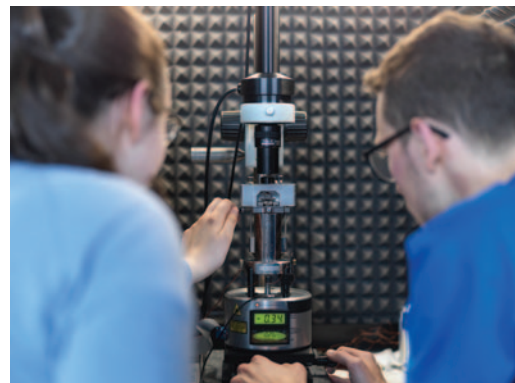
Study Abroad?

If travel is appealing to you we also offer a Study Abroad option with all of our 4 year degrees where you can spend your third year studying at a partner institution overseas.

Scholarships

The Physics Department rewards excellence by offering an academic scholarship for high-achieving applicants. This is open to applicants who select one of our Physics degrees as their firm choice and achieve A*A* in A Level Mathematics and Physics, plus an A or higher in a third A Level (or equivalent grades for those with alternative qualifications). Eligibility for the scholarship is subject to an interview during the application process. Successful BSc applicants will receive £750 in their first year of study. Successful MPhys/MSci applicants will receive £1000 in their first year of study.

Lancaster University offers a range of additional scholarships and bursaries, see www.lancaster.ac.uk/ugfinance.



Physics

MPhys (F303)

BSc (F300)

Physics is our flagship degree, and you'll find yourself exploring matter, forces, and the Universe around you. This course offers you the flexibility to tailor your degree to suit your interests. We've put together a list of optional modules to guide you in your selection, whether that's continuing down the main physics route or focusing on a pathway.

We offer pathways in:

**Quantum
Physics**

**Particle
Physics**

**Particle Physics
with Cosmology**

Our modern curriculum provides you with a broad conceptual and practical knowledge of physics that is used in present-day research. We are research leaders in many areas including Quantum Technology, Low Temperature Physics, Particle Physics, and Theoretical Cosmology, and you'll be taught directly by experts so that you benefit from their specialist knowledge.

Why choose a pathway?

If you choose a pathway, you will take the modules within Physics that provide the most exposure to that field. This includes laboratories, a group project and lecture modules most closely associated with that specialism.

Quantum technology is an emerging field of research. It uses unique properties of quantum mechanical systems to build better sensors, more secure communications systems, and new ways for processing information.

Particle Physics and Particle Physics with Cosmology will allow you to work with state-of-the-art particle accelerators to investigate and identify the nature of space and time.

Course content

The "common core" refers to the core modules that you will study throughout the degree – these are studied by all students, across all single honours degree schemes and pathways. Examples include:

Year 1

- Electric and Magnetic Fields
- Classical Mechanics
- Oscillations and Waves

Year 2

- Quantum Mechanics
- Relativity, Nuclei and Particle
- Electromagnetism, Waves and Optics

Year 3

- Atomic Physics
- Solid State Physics
- Statistical Physics

Containment Simulation

- Randomly threw the position of a neutrino interaction in a SuperFGD sized box
- Used the momentum of the event and the muon and electron stopping power and range tables to calculate how far the tracks would propagate in the x, y and z directions and therefore how often they would be contained



At the end of year one, we'll ask you to indicate your preference for one of the pathways. There are two options:

Option one – keep your horizons open and explore your interests by selecting optional modules from across our broad spectrum of topics, subject to prerequisites in later years

Option two – choose one of the following pathways

- Quantum Technology
- Particle Physics
- Particle Physics with Cosmology

Lent term of year two is where your degree really starts to flex, as you'll study a range of fascinating modules based on these choices. In year three, with fewer core modules you can continue to specialise within your chosen pathway or explore the full breadth of our optional modules.

The full list of core and optional modules for years three and four can be found on pages 26-27.

What if I want to change my choices?

That's fine! We're happy to guide you in choosing different modules.

Did you know?

Because all our single honours degrees have a common core, you can switch to one of our other degree schemes up to the end of Year one if you feel that it will suit you better.



Third Year Group Projects

All our students take on a group project in year three. Your group project will reflect the pathway you have taken. If you chose option one, you can complete any one of the below projects.

