

## Physics and Astronomy PhD (Condensed Matter Physics specialism)

**Video:** A PhD student talks about his work at Birmingham

### Postgraduate doctoral research degree in Physics and Astronomy PhD (Condensed Matter Physics specialism):

The research carried out by the Condensed Matter Physics Research Group probes fundamental and applied aspects of quantum effects in solids, superconducting qubits and novel superconducting and magnetic materials.

Our key research areas are: flux lines in high temperature and novel superconductors; superconducting qubits; quantum effects in solids; and biophysics applications.

**Study here and find out why the University of Birmingham was awarded The Times and The Sunday Times University of the Year 2013-14**  
[\(<http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx>\)](http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx)

#### Course fact file

**Type of Course:** Doctoral research

**Study Options:** Full time

**Duration:** PhD: 3.5 years full-time; MSc by research: 1 year full-time

**Start date:** Contact the School directly for further information

#### Related courses

**[Postgraduate research - School of Physics and Astronomy \(/schools/physics/postgraduate/postgraduate-research.aspx\)](/schools/physics/postgraduate/postgraduate-research.aspx)**

#### Contact

**Contact us online** (<http://bham.hobsons.co.uk/ask.aspx?cid=1223&did=24>) or at +44 (0)121 414 5005.

**[School of Physics and Astronomy \(/schools/physics/index.aspx\)](/schools/physics/index.aspx)**

#### Details

The research carried out by the Condensed Matter Physics Research Group probes fundamental and applied aspects of quantum effects in solids, superconducting qubits and novel superconducting and magnetic materials.

#### Research areas

##### Flux lines in high temperature and novel superconductors

The 'condensate' of Cooper pairs in a superconductor means that magnetic fields pass through in the form of quantised flux lines, each containing one quantum of flux associated with circulating supercurrents. The structure and dynamics of magnetic flux lines in superconductors, which may form a lattice, liquid or a 'glass' are studied experimentally by small-angle neutron diffraction and muon spin rotation, using international facilities.

The flux lattice structure tells us about fundamental interactions inside superconductors. In addition to "cuprate" high temperature superconductors, there is a wide range of metals with novel electrical and magnetic properties arising from strong electron correlations. They include Sr<sub>2</sub>RuO<sub>4</sub> which is believed to be a p-wave superconductor, in which the electrons are paired with parallel spin, as opposed to the opposite spins of conventional and cuprate superconductors. We are also investigating the properties of CeCoIn<sub>5</sub>, which is a "Pauli-limited" "heavy fermion" superconductor, in which the superconductivity in high magnetic fields is suppressed by the magnetic effects on the electron spin, instead of the usual diamagnetism. The properties of these novel materials are studied using muon and neutron measurements at temperatures down to 50 mK in fields as high as 11 T.

**[Professor Ted Forgan \(/staff/profiles/physics/forgan-edward.aspx\)](/staff/profiles/physics/forgan-edward.aspx)** and **[Dr Elizabeth Blackburn \(/staff/profiles/physics/blackburn-elizabeth.aspx\)](/staff/profiles/physics/blackburn-elizabeth.aspx)**

##### Superconducting Qubits

The study of Josephson tunnel junctions and device applications includes the evaluation of superconducting 'qubit' structures, which may form the building blocks of quantum computers. These are being made from both conventional and high temperature superconductors, and allow us to observe the quantum behaviour of a "macroscopic" object. Such measurements use temperatures close to absolute zero obtained with dilution refrigerators or adiabatic demagnetisation, plus clever design to avoid the disturbing influence of electrical noise.

Dr Chris Muirhead, **[Dr Mark Colclough \(/staff/profiles/physics/colclough-mark.aspx\)](/staff/profiles/physics/colclough-mark.aspx)** and **[Dr Edward Tarte \(/staff/profiles/eece/tarte-edward.aspx\)](/staff/profiles/eece/tarte-edward.aspx)**

##### Quantum effects in solids

We are interested in making measurements on a wide range of systems using big international facilities such as synchrotrons and neutron sources. With international and Birmingham collaborators, we are currently investigating the dynamics of solid helium, for which the structure and atomic motion is controlled by quantum mechanics, magnetic thin film structures and devices, unconventional superconductors and magnetic materials.

