Durham University

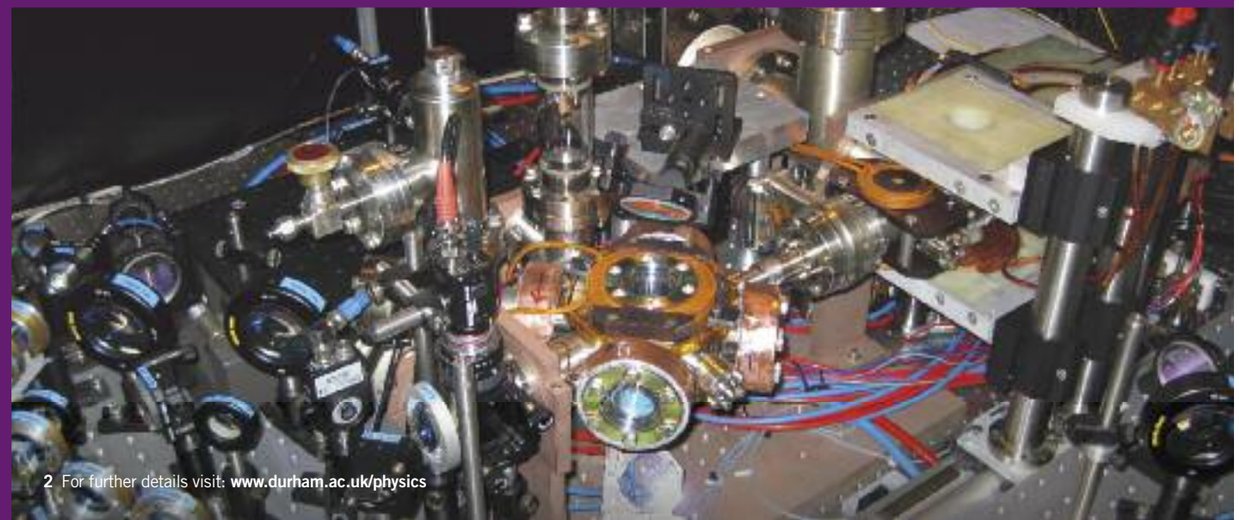
Physics

Ranked 4th

for Physics by *The Independent Complete University Guide 2012.*

Postgraduate study opportunities 2012/13

World-class taught and research degrees to PhD



Ranked 3rd
by *The Sunday Times University Guide 2012*.

Physics

The Department of Physics is one of the leading physics and astronomy departments in the UK. The Department provides research topics at the forefront of the subject with internationally renowned staff providing support, guidance and inspiration.

ABOUT THE DEPARTMENT

In the 2008 Research Assessment Exercise, 60% of the Department's research was rated internationally excellent. In addition, the Physics department was ranked 4th by *The Independent Complete University Guide 2012*.

Our research ranges from fundamental topics such as elementary particle physics and cosmology to the fundamental and applied areas of condensed matter physics, as well as atomic and molecular physics, observational astronomy, and advanced instrumentation.

The Physics Department hosts the Ogden Centre for Fundamental Physics, which houses the Institute for Particle Physics Phenomenology (IPPP) and the Institute for Computational Cosmology (ICC), both of which are world-class institutes with a high international profile.

TAUGHT PROGRAMMES

MSc in Particles, Strings and Cosmology

The MSc course is operated by the Centre for Particle Theory, which is a collaborative research centre of the departments of Physics and Mathematical Sciences. The course is intended for students who have already obtained a good first degree in either Physics or Mathematics, including in the latter case courses in quantum mechanics and relativity. Each student follows a programme of lecture courses and planned reading, and prepares a dissertation on a topic of current research.

Further information on this course can be found at **www.durham.ac.uk/physics/postgraduate/taught**

RESEARCH DEGREES

The following degrees are currently offered in all areas of research within the Department:

- MSc by research
- PhD.

MAIN RESEARCH AREAS

Advanced Instrumentation

The Advanced Instrumentation Group has around 40 staff and research students who develop state-of-the-art instruments for application across a wide range of disciplines including astronomical instrumentation, remote sensing, fusion diagnostics and biophysics. These projects bring together a range of core disciplines, including optics, precision engineering, electronics and software in which students can develop their skills to a high level.

