School of Mathematical and Physical Sciences
Department of Physics and Astronomy

Postdoctoral Research Fellow in Theoretical Particle Physics (Full time, fixed term for 24 months, extension up to 36 months possible subject to funding)

Salary range: Starting at £32,004 and rising to £38,183 per annum

Start date: 01 October 2017 (or earlier, by agreement)

A postdoctoral research associate is sought to join the South-Eastern Particle Theory Alliance (SEPTA), a consortium joining Royal Holloway, University of London, University College London and the University of Sussex. The post holder will be based at the University of Sussex and expected to perform research relevant to the activities of the Collider and Low Energy Phenomenology research area, whose members are Andrea Banfi, Frank Deppisch (UCL), Stephan Huber, Sebastian Jaeger, Nikolas Kauer (RHUL), and Veronica Sanz.

We are particularly interested in candidates working on collider BSM phenomenology, perturbative QCD, flavour physics and effective field theory, and/or BSM model building, and the post holder will be encouraged to interact with SEPTA members at Sussex as well as the London-based partners. Further SEPTA activities include particle physics of the early universe, gravitational waves, Dark Matter, Neutrino Physics, and models of quantum gravity.

Applicants will also benefit from the close links to and to the Experimental Particle Physics groups at Sussex, UCL and RHUL, the Sussex Astronomy Centre, and from the NExT Institute, a regional particle physics alliance in the South-East of England including Sussex and RHUL, the Rutherford Appleton Laboratory, and the University of Southampton.

Applicants should

- fill in a University of Sussex application form (available via the University website [www.sussex.ac.uk/jobs](http://www.sussex.ac.uk/jobs)) and send it to mpsrecruitment@sussex.ac.uk, quoting the above job reference number.

- send a CV, research statement, and publication list (as a single PDF document), and arrange for three letters of recommendation to be sent to mpsrecruitment@sussex.ac.uk, again quoting the job reference number.

Interested candidates are encouraged to make informal contact with Andrea Banfi (A.Banfi@sussex.ac.uk), Sebastian Jaeger (S.Jaeger@sussex.ac.uk), or Veronica Sanz (V.Sanz@sussex.ac.uk).

Sussex Particle Theory web site: [http://www.sussex.ac.uk/tpp](http://www.sussex.ac.uk/tpp)

NExT Institute: [http://next-institute.ac.uk](http://next-institute.ac.uk)

Sussex jobs web site: [http://www.sussex.ac.uk/jobs](http://www.sussex.ac.uk/jobs)

Closing date for applications: 3 January 2017

For full details and how to apply see [www.sussex.ac.uk/jobs](http://www.sussex.ac.uk/jobs)

*The University of Sussex is committed to equality of opportunity*
The University is committed to equality and valuing diversity, and applications are particularly welcomed from women and black and minority ethnic candidates, who are under-represented in academic posts in science, engineering and mathematics at Sussex.

2. Senior leadership and management

The Vice-Chancellor (Professor Adam Tickell) is the senior academic officer and, as Chief Executive, is responsible to the University Council for management of the University. He is supported by an executive group which includes the three Pro-Vice-Chancellors, the Registrar and Secretary, the Director of Finance and the Director of Human Resources. The Heads of the Schools of Studies at Sussex report to the Pro-Vice-Chancellors.

3. The School / Division

The School of Mathematical and Physical Sciences

The School of Mathematical and Physical Sciences was created in 2009 as part of a University wide restructuring. It brings together two outstanding and progressive departments – Mathematics, and Physics & Astronomy. The School aims to capitalise on the synergy between these subjects to deliver new and challenging opportunities for faculty and students.

The School of Mathematical and Physical Sciences combines pioneering research and stimulating teaching in an interdisciplinary academic setting. The faculty work at the frontiers of their fields, as is reflected in the recent growth of both subjects. Each department has a number of thriving research groups and links with outside agencies.

Acting Head of School is Professor Philip Harris.

The Department of Mathematics

The Department of Mathematics currently has 23 faculty divided into six research areas: Analysis and PDEs including Financial Mathematics, Mathematics Applied to Biology, Numerical Analysis and Scientific Computing, Geometry and Topology, and Probability and Statistics.