- Quantum Technology
- Particle Physics
- Industrial Group Project

Fourth Year MPhys Projects

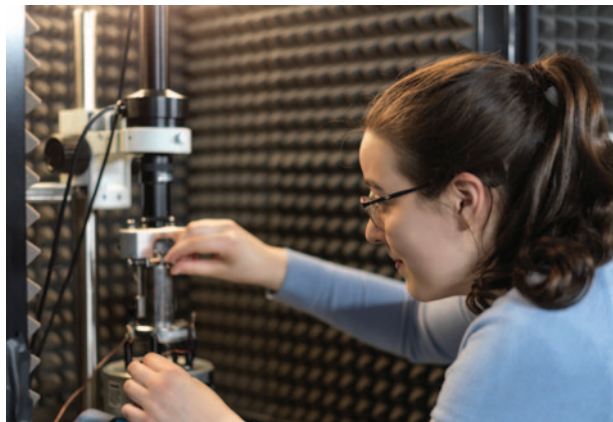
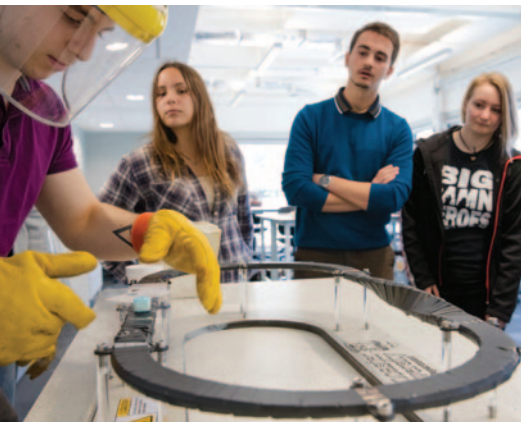
In the final year of the MPhys, you will complete an extended investigative project. You can use experimental data from the Large Hadron Collider at CERN or various neutrino experiments around the world, or undertake experiments in one of our leading research groups with access to our state-of-the-art facilities.

Optional modules - Year 3

	Physics	Quantum Technology	Particle Physics	Particle Physics with Cosmology
Introduction to Astronomy & Astrophysics	✓	✓		
Physics of Fluids	✓	✓	✓	✓
Groups and Symmetries	✓	✓	C	C
Physics of Quarks and Leptons	✓	✓	C	C
Physics of Living Systems	✓	✓	✓	✓
Energy	✓	✓	✓	✓
Computer Modelling	✓	✓	✓	✓
Space and Auroral Physics	✓	✓	✓	✓
Lasers and Applications	✓	✓	✓	✓
The Early Universe			✓	C
Advanced Stellar Astrophysics			✓	✓
Stellar Structure and the Interstellar Medium			✓	✓
Solid State Quantum Technologies	✓	C	✓	✓
Quantum Information Processing	✓	C	✓	✓
	<i>Pick 3 or 4, depending on group project</i>	<i>Pick 1</i>	<i>Pick 3</i>	<i>Pick 2</i>

✓ = optional module (subject to prerequisites) C = core module

*Not all optional modules are available every year



For more information please visit lancaster.ac.uk/physics

Optional modules - Year 4

	Physics	Quantum Technology	Particle Physics	Particle Physics with Cosmology
Advanced Relativity and Gravity	✓	✓	✓	C
Experimental Methods in Particle Physics	✓	✓	C	C
Gauge Theories	✓	✓	C	C
Statistical Data Analysis in Physics	✓	✓	C	C
Physics of Space Plasmas	✓	✓	✓	✓
Advanced Magnetism	✓	✓	✓	✓
Quantum Transport	✓	C	✓	✓
Quantum Information Processing	✓		✓	✓
Advanced Electrodynamics and Gravity	✓	✓	✓	✓
Matter at Low Temperature	✓	C	✓	✓
Lasers and Applications	✓	C	✓	✓
Physics at the Nanoscale	✓	C	✓	✓
Quantum Field Theory of Many Body Systems	✓	✓	✓	✓
Physics of Fluids	✓	✓	✓	✓
Groups and Symmetries	✓	✓		
Physics of Quarks and Leptons	✓	✓		
Solid State Quantum Technologies	✓		✓	✓
Physics of Living Systems	✓	✓	✓	✓
Energy	✓	✓	✓	✓
Computer Modelling	✓	✓	✓	✓
Space and Auroral Physics	✓	✓	✓	✓
Cosmological Inflation			✓	C
Formation and Evolution of Galaxies			✓	✓
The Early Universe			✓	
Advanced Stellar Astrophysics			✓	✓
Stellar Structure and the Interstellar Medium			✓	✓
	<i>Pick 6</i>	<i>Pick 2</i>	<i>Pick 3</i>	<i>Pick 1</i>