Research projects in astronomical instrumentation are based around developing and testing of new technologies for application on the world's major ground and space-based telescopes, and often include on-sky verification at one of the major international observatories in La Palma, Chile and Hawaii.

Our plasma instrumentation research is aimed at developing new diagnostics for the control of magnetically confined fusion plasmas, and is conducted in collaboration with Culham Centre for Fusion Energy. We are also developing new methods of hyperspectral imaging for application to Earth remote sensing, in collaboration with colleagues in Geography, Geology and Archaeology.

Finally the group investigates applications of new instrumentation technologies within the Life Sciences and Medicine. One example is advanced optical microscopy and imaging where methods normally applied to ground based telescopes, such as adaptive optics, are used to overcome the challenges of imaging deeply in biological tissue. This work is being undertaken in collaboration with life scientists from many other departments in the Faculty through the Biophysical Sciences Institute and from outside the University.

For further information on this research group see **www.durham.ac.uk/physics/postgraduate/research/cfai**

Astronomy and Astrophysics

The Extragalactic Astronomy and Cosmology Group is one of the largest of its kind in Europe, encompassing both observational and theoretical aspects of the formation and evolution of galaxies and their central supermassive black holes, the nature of dark matter, and large scale distribution of matter in the universe and tests of cosmological theories.

The observational research programme makes extensive use of a wide range of facilities including the largest optical, infra-red and sub-millimetre telescopes, radio arrays and space-based facilities such as the Hubble Space Telescope and the Chandra and XMM-Newton X-ray satellites. The research programme of the theoretical cosmology group makes extensive use of large numerical simulations performed using the state-of-the-art supercomputer at the Institute for Computational Cosmology (ICC), which is the UK base of the Virgo consortium.

The programme also includes semi analytical modelling of galaxy formation and analysis of large redshift surveys like the Anglo-Australian 2dF galaxy redshift survey and the upcoming Pan-STARRS survey.

The Very High Energy (VHE) Gamma Ray Astronomy Group studies gamma rays from objects such as neutron stars, white dwarfs, pulsars, X-ray binary systems, supernova remnants and active galactic nuclei. They are part of the world-leading High Energy Stereoscopic System (HESS) collaboration, which operates an array of telescopes in Namibia.

There are also researchers studying the solar system, high energy astrophysics and applied historical astronomy.

For further information on this research group see **www.durham.ac.uk/physics/postgraduate/research/astro**

Atomic and Molecular Physics

In Durham, we focus on using atoms and molecules as very clean quantum-mechanical systems, and their manipulation with lasers and electromagnetic fields. Particularly with recent advances in cooling and trapping of dilute atomic and molecular gases, very precise interrogation and control of the system dynamics is possible, revealing the fundamentally quantum nature of the world around us. The Durham atomic and molecular physics group has around 40 staff and research students. We have strong ongoing experimental and theoretical research programmes, which frequently co-operate closely. There is a particular focus on the theoretical and experimental study of ultracold atomic and molecular gases, including the exciting fields of Bose-Einstein condensates and quantum information processing.

Our theoretical programmes include multiphoton processes with atoms and ions in intense laser fields; atomic physics aspects of interacting Rydberg atoms; the theory of atomic Bose-Einstein condensates; and nonlinear and quantum-chaotic dynamics in cold atomic gases.

Experimental research at Durham covers the study of quantum degenerate mixtures and bright matter-wave solitons in atomic Bose-Einstein condensates; quantum information processing and entanglement using highly excited Rydberg atoms; trapping and manipulation of cold atoms with magnetic nanowires; ultracold neutral plasmas; ultracold polar molecules; and electromagnetically induced transparency and slow light, with the aim of making very sensitive measurements of magnetic fields and rotations.

For further information on this research group see **http://massey.dur.ac.uk/index.html**

Condensed Matter Physics

Condensed Matter Physics encompasses the study of all aspects of matter from single crystals to composites and biological cells. It therefore underpins a huge range of science from technological advances such as the silicon chip and liquid crystal displays to fundamental understanding of phenomena such as non-Fermi liquid theory, advanced many-body quantum mechanics and protein interactions. We have world-class researchers working across condensed matter physics in the Centre for Material Physics collaborating with the best groups around the world. We employ a wide variety of different experimental methods including optical, magnetic, and electron resonance techniques. We also have electron and X-ray diffraction and scattering measurements ongoing in-house.