In the 2014 research excellence framework (REF), 81 per cent of the research outputs in Mathematics at Sussex were rated as world-leading (4*) or internationally excellent (3*). Mathematics at Sussex was ranked 22nd in the UK in a recent league table (Guardian 2016). It also repeatedly scores well in the UK National Student Survey.

The Department has more than 350 undergraduate students, 64 MSc students, more than 60 PhD students and 2 research fellows.

Research Areas

Research in Mathematics at Sussex is currently supported by international and national grants. The Department coordinates an Innovative Training Network (Makridakis, EU H2020) and is partner of another Innovative Training Network (Madzvamuse, EU H2020). The Leverhulme Trusts funds two research projects (Duering and Madzvamuse). EPSRC funds several PhD positions and a first grant (Koch). The Icelandic Research Fund contributes to the research activities of Giesl and Scalas. Faculty at Sussex recently organised specialised meetings and conferences hosting distinguished researcher with support from the London Mathematical Society.

Analysis and PDEs
Research in this group spans a broad spectrum underpinned by the rigorous treatment and analysis of linear and nonlinear partial differential equations (PDEs). This ranges from PDEs arising in geometry, physics and mechanics to those in control theory, finance and material sciences. A core of our activities is on calculus of variations and geometric and harmonic analysis and there are subgroups with major interests in geometric measure theory, spectral theory, function spaces, dynamical systems, fluid mechanics, nonlinear elasticity and homogenisation. Current members are: Dr Filippo Cagnetti, Dr Miroslav Chlebik, Dr Masoumeh Dashti, Dr Peter Giesl, Dr Gabriel Koch, Prof Michael Melgaard, Dr Mariapia Palombaro, Dr Qi Tang, and Dr Ali Taheri (coordinator).

Web site: [http://www.sussex.ac.uk/apde/](http://www.sussex.ac.uk/apde/)

**Mathematics Applied to Biology**

The Mathematics Applied to Biology research group develops new theoretical, mathematical and computational frameworks, as well as cutting-edge techniques and software algorithms for problems arising in a wide range of disciplines, such as cell motility and cell morphology, cell biology, developmental biology, biomedicine, epidemiology, immunology, neural systems, genetics networks and engineering.

The group’s mathematical expertise is at the interface of dynamical systems, geometric PDEs, bulk-surface reaction diffusion systems, stochastic processes, graph/network theory and time-delayed systems. Current members are: Dr Konstantin Blyuss, Dr Istvan Kiss (coordinator) Dr Yuliya Kyrychko and Dr Anotida Madzvamuse.

Web site: [http://www.sussex.ac.uk/mab/](http://www.sussex.ac.uk/mab/)

**Numerical analysis and scientific computing**

Research concentrates on the modelling and analysis of problems coming from the physical and life sciences, engineering and finance, leading to partial differential equations. The interests of the group spans from the mathematical analysis of mathematical (mainly differential) models to their computer implementations (scientific computing), passing through the development and analysis of novel numerical methods. Current members are: Dr Bertram Duering, Dr Max Jensen, Dr Omar Lakkis, Prof Charalambos Makridakis (coordinator) and Dr Vanessa Styles.

Web site: [http://www.sussex.ac.uk/nasc/](http://www.sussex.ac.uk/nasc/)

**Geometry and Topology**

Research interests are in the theory of knots, braid groups, topology, combinatorics of finite projective spaces, coding theory and its connections between finite geometry and algebraic geometry, combinatorial structures, algebraic geometry over finite fields, classical algebraic and projective geometry. The group comprises Research Faculty: Prof James Hirschfeld, Dr Roger Fenn, and Research students: Awss Al-Ogaidi, Salam Alabdullah, Zainab Hamed, Mohammad Hazzazi, Fatma Karaoglu.

**Probability and Statistics**

Research interests are in probability theory, discrete-time and continuous-time stochastic processes, rigorous statistical physics, optimal strategies in diverse games and gambles, the mathematics of spread betting and the development of statistical methodologies for problems arising in engineering and medicine.

