

ASTROPHYSICS IN LIVERPOOL

BSc (Hons) PHYSICS with ASTRONOMY
MPhys ASTROPHYSICS

www.astro.ljmu.ac.uk



Contents

Why study Astrophysics?.....	2
Why choose Liverpool?.....	2
The courses	3
Astrophysics in Liverpool.....	4
Why study with us?.....	5
Course structure.....	6
Final year projects.....	10
Research	12
Postgraduate research opportunities	12
The Liverpool Telescope.....	13
Career prospects.....	14
Application information.....	15

Why study Astrophysics?

Astrophysics is the study of the Universe, and everything in it. It involves the most extreme physical conditions in the Universe and so provides tests of all branches of Physics that cannot be achieved in the laboratory. Some major questions that are asked include how the Universe began, and how it evolves; how galaxies, stars and planets are born and how they evolve; how widespread is life?

Astrophysics graduates are ideally equipped to pursue a wide variety of well-paid careers in industry, education, scientific research and business, and will have had the enjoyable and satisfying experience of studying a subject which fires the imagination and broadens their horizons.

Why choose Liverpool?

Liverpool has been repeatedly voted one of the friendliest cities in the UK, and was recently named one of the top destinations in the world. The city has students from three universities living in and around the centre. Liverpool has a low cost of living and is amongst the most cost-effective student cities in the UK with many shops, restaurants, cinemas and public transport offering student discounts. The city centre is relatively compact and you can walk between most places with ease. There are also a number of parks both in the city and the suburbs, with free activities throughout the year. Travelling to Liverpool is straightforward with Liverpool John Lennon Airport and Lime Street Station within easy reach of most student accommodation.

The Courses

The BSc (Hons) Physics with Astronomy course is an integrated programme which brings together Physics, Astronomy and Mathematics so that students develop a broad and up-to-date understanding of the Universe and its contents.

The MPhys Astrophysics degree provides a more in-depth appreciation of the physical Universe and gives students an opportunity to learn research techniques within an active research environment.

Both courses are fully accredited physics programmes by the Institute of Physics. They stress problem solving techniques and provide basic training in the principles of computing and data analysis, which are relevant for careers as professional physicists or for entry in postgraduate research.

“Astronomy is a fascinating subject, the degree has certainly broadened my horizons!”

Dr Maia Orsi,
BSc (Hons) Graduate

Dr Rebekah Hounsell,
University of
Pennsylvania, USA
(LJMU Graduate)



“I chose this undergraduate course because of the variety of modules available throughout, especially the Astrophysics and Mathematics modules.

I specifically enjoyed the field trip to Tenerife as we gained hands on experience in a professional observatory and studied a variety of objects which inspired me to continue onto PhD level study and into an Astrophysics career.”



Astrophysics in Liverpool

The three-year BSc (Hons) Physics with Astronomy and four-year MPhys Astrophysics programmes are Joint Degrees taught between the Astrophysics Research Institute of Liverpool John Moores University (LJMU) and the Department of Physics of the University of Liverpool (UoL). Designed to bringing together the expertise and facilities of two major universities in a unique partnership. The teaching is underpinned by the highly rated research activities of both departments.

The Physics Department of UoL has international expertise in the fields of Particle Physics, Nuclear Physics, Condensed Matter Physics and Surface Physics and the Astrophysics Research Institute at LJMU has similar recognition in several fields of Astrophysics including Galaxy Formation and Evolution, Computational Galaxy Formation, Time Domain Astrophysics, Star Formation and Stellar Populations, and Astronomical Instrumentation. Students are therefore taught by recognised international experts in both Physics and Astrophysics.

The pooling of expertise and resources of the two Universities produces major advantages for our students. The UoL Physics Department possesses a wide range of state-of-the-art facilities including the award winning Central Teaching Laboratories (CTL). The CTL (pictured) is a multi-storey building designed to enhance the student experience by creating high quality, contemporary learning facilities to support undergraduate teaching and promote inter-disciplinary learning between the sciences. The Astrophysics Research Institute of LJMU provides access to data from some of the top observing facilities around the world, such as the Hubble Space Telescope, the European Southern Observatory Very Large Telescopes and ALMA, and the Sloan Digital Sky Survey.