Theoretical work, usually in close collaboration with experiment, is also a vital aspect of condensed matter physics. In Durham, studies include computational modelling from the level of the electrons to photonic structures and self-assembling structures within biological cells are investigated.

Experiments and computational simulations are supported by state-of-the-art equipment based in the Department, including femtosecond lasers, scanning probes, scanning and transmission electron microscopes, SQUID magnetometers, a range of cryostats (300mK to 1000K), magnets (up to 17T) and a supercomputer cluster. Extensive use is made of international facilities including neutron and synchrotron radiation sources, muon spectroscopy and high magnetic facilities and supercomputers.

Research topics include: nanoscale science and technology; biological and soft matter physics, superconductivity; X-ray scattering and magnetism; organic electroactive materials; novel advanced materials; muon spectroscopy; photonics; semiconductors, electroceramics and crystals; and terahertz physics.

For further information on this research group see **www.durham.ac.uk/cmp**

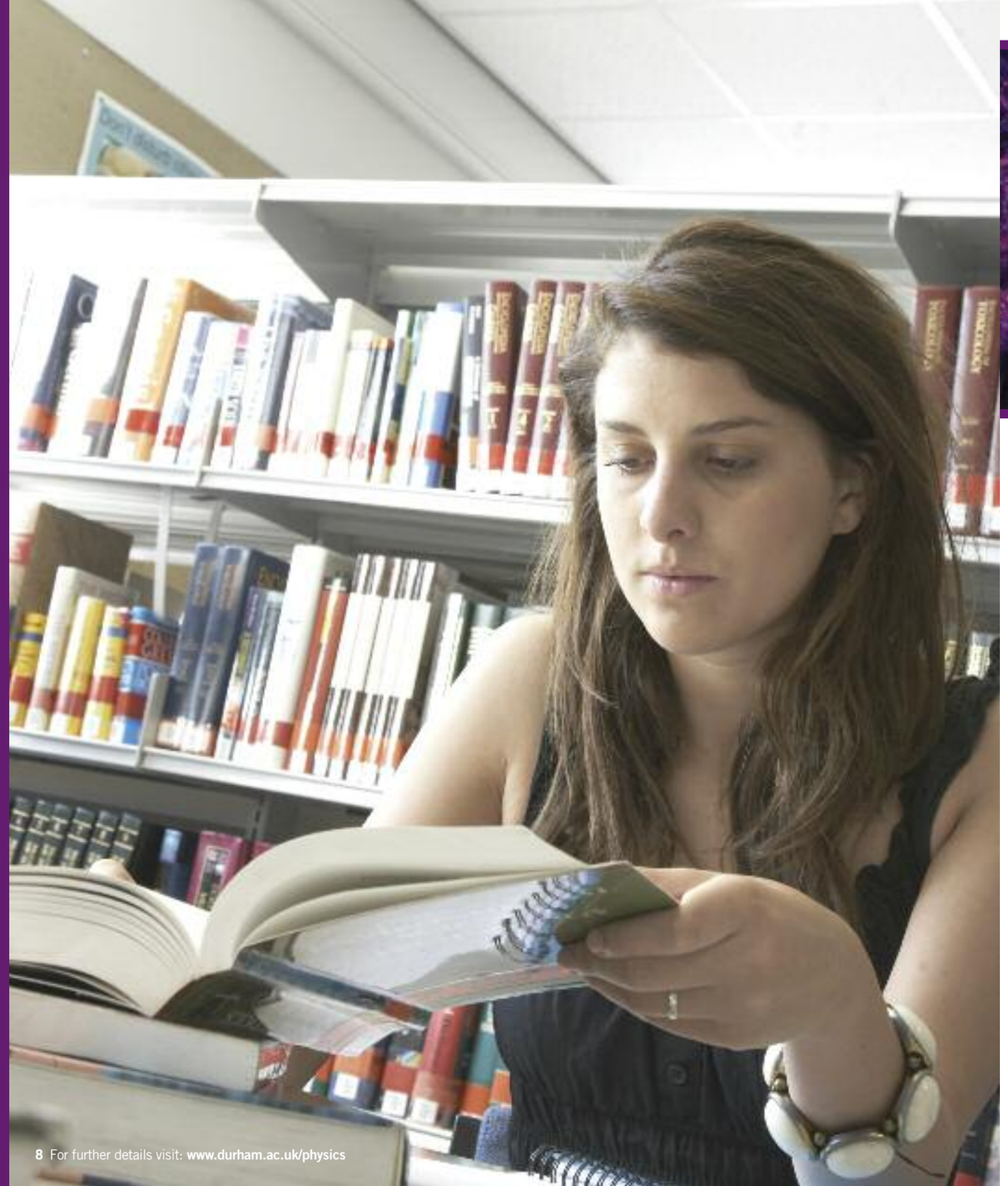
Elementary Particle Theory

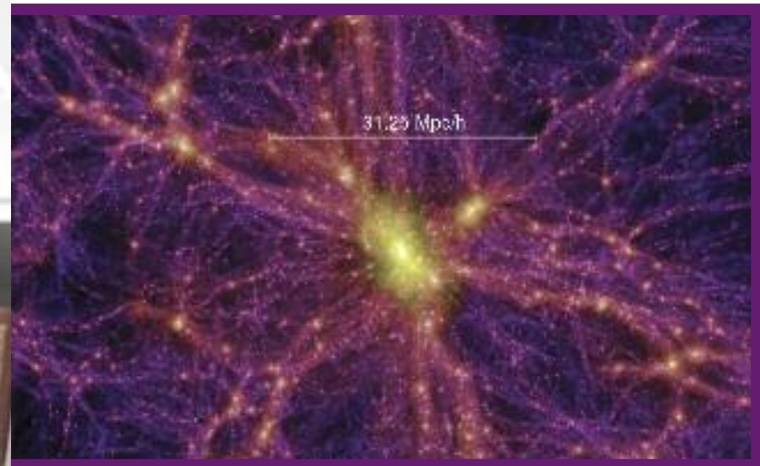
Elementary particle research studies the tiny building blocks of matter that make up the whole Universe. Fundamental questions need to be answered: What are these elementary particles? What are the forces they experience? How do they shape the Universe in which we live? And, most importantly, why Nature has chosen these particles and forces? The Centre for Particle Theory is one of the largest research groupings in the world working on such topics, and involves researchers in both the Departments of Mathematical Sciences and Physics with a large measure of overlap between the two. The Physics 'half' includes the Institute for Particle Physics Phenomenology (IPPP), a joint venture between the Research Council and the University to maximise the physics output from the UK's involvement in major experimental facilities like the Large Hadron Collider (LHC) which has just started its operations at CERN.