✓ = optional module (subject to prerequisites) C = core module

*Not all optional modules are available every year

Physics with Astrophysics

MPhys (F321)

BSc (F340)

Supernovae, black holes, and distant galaxies – there is much to discover, and it holds the key to our existence. Our Physics with Astrophysics course will allow you to develop your understanding of the relationship between the physical laws of the Universe and the astrophysical and cosmological domains. This course can be tailored to meet your interests, and, in addition to studying astrophysics, students are able to specialise further in the following pathways:

Astrophysics with Cosmology

Astrophysics with Space Physics

Our lecturers conduct world-leading investigations into space and planetary science, observational astrophysics, and observational and theoretical cosmology – their research directly informs what you will learn!

Course content

All single honours degree schemes study the "common core" curriculum as described on page 24. From Year 2 onwards, degree scheme specific and optional modules play an increasingly larger role until you graduate.

Near the end of your first year studying the "common core" curriculum, we'll ask you to indicate whether you would like to study along one of our more specialised pathways. Year two is where you'll start to delve deeper into astrophysics, with enthralling lectures in cosmology, astronomy, and solar system science. The Physics with Astrophysics core modules in year two include:

- Introduction to Astronomy and Astrophysics
- The Dynamics and Content of the Universe
- Solar System Physics

Did you know?

Because all our single honours degrees have a common core, you can switch to one of our other degree schemes up to the end of Year one if you feel that it will suit you better.

In year three, you have two options:

Option one

Keep your horizons open and explore your interests by selecting optional modules from across the spectrum of topics, subject to prerequisites.

Option two

Study a pathway!

- Astrophysics with Cosmology
- Astrophysics with Space Physics

Examples of core and optional modules for Physics with Astrophysics in Years three and four can be found on pages 30-31.

What if I want to change my choices?

That's fine! We're happy to guide you in choosing different modules.

Third Year Group Projects

In your third year you'll also complete an extended research project. If you have selected the Cosmology pathway, you will take part in the Cosmology or Astrophysics Group Project module, otherwise you'll complete the Astrophysics Group Project module.

Fourth Year MPhys Projects

In the final year of the MPhys, you will complete an extended investigative project in an area that interests you! You could choose to analyse data from the European Southern Observatory, the Hubble Space Telescope, the Cassini mission or one of the many other state-of-the-art facilities that our world-leading researchers are involved with. Prefer numerical work? You can build or work with existing models of fundamental solar system processes such as x-ray emissions from the outer planets.



Optional modules - Year 3

	Astrophysics	Astrophysics with Cosmology	Astrophysics with Space Physics
Physics of Fluids	✓	✓	✓
Groups and Symmetries	✓	✓	✓
Physics of Quarks and Leptons	✓	✓	✓
Physics of Living Systems	✓	✓	✓
Energy	✓	✓	✓
Computer Modelling	✓	✓	✓
Space and Auroral Physics	✓	✓	C
Lasers and Applications	✓	✓	✓
The Early Universe	✓	C	✓
Advanced Stellar Astrophysics	C	C	C
Stellar Structure and the Interstellar Medium	C	C	C
Solid State Quantum Technologies	✓	✓	✓
Quantum Information Processing	✓	✓	✓
Astrophysics Laboratory	C	C	C
	<i>Pick 2</i>	<i>Pick 1</i>	<i>Pick 1</i>