**[Dr Elizabeth Blackburn \(/staff/profiles/physics/blackburn-elizabeth.aspx\)](/staff/profiles/physics/blackburn-elizabeth.aspx)**

##### Biophysics applications

We are using magnetic measurements in an interdisciplinary project using SQUIDS and minute electrical connections for observation of living biological systems

**[Dr Mark Colclough \(/staff/profiles/physics/colclough-mark.aspx\)](/staff/profiles/physics/colclough-mark.aspx)** and **[Dr Edward Tarte \(/staff/profiles/eece/tarte-edward.aspx\)](/staff/profiles/eece/tarte-edward.aspx)**

## Related links

[School of Physics and Astronomy \(/schools/physics/index.aspx\)](https://schools/physics/index.aspx)

## Fees and funding

[Standard fees \(/postgraduate/dr-fees/tuition.aspx\)](https://postgraduate/dr-fees/tuition.aspx) apply.

Learn more about [fees and funding \(/postgraduate/dr-fees/index.aspx\)](https://postgraduate/dr-fees/index.aspx).

### Scholarships and studentships

We have a number of studentships supported by the UK research councils EPSRC and STFC available each year, including some CASE awards. These studentships cover the costs of tuition fees and provide a subsistence allowance for 3.5 years. They are available to UK nationals with at least an upper second-class Honours degree from a UK university, or equivalent. Preference is usually given to those holding four-year MPhys or MSci degrees.

We offer about half a dozen postgraduate teaching assistantships each year as top-ups to EPSRC and STFC studentships. There are also substantial opportunities for postgraduate demonstrators. EU nationals may be eligible for fees-only awards, which are occasionally supplemented by the School. Scholarships may be available, for more information contact the School directly or email [sfo@contacts.bham.ac.uk \(mailto:sfo@contacts.bham.ac.uk\)](mailto:sfo@contacts.bham.ac.uk)

International students can often gain funding through overseas research scholarships, Commonwealth scholarships or their home government.

## Entry requirements

Learn more about [entry requirements \(http://www.birmingham.ac.uk/students/dr/requirements\)](http://www.birmingham.ac.uk/students/dr/requirements).

### International students

We accept a range of qualifications from different countries – learn more about [international entry requirements \(/postgraduate/requirements-dr/step1.aspx\)](https://postgraduate/requirements-dr/step1.aspx).

[Standard English language requirements \(/postgraduate/requirements-pgt/international/index.aspx\)](https://postgraduate/requirements-pgt/international/index.aspx) apply.

## How to apply

Learn more about [applying \(/postgraduate/requirements-dr/index.aspx\)](https://postgraduate/requirements-dr/index.aspx)

[Apply now \(https://pga.bham.ac.uk/lpages/EPSo05.htm\)](https://pga.bham.ac.uk/lpages/EPSo05.htm)

When clicking on the Apply Now button you will be directed to an application specifically designed for the programme you wish to apply for where you will create an account with the University application system and submit your application and supporting documents online. Further information regarding how to apply online can be found on the [How to apply pages \(http://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx\)](https://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx)

[Apply now \(https://pga.bham.ac.uk/lpages/EPSo05.htm\)](https://pga.bham.ac.uk/lpages/EPSo05.htm)

## Related links

[Postgraduate degree courses - School of Physics and Astronomy \(/schools/physics/postgraduate/index.aspx\)](https://schools/physics/postgraduate/index.aspx)

## Research interests of staff

The School of Physics and Astronomy was placed among the leading research institutions in the latest (2008) Research Assessment Exercise.

Our research portfolio is wide-ranging, and covers three principal themes: Particle and Nuclear Physics; Quantum Matter and Nanoscale Science; and Astronomy. We have over 120 academic and research staff together with 120 graduate students with around 50 technical and clerical support staff. Our annual research income is over £8 million and more than 250 research publications are produced each year.

Visit the website for the [Condensed Matter research group \(http://www.cm.ph.bham.ac.uk/\)](http://www.cm.ph.bham.ac.uk/) for further information.