IPPP has a wide research programme focussing on the interpretation of present and future data, and making testable predictions for forthcoming experiments from the current theoretical understanding. This research covers potential exciting discoveries in the near future like the Higgs boson, supersymmetric particles and the determination of the number of space-time dimensions.

This phenomenological research at the interface between theory and experiment is complemented by studies in string theory and gravity and in astroparticle physics, with emphasis on the role of particles and forces in the evolution of the Universe.

For further information on this research group see **www.ippp.dur.ac.uk**





RESEARCH INSTITUTES

The Department of Physics is involved with several interdisciplinary and/or international Research Institutes:

Biophysical Sciences Institute

The BSI uses experiment, theory and simulation in a completely integrated, multi-scale approach to the solution of biological problems across the University. Physics staff working on terahertz, biological sensors, theoretical techniques for considering statistical and non-equilibrium physics, advanced instrumentation and imaging techniques seek to increase understanding of biological processes such as self-assembly, stress, ageing and signalling mechanisms.

Durham Energy Institute

Staff in Physics including those involved in solar cells, novel advanced materials, superconducting materials and instrumentation for fusion energy contribute to the Durham Energy Institute. The Institute tackles the provision and security of energy supply, which is seen as one of the most significant technological and social challenges of the 21st century.

Institute for Computational Cosmology

Members of the Institute for Computational Cosmology use state-of-the-art supercomputers to study the growth of galaxies and large-scale structures in the Universe. Among the aims of this research is the desire to quantify the properties of dark matter and dark energy, the two major unexplained influences in cosmology.