✓ = optional module (subject to prerequisites) C = core module

*Not all optional modules are available every year



Optional modules - Year 4

	Astrophysics	Astrophysics with Cosmology	Astrophysics with Space Physics
Advanced Relativity and Gravity	C	C	C
Experimental Methods in Particle Physics	✓	✓	✓
Gauge Theories	✓	✓	✓
Statistical Data Analysis in Physics	C	C	C
Physics of Space Plasmas	✓	✓	C
Advanced Magnetism	✓	✓	✓
Quantum Transport	✓	✓	✓
Quantum Information Processing	✓	✓	✓
Advanced Electrodynamics and Gravity	✓	✓	✓
Matter at Low Temperature	✓	✓	✓
Lasers and Applications	✓	✓	✓
Physics at the Nanoscale	✓	✓	✓
Quantum Field Theory of Many Body Systems	✓	✓	✓
Physics of Fluids	✓	✓	✓
Groups and Symmetries	✓	✓	✓
Physics of Quarks and Leptons	✓	✓	✓
Solid State Quantum Technologies	✓	✓	✓
Physics of Living Systems	✓	✓	✓
Energy	✓	✓	✓
Computer Modelling	✓	✓	✓
Space and Auroral Physics	✓	✓	
Cosmological Inflation	✓	C	✓
Formation and Evolution of Galaxies	C	C	C
The Early Universe	✓		✓
	<i>Pick 3</i>	<i>Pick 2</i>	<i>Pick 2</i>

✓ = optional module (subject to prerequisites) C = core module

*Not all optional modules are available every year

Theoretical Physics

MPhys (F321)

BSc (F340)

Quite possibly the most astonishing aspect of the world around us is that so much of it can be understood by using a relatively small number of physical laws.

Course content

All students across our single honours Physics degree schemes study the same set of "common core" modules in the first year (as described on page 24), ensuring you are equipped with the fundamentals of physics. Lent term of Year two is where you begin to specialise more specifically in your chosen degree scheme. The Theoretical Physics core modules in Year 2 are:

- The Dynamics and Content of the Universe
- Mechanics and Variations
- Classical Fields

In your third year you'll take "common core" and Theoretical Physics core modules. The third year Theoretical Physics core modules are:

- Groups and Symmetries
- Theoretical Physics Independent Study
- Theoretical Physics Group Project

You'll also choose two additional modules, subject to prerequisites, to tailor your degree to your personal interests.

In the fourth year there's even more flexibility! Your extended research project will provide you with first-hand research experience on a topic of your choice, and you select all of your modules, creating a personalised programme that develops your skills and knowledge in the topics that fascinate you the most.

Third and Fourth Year Projects

The third year Theoretical Physics Project is popular amongst our students, as they work collaboratively to investigate a theoretical physics-based problem. This work is not tightly constrained by defined limits, allowing you to explore open-ended problems and deepen your passion for the area of theoretical physics that interests you the most.

Final year MPhys students will undertake an extended research project on a topic of your choice! Throughout the project, you will demonstrate your ability to plan, manage and execute an investigation. Previous project titles can be found on page 17.

Year 3 optional modules

(pick 2):

Introduction to Astronomy & Astrophysics
Physics of Fluids
Physics of Quarks and Leptons
Physics of Living Systems
Energy
Computer Modelling
Space and Auroral Physics
Lasers and Applications
The Early Universe
Solid State Quantum Technologies
Quantum Information Processing

Year 4 optional modules

(pick 6; at least 3 of these, no more than 3 of these):

Advanced Relativity and Gravity
Experimental Methods in Particle Physics
Gauge Theories
Statistical Data Analysis in Physics
Physics of Space Plasmas
Advanced Magnetism
Quantum Transport
Quantum Information Processing
Advanced Electrodynamics and Gravity
Matter at Low Temperature
Lasers and Applications
Physics at the Nanoscale
Quantum Field Theory of Many Body Systems
Physics of Fluids
Physics of Quarks and Leptons
Physics of Living Systems
Energy
Computer Modelling
Space and Auroral Physics
Cosmological Inflation
The Early Universe

*Not all optional modules are available every year

What do our students think?

Theoretical Physics has been a diverse and challenging course. It's given me the confidence and know-how to tackle complex problems, and provided me with the opportunity to collaborate with other students, which I may not have had the chance to do elsewhere. In my third year, I very much adapted my research project to suit my interests – my research, Superconductivity and its use in Healthcare, definitely helped me to secure my place on the Scientific Training Programme within the NHS. I'll soon begin my three-year training course in Radiation Safety and Diagnostic Radiology and I cannot wait!