## Related research

- [Condensed Matter Physics \(http://www.cm.ph.bham.ac.uk/\)](http://www.cm.ph.bham.ac.uk/)
- [School of Physics and Astronomy research \(/research/activity/physics/index.aspx\)](https://research/activity/physics/index.aspx)

## Related staff

[Professor Edward Forgan \(/staff/profiles/physics/foran-edward.aspx\)](https://staff/profiles/physics/foran-edward.aspx)

## Employability

### University Careers Network

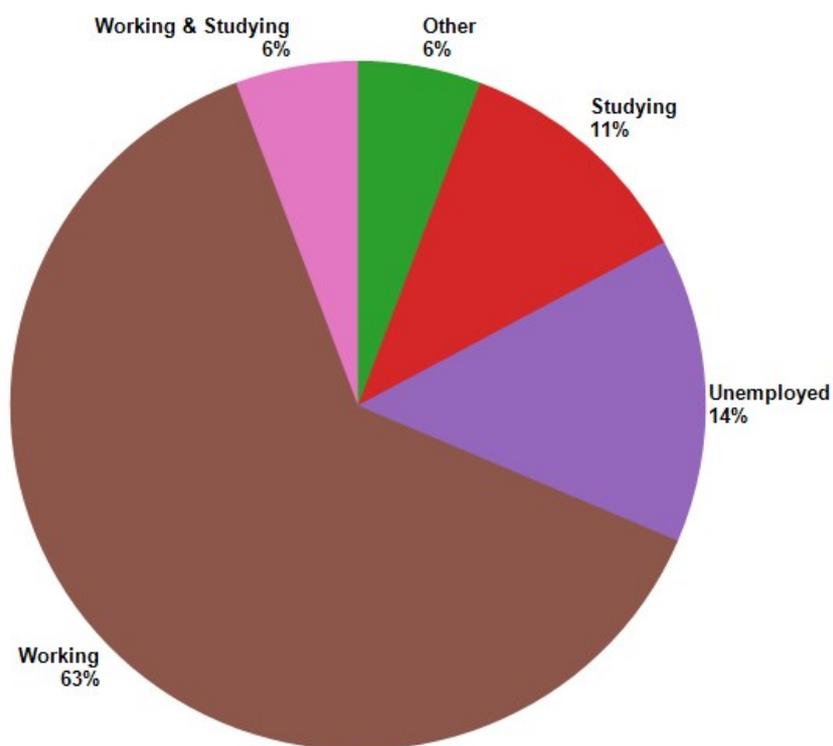
Preparation for your career should be one of the first things you think about as you start university. Whether you have a clear idea of where your future aspirations lie or want to consider the broad range of opportunities available once you have a Birmingham degree, our Careers Network can help you achieve your goal.

Our unique careers guidance service is tailored to your academic subject area, offering a specialised team (in each of the five academic colleges) who can give you expert advice. Our team source exclusive work experience opportunities to help you stand out amongst the competition, with mentoring, global internships and placements available to you. Once you have a career in your sights, one-to-one support with CVs and job applications will help give you the edge.

If you make the most of the [wide range of services \(https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx\)](https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx) you will be able to develop your

## Destinations of Leavers from Higher Education (DLHE) 2011/12 (postgraduate taught graduates)

The DLHE survey is conducted 6 months after graduation.



### Examples of employers

- Siemens
- Rolls Royce PLC
- Optical Performance Centre
- KPMG
- Microsoft Ltd
- King Edwards Consortium
- J.Sainsburys PLC
- Mondrago Investigations Limited
- Self employed
- NHS

### Examples of occupations

- Software Engineer
- Trainee Clinical Scientist
- Technology Graduate
- Secondary School Teacher - Physics
- Research Analyst
- Nuclear Manufacturing Engineer Intern
- Musician
- Recruitment Consultant
- Internet Application Engineer
- Data Analyst

### Further study - examples of courses

- MSc Astrophysics

- MSc Computer Science
- MSc Forensic Ballistics
- MSc Medical Imagery
- MSc Nuclear Physics
- MSc Physics and Technology
- MRes Chemical Engineering
- PhD Electronic Engineering
- PhD Physical Sciences

Visit the [Careers section of the University website \(https://intranet.birmingham.ac.uk/as/employability/careers/college/eps.aspx\)](https://intranet.birmingham.ac.uk/as/employability/careers/college/eps.aspx) for further information.