The group comprises Research Faculty: Dr Andrew Duncan, Dr Nicos Georgiou, Prof Enrico Scalas (coordinator), Dr Dimitrios Tsagkarogiannis, Emeritus Faculty: Prof Charles Goldie, Dr
The Department of Physics and Astronomy

The Physics & Astronomy Department currently has 39 faculty divided into five research groups: Astronomy; Atomic, Molecular & Optical Physics; Experimental Particle Physics; Materials Physics; Theoretical Particle Physics.

We are part of the South East Physics Network (SEPNet) - a consortium of nine physics departments of the University of Sussex, University of Kent, Queen Mary University of London, Royal Holloway University of London, Southampton University, University of Surrey, University of Portsmouth, University of Hertfordshire, and the Open University. This has been awarded substantial government funding (from HEFCE) to support vital UK science research, teaching and development.

In the highly acclaimed Thomson Scientific 2006 ranking of the research impact of all departments in UK universities, the University of Sussex came top in Physics and in Space Science/Astronomy. It was ranked 8th in the UK in the Research Assessment Exercise of 2008. It was ranked 5th in Great Britain and 37th in the world according to the Times Higher Education World University Rankings (2010). Sussex is ranked 5th in UK for Physics in the Times Good University Guide (2013), and scored 100% for overall satisfaction in the 2013 National Student Survey.

The Department has approximately 350 undergraduate students, 30 MSc students, over 110 PhD students and 41 postdoctoral fellows.

Research groups

4.1. The Astronomy Centre

Current research interests are: physics of the early Universe; constraining cosmological models; numerical simulations of structure formation; extragalactic survey science; and galaxy formation and evolution. The first of these has strong overlaps with the Theoretical Particle Physics group.

The Centre consists of 12 permanent faculty members: Chris Byrnes (Royal Society URF), Ilian Iliev, Antony Lewis, Jon Loveday, Seb Oliver (Director of Research & KE for the School), Kathy Romer, Mark Sargent, David Seery, Robert Smith, Peter Thomas (Director of the Astronomy Centre), Stephen Wilkins; there are currently 8 postdoctoral researchers and 22 PhD students. The group’s main source of funding comes from a consolidated grant Science and Technology Facilities Council (STFC) and EU funding in the form of Starting, Consolidator and Cooperation grants.

The Centre’s activity is focussed around three themes: Theoretical cosmology, with focus on inflationary cosmology, the cosmic microwave background, dark energy, and statistical methods; Simulations/modelling of reionization, large-scale structure, galaxy and cluster formation; Observations; surveys of galaxies and clusters from the infra-red through to X-ray.

We have major roles in extra-galactic surveys: Seb Oliver coordinates the Herschel Multi-tiered Extra-galactic Survey (HerMES) and EU funded Herschel Extra-galactic Legacy Project (HELP); Kathy Romer leads the XMM Cluster Survey (XCS); Jon Loveday leads the Galaxy Mass Assembly (GAMA) spectra working group. We are partners in various supercomputing collaborations including COSMOS and VIRGO. We have key roles in Cosmology and Dark Energy studies including Planck and the Dark Energy Survey.

The Centre has access to substantial computing resources, including locally and various
supercomputing consortia.

The Astronomy Centre’s web site is http://www.sussex.ac.uk/astronomy/

4.2. The Atomic, Molecular & Optical (AMO) Physics Group

Research in the AMO group at Sussex is devoted to the study of fundamental physics and quantum effects and technologies using the techniques of atomic and laser physics. The research covers both experimental and theoretical AMO physics.