Why study with us?

- Access to observations from the 2-metre aperture Liverpool Telescope sited on La Palma in the Canary Islands and run remotely from the LJMU Astrophysics Research Institute. This is the largest robotic research telescope in the world and provides our students with use of a major research facility with the latest telescope and detector technology.
- An opportunity of a week-long field trip to the Teide Observatory on the island of Tenerife at the end of year 2. Students gain unrivalled practical experience of making astronomical measurements with large telescopes at a professional observatory. Every student is entitled to go and the costs are included in the course fees.
- First hand experience with cutting edge research conducted by astronomers from one of the largest astrophysics departments in the country.
- Access to the facilities of two universities, including excellent learning resource centres and general support services, especially the student residences and student unions of both institutions.



“Liverpool stands out because of the people, there are so many different people around and everyone is so friendly”

LJMU Student





Course Structure

Astrophysics is the application of Physics to astronomical objects in order to understand the Universe and so you will study all areas of Physics. Quantum Mechanics and Atomic Physics are as essential to Astronomy as Einstein's Special and General Relativity. All Astrophysics or Physics with Astronomy degrees have large components of essential Physics and Mathematics, as well as computing techniques, IT, and practical courses.

Much of the content of the BSc (Hons) Physics with Astronomy and MPhys Astrophysics is common to the Physics degree of the same level, with the emphasis on Astrophysics increasing as students progress through the course.

The BSc (Hons) Physics with Astronomy and MPhys Astrophysics courses are identical in the first two years but diverge in content in the third year and the MPhys students undertake

an additional fourth year of study. This means students can transfer between both courses up to the end of the second year, subject to a good performance in assessments. Students may also transfer between the standard Physics degree programme and the Astrophysics courses at the end of Year 1.

In the first and second year of the degree, students attend weekly problem sessions, working in small groups to strengthen their understanding of the material. In further years they attend small tutorial groups.

In their final year, students undertake a research project related to a staff member's research speciality, with topics ranging from planets, massive stars and galaxies to cosmology. Access to the Liverpool Telescope is a unique feature.

Upon graduation, our students receive a single degree certificate bearing the crests of both Universities.





Years 1 BSc/MPhys

SEMESTER 1

Newtonian Dynamics
Thermal Physics and Properties of Matter
Introduction to Computational Physics
Maths for Physicists I
Practical Physics

SEMESTER 2

Wave Phenomena
Foundations of Modern Physics
Introduction to Astrophysics
Maths for Physicists II
Practical Physics

Year 2 BSc/MPhys

SEMESTER 1

Electromagnetism I
Quantum and Atomic Physics I
Computational Physics
Maths for Physicists III
Practical Astrophysics I

SEMESTER 2

Condensed Matter Physics
Nuclear and Particle Physics
Computational Astrophysics
Stellar Physics
Practical Astrophysics I

“ The lecturers for the Astrophysics course are very approachable ”

LJMU Student



Year 3 BSc

SEMESTER 1	SEMESTER 2
Advanced Observational Astrophysics Physics of Galaxies Quantum and Atomic Physics II Statistical Physics Option Module	Astrophysics Project Relativity and Cosmology Electromagnetism II Option Module

Choose one option module from: Stellar Atmospheres, Planetary Physics, Practical Astrophysics II, Computational Modelling, Physics of Music, Philosophy of Science, Solid State Physics, Energy Generation and Storage, Nuclear Physics, Nuclear Power, Particle Physics, Surfaces and Interfaces, Material Physics and Characterization, Semiconductor Applications, and Magnetic Properties of Solids.

Year 3 MPhys

SEMESTER 1	SEMESTER 2
Advanced Observational Astrophysics Physics of Galaxies Quantum and Atomic Physics II Statistical Physics Option Module	Relativity and Cosmology Computational Modelling Electromagnetism II Option Module

Choose two option modules from: Stellar Atmospheres, Planetary Physics, Practical Astrophysics II, Physics of Music, Philosophy of Science, Solid State Physics, Energy Generation and Storage, Nuclear Physics, Nuclear Power, Particle Physics, Surfaces and Interfaces, Material Physics and Characterization, Semiconductor Applications, and Magnetic Properties of Solids.