Kiera Bernardo - 4th year



Scan to hear Giulia's experience of Theoretical Physics

Did you know?

Because all our single honours degrees have a common core, you can switch to one of our other degree schemes up to the end of Year one if you feel that it will suit you better.

Why Theoretical Physics at Lancaster?

Our theoretical physicists devote themselves to uncovering the most appropriate mathematical laws for deducing the essence of physical phenomena on all scales, from the quantum world of microscopic matter and nanomaterials to the geometry of curved space-time and the large-scale structure of the cosmos. I love helping our students with their first taste of open-ended research – it never fails to amaze me how far a group can progress by working collaboratively and supporting each other.

Professor Ed McCann

Theory Group Project Supervisor

What if I want to change my choices?

That's fine! We're happy to guide you in choosing different modules.



Theoretical Physics with Mathematics

MSci (F3G1)

BSc (F3GC)

The ideal course for those with a love of Physics and Mathematics, this degree combines specialised theoretical physics with the rigours of mathematics, creating a challenging and rewarding programme. Taught jointly with the Department of Mathematics and Statistics, this course will allow you to develop your understanding of the mathematical foundations of physics, exploring topics like how quantum mechanics is underpinned by the powerful mathematical concept of a Hilbert space.

Course content

Mathematical foundations are laid down early in this degree scheme: in the first year, content will be one-third physics and two-thirds mathematics, covering topics like Quantum Physics and Electromagnetism, along with the core of mathematics such as Geometry and Calculus, Numbers and Relations, and Probability.

In the second year, in addition to mathematical topics like Group Theory and Differential Equations, you will explore fundamental physics such as Quantum Mechanics and Relativity, Nuclei and Particles.

This continues into the third year, where, in addition to the "common core" modules listed on page 24, you will take the Theoretical Physics Independent Study and Theoretical Physics Group Project modules as well as selecting one optional Physics module and two optional Mathematics modules.

In your fourth year, in addition to your MSci project, you will select three optional modules from Physics and two from Mathematics. At this point, you can cover advanced options like Quantum Field Theory and Advanced Relativity and Gravity.

For the full list of core and optional modules for Theoretical Physics with Mathematics across both the Physics and Mathematics, scan here:



Third and Fourth Year Projects

In the third year Theoretical Physics Group Project module, you will investigate an area of current research; in previous years, this has included topics like Machine Learning, Cryptography, and the Spread of Infectious Diseases.

You choose the topic of your fourth year MSci project. This project work will give you the opportunity to carry out a detailed investigation into a specific area of physics; you will further develop your analytical and problem-solving skills, formulate conclusions and critically compare your results to relevant theory. Examples of MSci projects can be found on page 17, and recent topics include Quantum Computation, and Electrodynamics.

Scan to hear Sam's experience of Theoretical Physics with Mathematics



For more information please visit lancaster.ac.uk/physics

What do our students think?

I've always enjoyed studying Mathematics, and something I loved about Lancaster was the flexibility within degree schemes. This course has given me a deeper appreciation for maths that I would never have found otherwise. Physics wasn't a field of study I'd ever considered pursuing when I was younger, however it's one of the best decisions I've made!

Avanthika Ravi - 2nd year

Why Theoretical Physics at Lancaster?

Theoretical Physics with Mathematics perfectly combines the rigours of mathematics with deep questions about theoretical physics. I enjoy sharing my passion for the subject with students and their enthusiasm is infectious. When our students graduate, they are equipped with all the tools they need to push the boundaries of quantum mechanics, general relativity and beyond!

Dr Jonathan Gratus

Theoretical Physics with Mathematics
Degree Scheme Manager



Study Abroad

You have the option to study abroad with any of our programmes during your time here at Lancaster.

A year studying at a university abroad provides a unique opportunity to broaden your educational experience and study of physics within a different academic and cultural context. We have opportunities in the USA, Canada, Australia, Asia or Europe.

If you choose this option you will spend your third year studying at one of our partner universities, taking modules equivalent to those that you would have taken at Lancaster. In addition, you may also have the option of choosing topics not delivered at Lancaster.

We will support you throughout the process and offer advice on matters concerning your trip. Being able to travel, experience new cultures, make new friends and boost employability means the majority of our students find it a hugely positive experience.