There are six experimental faculty in the AMO group. Winfried Hensinger is developing new quantum technologies using trapped ions. His group is developing a quantum simulation engine and they are in the process of constructing a large-scale trapped-ion quantum computer. Another research area is the development of portable quantum sensors. Peter Kruger, is starting a major activity in Quantum Systems and Technologies. This will involve a range of experiments and device development at the interface of cold atomic and condensed matter physics. Matthias Keller is investigating the interaction of single photons and ions assisted by optical cavities with the aim of generating large scale entangled states and developing quantum networks. His work also includes the physics of trapped molecular ions. Alessia Pasquazi is working on ultra-fast photonics and also on optical sources for quantum technologies. Marco Peccianti’s research is focussed on Tera-Hertz Imaging and applications of Tera-Hertz radiation. Jose Verdu's team is developing a novel Penning trap technology based upon superconducting microwave transmission-lines. This work has applications to circuit-QED with trapped electrons, quantum metrology and mass spectrometry.

There are four theorists in the AMO group. Jacob Dunningham (AMO group leader) is investigating Bose-Einstein condensates and quantum technologies with a particular emphasis on quantum metrology, sensing, and imaging. Claudia Eberlein works on quantum field theory applied to atomic, optical, and nano-physics. Barry Garraway is developing new kinds of atom traps with applications to quantum information and quantum metrology and in addition works on cavity QED and non-Markovian dynamics. Diego Porras applies the techniques of quantum optics to condensed matter systems.

Along with the faculty there are currently 14 research fellows and 40 PhD students in the AMO group. Sources of funding include the European Union, EPSRC and European and national research networks on quantum information processing. The Atomic, Molecular & Optical Physics group web site is http://www.sussex.ac.uk/amo

4.3. The Experimental Particle Physics (EPP) Group

The Sussex EPP group counts ten permanent faculty members, plus one Emeritus Professor. The group’s main source of funding is the Science and Technology Facilities Council (STFC), with additional support from the European Research Council (ERC) and the Royal Society.

Antonella De Santo, who is also the EPP Group Leader, together with Fabrizio Salvatore has established and leads a fast-growing team working on the ATLAS experiment at the CERN Large Hadron Collider (LHC). The other ATLAS faculty members are Lily Asquith, Alessandro Cerri and Iacopo Vivarelli. The group has a long-standing leadership in the search for supersymmetry at ATLAS, and also leads in the areas of jet physics, Higgs physics, flavour physics, and top physics. Sussex also holds key responsibilities in the ATLAS High-Level Trigger (HLT) system, including in view of future LHC and ATLAS upgrades. It also has a major role in the proposed Level-1 tracking trigger project, for use by ATLAS at the High-Luminosity LHC.
Historically, the Sussex EPP is world-renowned for its high-precision measurement of the neutron electric dipole moment (EDM). The EDM is uniquely sensitive to physics beyond the Standard Model, and the group is currently involved in the nEDM experiment at the PSI. Philip Harris leads this effort at Sussex together with Clark Griffith and Visiting Senior Lecturer Mike Hardiman.

Sussex EPP also boasts a vibrant and expanding programme of neutrino physics. Sussex is one of the leading UK institutes involved in the SNO+ experiment, which seeks to determine whether the neutrino is its own antiparticle by searching for neutrino-less double-beta decays. Simon Peeters leads the SNO+ effort at Sussex, together with Lisa Falk and Jeff Hartnell. Additionally, Jeff Hartnell was recently awarded substantial ERC funding to work on the Fermilab-based NOvA neutrino oscillation experiment and the future long-baseline programme (LBNE/LBNF). Peeters and Falk are also involved in LBNE/LBNF.

Sussex EPP currently has ten postdoctoral level researchers, eleven PhD students, three engineer/technician posts directly involved in EPP research, and a Linux system administrator. We have a number of well-equipped laboratories, and we enjoy good access to the University’s technical facilities, including shared technicians. Sussex EPP researchers have uncontended access to a dedicated Grid Tier-3 cluster, and Sussex is a member of the SouthGrid Tier-2 grouping of Grid-enabled research institutions in the South of England.

Sussex EPP has close links with colleagues in the Sussex Theoretical Particle Physics group and with other partners in the SEPnet consortium.

The Experimental Particle Physics group web site is http://www.sussex.ac.uk/epp

### 4.4. The Materials Physics Group

This is a new research group set up by Professor Alan Dalton who joined the Department from Surrey University in February 2016.

A number of new appointments are underway.