Year 4 MPhys

SEMESTER 1	SEMESTER 2
Astrophysics Project	Astrophysics Project
Astro Optional Modules:	Astro Optional Modules:
Stellar Populations	Time Domain Astrophysics
Elements of Stellar Dynamics	Physics of the Radiative Universe
Computational Astrophysics	The Interstellar Medium

Other optional modules: Classical Mechanics, Advanced Quantum Physics, Accelerator Physics, Physics of Life, Advanced Nuclear Physics, Neutrinos and Dark Matter, Advanced Particle Physics, Nanoscale Physics and Technology, Functional Materials Design, Strongly Correlated Electron Systems, Advanced Materials Characterization, Advanced Computing, Quantum Optics, Physics in Everyday Life.

Final Year Projects

Undergraduates on both the BSc and MPhys degrees complete a project in their final year – the MPhys projects are longer and more detailed than the BSc projects.

Each student works closely with a staff member on some aspect of the staff member's own research. The projects are designed to be open-ended and the results often lead to a publication in an Astrophysics journal.

Previous final year projects include:

- Near Earth Objects
- Planets beyond the solar system
- X-ray-emitting neutron star binaries
- Observing extragalactic Novae with the Liverpool Telescope
- Supernovae light curves
- Distances and ages of Galactic open clusters
- The genesis of the Milky Way
- Star formation in colliding galaxies
- Star formation in the spiral arms of disk galaxies
- Dynamics of galaxy clusters
- Machine learning analysis of stellar spectra



“ During my time at LJMU the Astrophysics modules I have taken have consistently been interesting, thought provoking, and challenging. The Tenerife trip was an amazing insight into the experience of Astrophysics research and gave a great context to the work that we had been doing ”

Sam Walton,
MPhys graduate and LJMU PhD student



Doug Arnold, BSc (Hons) graduate **New Robotic Telescope DevOps Engineer**

"The Astrophysics side of my degree was seamlessly integrated into the course, the excellent links between the Physics Department at UoL and the ARI at LJMU made it just as easy to contact our Astrophysics tutors and also give feedback on the courses through the departmental Student-Staff Committee meetings.

The broad range of topics on the Astrophysics course, taught by field leading researchers, gave me an excellent overview of the different branches of astronomical research. The lab sessions were excellent, were taught to use modern tools and methods often on data taken by leading telescopes.

The field trip to Tenerife was an amazing opportunity to get hands on experience with all elements of using a telescope at one of the premier sites in the world. Being on the mountain for a week, working all night and being part of the observatory life, was something I will never forget.

The lecturers for the Astrophysics course were very approachable and obviously had a passion for sharing their experience and expansive knowledge of a broad range of subjects."



Research

The Astrophysics Research Institute has over 100 individuals conducting observational and theoretical research in stellar, Galactic and extragalactic Astronomy. Research interests of the staff are broad and include such topics as: star formation and evolution, structure and evolution of galaxies and galaxy clusters, the history of the Milky Way Galaxy, cosmology, novae, supernovae, gamma ray bursts, and gravitational waves. An independent annual assessment of research productivity consistently shows us to be one of the most productive Astrophysics research environments in the UK.

We are the only research group in the UK to own a large optical telescope on an international observatory site (the Liverpool Telescope on La Palma), providing both undergraduate and postgraduate students with a unique research tool.



Postgraduate Research Opportunities

The Astrophysics Research Institute offers higher degree programmes at MSc, MPhil, and PhD level in Astrophysics. The majority of postgraduate students will follow a three and a half-year full-time route leading to the award of PhD. Graduates from our own undergraduate degrees are well represented in our PhD student population, which includes graduates from other UK universities and several students from the EU and beyond.