Institute for Particle Physics Phenomenology

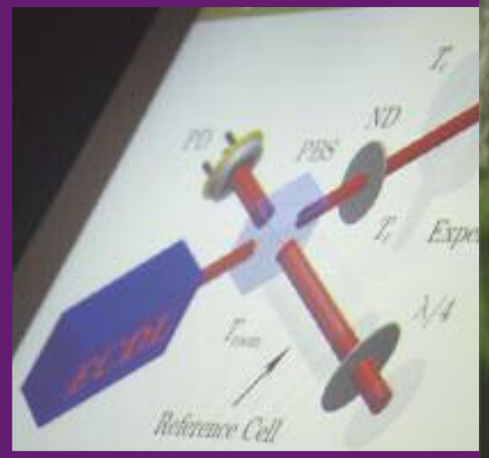
The Institute for Particle Physics Phenomenology (IPPP) aims to foster world-class research in particle physics phenomenology – the bridge between theory and experiment in the study of the tiny building blocks of all matter in the universe and of the fundamental forces that operate between them. IPPP members provide, in particular, predictions for physics at the Large Hadron Collider (LHC) and will utilise the results obtained there to seek answers to many fundamental questions. Research at the IPPP encompasses a wide range of theoretical methods, reaching from the latest developments of analytical techniques to large-scale computing on the GRID.

RECENT THESIS TITLES

- "Quark and Gluon form factors at three loops in Perturbative QCD"
- "Optical binding phenomena: Observations and Mechanisms"
- "Constraining dark energy using real and mock Galaxy surveys"
- "Braneworld black holes"
- "Coherent atom-light interactions in multi-level systems".

POSTGRADUATE RESEARCH FACILITIES

The Department has excellent facilities for PhD students. All students have their own workspace, with network-linked computers, and participate in many research seminar series. The Department regularly plays host to international conferences in all of its major research areas.



TYPICAL ENTRY REQUIREMENTS FOR RESEARCH DEGREES

- Either a First or 2:1 degree (or equivalent).

ENGLISH LANGUAGE REQUIREMENTS

- IELTS of 6.5 or equivalent.

We welcome applications from holders of international qualifications. For advice on the equivalency of international qualifications and further information on English language requirements, please contact our International Office on **international.office@durham.ac.uk** or visit our website at **www.durham.ac.uk/international**

FUNDING OPPORTUNITIES FOR POSTGRADUATE RESEARCH STUDENTS

- For UK/EU: EPSRC/STFC studentships and industrial studentships
- For EU/OS: Marie Curie ITN studentships, Gemini studentships.

The University also has a range of funding opportunities for postgraduate students. To find out what support you could be eligible to receive see our online funding database at **www.durham.ac.uk/study/postgraduate/fees/search**

CAREER OPPORTUNITIES

Graduates of the Department of Physics are generally highly prized in any profession requiring strong analytical and problem solving skills. A PhD in Physics is extremely valuable for those who intend to stay in science and wish to eventually secure senior, well-paid scientific jobs. Past graduates have gone on to work in a variety of positions such as Research Scientists, University Lecturers, Patent Lawyers, IT Consultants, and Senior Scientific Managers.

CAREERS AND EMPLOYABILITY

For further information on career options and employability, including the results of the Destination of Leavers survey, student and employer testimonials and details of work experience and study abroad opportunities, please visit **www.durham.ac.uk/physics/postgraduate/employability**

KEY INFORMATION

- Total number of research postgraduates: 171
- Total number of undergraduates: 769
- Total number of permanent academic staff: 67.

Name:
Elise Jennings

Home Country:
Ireland

Postgraduate Course:
PhD Physics

The Department of Physics at Durham University is well known for its world-leading research in areas such as high energy particle physics and computational cosmology. The graduate lectures given in the first year of my research were very good and provided a good background of knowledge before specialising in one research area.

I've enjoyed being part of a large research group which is very active in many international collaborations and has several seminars and informal meetings every week where everyone can discuss their research. I have made very good friends from both particle physics and cosmology and I've been given the opportunity to travel to many conferences and schools abroad and in the UK.

There is a nice informal atmosphere in my department and my supervisors are very friendly and helpful. Every week we have very useful discussions which guide my research in the right direction. Any questions you have can be answered by other students or postdocs too, so don't feel you are totally alone in your research. Durham is a great place to be a graduate student as the University's colleges are a big part of the City itself. There is a great social atmosphere and there are lots of opportunities to make good friends from your department or college.

Durham University

Contact details

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