The group will focus on understanding the fundamental structure-property relationships in materials containing one- and two-dimensional structures such as carbon nanotubes, graphene and other layered nanomaterials. Prof Dalton is particularly interested in developing viable applications for nano-structured organic composites (mechanical, electrical and thermal). He is also interested in the directed-assembly and self-assembly of nanostructures into functional macrostructures and more recently interfacing biological materials with synthetic inorganic and organic materials and associated applications.

The Materials Physics group webpage is [http://www.sussex.ac.uk/materials-physics/](http://www.sussex.ac.uk/materials-physics/)

### 4.5. Sussex Centre for Quantum Technologies

The Sussex Centre for Quantum Technologies is focused on the exploitation and development of disruptive quantum technologies. The Centre hosts ten research groups covering the broad spectrum of quantum technologies as well as hosting a number of associate member groups that share significant overlap with our mission.

Our research groups are involved in the UK Quantum Technology Hub on Networked Quantum Information Technologies and the UK Quantum Technology Hub for Sensors and Metrology as well as DSTL initiatives, Centres for Doctoral Training and numerous national and international collaborations. The centre is integrated within the UK National Quantum Technology Programme. The centre leadership consists of Prof. Winfried Hensinger (director) and Prof.
Jacob Dunningham (deputy director).

The Centre’s five experimental research groups are led by Prof Winfried Hensinger (Ion Quantum Technology), Dr Matthias Keller (Ion Trap Cavity-QEG and Molecular Physics), Prof Peter Krueger (Quantum Systems and Technologies), Dr Alessia Pasquazi (Ultrafast Photonics), Dr Marco Peccianti (Tera-Hertz Imaging), and Dr Jose Verdu (Electrons in Quantum Circuits). The centre also hosts ground breaking theory groups led by Prof Claudia Eberlein (Quantum Field Theory in AMO), Prof Jacob Dunningham (Quantum metrology, Bose-Einstein condensates and Entanglement), Prof Barry Garraway (Trapped Ultracold Atoms &Theoretical Quantum Optics) and Dr Diego Porras (Quantum optics and condensed matter systems).

The Sussex Centre for Quantum Technologies features numerous state-of-the-art quantum technology laboratories along with key infrastructure. In addition to the high quality research environment, training plays an integral role and the centre hosts the pioneering MSc in Frontiers of Quantum Technology as well as carrying out specialized quantum technology training for doctoral and postdoctoral researchers.

The Sussex Centre for Quantum Technologies web page is http://www.sussex.ac.uk/scqt/

4.6. The Theoretical Particle Physics (TPP) Group

The current research activities in the group are: particle astrophysics and cosmology, including cosmological phase transitions, baryogenesis, topological defects, inflation, dark matter, and dark energy; collider and low-energy phenomenology, including Higgs and BSM physics, flavour, QCD, supersymmetry and extra dimensions; and quantum field theory, including quantum gravity, tests the asymptotic safety conjecture, the renormalisation group, effective theory and strong coupling phenomena.

The group consists of Andrea Banfi, Xavier Calmet, Mark Hindmarsh, Stephan Huber (group leader), Sebastian Jaeger, Daniel Litim, Veronica Sanz, Emeritus Professors David Bailin and Norman Dombey, two Postdoctoral Research Fellows, and about 20 PhD and MSc students. The group maintains a research consortium with Royal Holloway (Nikolas Kauer) and University College London (Frank Deppisch). The group's research funding comes mainly from the UK Science and Technology Facilities Council (STFC), and is also supported by the European Science Foundation and the Higher Education Funding Council for England.

The group has close links with both the Experimental Particle Physics and Astronomy research groups, and is a member of the NExT Institute, a regional collaboration for particle physics phenomenology. It benefits from excellent computing resources including a Linux-based system of workstations and servers and access to the University’s High Performance Computing cluster.

The Theoretical Particle Physics group web page is http://www.sussex.ac.uk/tpp/
JOB DESCRIPTION

CORE JOB DESCRIPTION

Job Title: Research Fellow in Theoretical Particle Physics
Grade: Research Fellow I, Grade 7
School: MPS
Location: Pevensey II
Responsible to: Principal Investigator through to Head of School
Direct reports: n/a
Key contacts: Members of research group, members of faculty within the School and University.