For more information on our research and postgraduate opportunities please visit www.astro.ljmu.ac.uk

The Liverpool Telescope

A major project we are involved in is the operation of the robotic Liverpool telescope (LT) as a National Facility of UK Astronomy. Designed and built on Merseyside, the LT is exploring the Astrophysics of objects that vary on timescales from seconds to years. This includes everything from the variability of short-period comets and the precise determination of the orbits of Earth-crossing asteroids at one end of the distance scale to the origins of gamma ray bursts and the large-scale clustering of galaxies at the other. The LT can also react extraordinarily rapidly to anything that unexpectedly appears in the sky.



The telescope has a main mirror of 2m across and weighs 23 tonnes. The LT is sited 2,363m above sea-level on the island of La Palma in the Canaries, but is remotely controlled from the Astrophysics Research Institute. Indeed the LT is the largest fully-robotic telescope ever built. Students on our programmes have unique access to this premier international research facility to conduct research at the very frontiers of knowledge.



Career Prospects

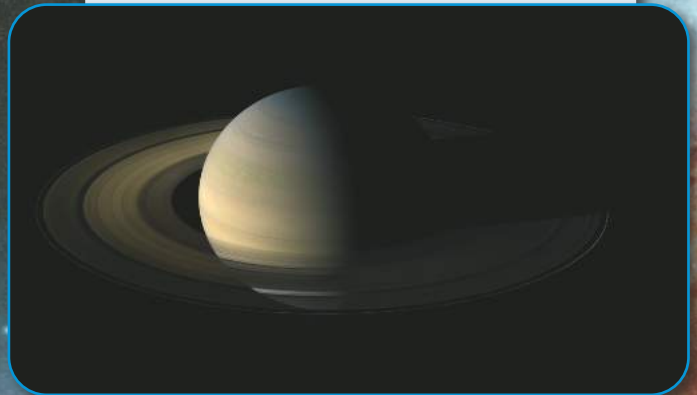
Any Physics-based course can lead to an exceptionally wide variety of careers. Successful graduates from our Astrophysics programmes acquire a wide range of mathematical and problem-solving skills which are highly valued by employers. Employment areas include research, either in universities (carrying on Astrophysics research) or in an industrial setting and knowledge of computing and practical work can lead to careers in remote sensing, materials (possibly for use in space science and satellite technology) and telecommunications.

Techniques learnt in data analysis and modelling are readily applied to medicine, and medical Physics (for example in medical imaging).

Outside the laboratory there are opportunities in teaching, technical writing and scientific journalism, along with aspects of museum work and public understanding of science and technology. Financial institutions value problem solving skills highly and Astrophysics graduates take up careers in the city – Astrophysics is not just for astronomers, or even astronauts.

Dr Maia Orsi, BSc (Hons) Graduate

"Astronomy is a fascinating subject, the degree has certainly broadened my horizon! I particularly enjoyed the field trip to the observatory in Tenerife to get some hands-on experience. The staff at the ARI are very friendly and provide a lot of support for students."



Application Information

Our average first year intake on our Astronomy and Astrophysics degrees is around 30 undergraduate students. Application is via UCAS (www.ucas.ac.uk)

COURSE	DURATION	UCAS CODE
BSc (Hons) Physics with Astronomy	3 years	F3F5
MPhys Astrophysics	4 years	F521

Applications to either course must be made via the University of Liverpool.

As a general guide, applicants should have three good passes at A2-level which must include Mathematics and Physics. For details of required grades please refer to www.ljmu.ac.uk/courses.

Applications from those offering a mixture of A2 and AS-level qualifications or other certificates, diplomas or access courses will also be considered. Please be aware you should have studied Physics and Mathematics on these courses, with content equivalent to A2-level. Please contact us if you are unsure.

The Astrophysics Research Institute actively supports the University Equal Opportunities policy and strategy in its underlying philosophy to value and respect individuals and its commitment to fulfil the potential of each student.

Astrophysics in Liverpool



COURSE

BSc (Hons) Physics with Astronomy
MPhys Astrophysics

DURATION

3 years
4 years

UCAS CODE

F3F5
F521

For more information please contact:

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Astronomical images from the LJMU Liverpool Telescope, Hubble Space Telescope, and NASA.