How to apply

If you wish to study MSci Theoretical Physics with Mathematics Abroad, you should select Theoretical Physics with Mathematics (Study Abroad) (F3G5). If you wish to take any of our other courses, you should select the MPhys Physics (Study Abroad) (F305) degree scheme and let us know in your personal statement which course you prefer.



“

Tara Kalsi
MPhys Hons Physics (Study Abroad) Graduate
PhD Lancaster University

Tell us about your time studying abroad

I spent my third year at the Australian National University in Canberra which was an incredible opportunity. There was massive flexibility in module choices and degree scheme, making this a seamless experience - I mixed-and-matched advanced courses in quantum mechanics and nonlinear physics, with a reading project in group theory and modules heavily based on research-based laboratories, including building a Mach-Zehnder interferometer to measure the hyperfine energy levels of cesium. Being in the Southern Hemisphere, I was able to see different constellations over the course of the year, and travel for an extended period during their summer (our winter) up the East coast of Australia up to the Daintree Rainforest and Cape Tribulation, Cambodia, Indonesia, and Vietnam.

What are you doing after your Physics degree?

I am studying a PhD in Condensed Matter Theory, looking at entanglement and interactions in many-body quantum systems. Specifically, I am enrolled in the Graphene-NOWNANO Centre for Doctoral Training. Graphene is an atomic scale 2-dimensional hexagonal lattice comprised purely of carbon atoms, and is part of a much larger family of 2D materials which can be combined in various ways to create structures to different effect, analogous to Lego. A 6-month formal training element teaching the fundamentals of 2D materials, their applications, and key techniques in their fabrication, manipulation, characterisation, modelling etc. is followed by a 3.5 year research project. By virtue of the training element, these are quite interdisciplinary in general, spanning theory, proof of concept, application etc.



How did Lancaster help with that?

My continual exposure to research environments and the extensive research projects I carried out throughout my degree, both in Lancaster and abroad, helped me to make an informed decision about continuing in research and academia. I most enjoyed the balance between analytics and numerics in my Master's project – something that I continue to value! On a more practical note, my Master's project supervisor and the study abroad academic advisor Dr David Burton were very encouraging and fully supported the applications I made in my final year.

How did your studies develop your skills?

While some skills, such as computational modelling/programming techniques, are taught in specific modules, communication skills are continually developed, particularly when communicating scientific results in report writing and presenting findings to an audience.

What advice do you have for students who might be worried about having the skills to become employable?

The wide range of skills I have honed throughout my studies are highly transferable and I am confident in applying these in various situations. What is more, physics requires one to think critically, particularly about the physical interpretation and meaning of problems, which then helps in problem solving more generally – something that is desired in most jobs.

”

How to join us

We share your excitement for Physics and are always happy to answer any questions about our courses and the application process. Once you apply, we will look at all the aspects of your application and keep you well informed. We look forward to welcoming you here at Lancaster as a student in our Department.

You can apply through the Universities and Colleges Admissions Service (UCAS); find out more at www.ucas.com

Interviews

As part of the application process, we will offer you the option of an interview so that you can gain first-hand experience of life in the Physics Department. The interview also serves as part of the eligibility criteria for the Physics Scholarship. Interviews will be run in-person at Lancaster University, and we look forward to welcoming you. International applicants have the option of an online interview.

Ask a student

Want to know more about Physics? Interested in finding out what the social scene is like, or what it's like to study at Lancaster? Chat to our students online! Visit: www.lancaster.ac.uk/chat



For more information please visit lancaster.ac.uk/physics

Still have questions?





For more details about the Department, our degrees, or research, news and more please visit our website

www.lancaster.ac.uk/physics

Or contact us:

Email: physics-admissions@lancaster.ac.uk

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We are easy to find!

By Road

From the north or south: Leave the M6 motorway at junction 33 and take the A6 north towards Lancaster. Turn right at the third set of traffic lights on the A6 into the University main entrance – Bigforth Drive.

By coach and bus

Lancaster city is on the national coach network; National Express coaches call at the University.

Local buses run from the railway station and Lancaster bus station to the University every 5 minutes on weekdays.

Further details can be found on www.lancaster.ac.uk/travel

By Rail

There are direct rail links between Lancaster and many of the UK's major cities and airports.





Physics

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