Role description: Research Fellow I is an early career-grade research position. Post-holders will be expected to contribute to the work of the research team, and also to develop their research skills with support from more experienced members of staff.

PRINCIPAL ACCOUNTABILITIES

1. To engage in individual and/or collaborative research activity resulting in high-quality publications; and to develop research funding and knowledge exchange income individually or in collaboration with others, as appropriate, depending on the size and scope of the bid.

2. To contribute to School teaching activities.
KEY RESPONSIBILITIES

1. Research, Scholarship & Enterprise

1.1 Develop research objectives and proposals for own or joint research, at acceptable levels, with assistance if required.

1.2 Conduct research projects individually and in collaboration with others.

1.3 Analyse and interpret research findings and draw conclusions on the outcomes.

1.4 Produce high-quality research outputs for publication in monographs or recognised high-quality journals, or performance/exhibition, as appropriate, and contribute to the School’s REF submission at acceptable levels of volume and academic excellence.

1.5 Contribute to the preparation of proposals and applications to external bodies, for example for funding purposes.

1.6 Individually or with colleagues, explore opportunities for enterprise activity, knowledge exchange income and/or consultancy, where permissible.

1.7 Build internal contacts and participate in internal networks and relevant external networks in order to form relationships and collaborations.

1.8 Continually update knowledge and understanding in field or specialism, and engage in continuous professional development.

2. Teaching & Student Support

2.1 Undertake teaching duties, if required.

2.2 Assist in the assessment of student knowledge and supervision of student projects if required.

2.3 Assist in the development of student research skills, for example as part of a postgraduate supervision team.

3. Contribution to School & University

3.1 Attend and contribute to relevant School and project meetings.

3.2 Undertake additional duties, as required by the Principal Investigator and/or Head of School.

4. Role-specific duties

4.1 To carry out original research in the area of theoretical particle physics, within a sub-area relating to the topics funded by our STFC rolling grant (particle astrophysics and cosmology).
4.2 Participate in the host group’s regular meetings and seminars, assisting with their organisation if required.
4.3 Seek and exploit collaborations within the Sussex/Royal Holloway research consortium.

This Job Description sets out current duties of the post that may vary from time to time without changing the general character of the post or level of responsibility entailed.

INDICATIVE PERFORMANCE CRITERIA

- A PhD or equivalent scholarly or relevant professional activity
- Pursuing a line of independent research within a research group.
- Publishing research (either from a recently completed PhD or new original research).
- Other forms of externally recognised professional practice of creative output of a standing equivalent to regular publication of original research.
- Initiating, developing or participating in links between the University and external bodies such as business and industry, the professions, community organisations and policy-makers.
- Evidence of successful engagement in teaching or supervision.
PERSON SPECIFICATION

ESSENTIAL CRITERIA

1. Normally educated to doctoral level, or other equivalent qualification, or appropriate level of experience, as appropriate to the discipline (see role-specific criteria below).

2. Evidence of engagement in high-quality research activity.

3. Excellent presentation skills, with the ability to communicate effectively, both orally and in writing, with students, colleagues and external audiences.

4. Ability to work individually on own initiative and without close supervision, and as part of a team.

5. Ability to exercise a degree of innovation and creative problem-solving.

6. Excellent organisational and administrative skills.

7. Ability to prioritise and meet deadlines.

8. Excellent IT skills.

ESSENTIAL ROLE-SPECIFIC CRITERIA

1. High level of knowledge and skill in theoretical particle physics.

2. Established publication record in the area of particle physics phenomenology.

3. Willingness and ability to travel to collaborative meetings and conferences as required.

DESIRABLE CRITERIA

1. Emerging track record of high-quality publications in reputable journals and other appropriate media of similar standing.

2. Experience of generating research or knowledge exchange income.

DESIRABLE ROLE-SPECIFIC CRITERIA

1. Experience in one or more of the specific fields of the particle phenomenology research area: Collider QCD, flavour, Beyond-Standard-Model model building.