Research Associate in Quantum Communications

Department of Physics

Closing date: 21 March 2018
Interview date: 12 April 2018
Vacancy reference: 6437
A Postdoctoral Research Associate (PDRA) position is available in the area of quantum technologies, supported via the EPSRC Quantum Communications Hub. The Hub, led by Professor Tim Spiller at the University of York, is a major collaboration between eight universities (Bristol, Cambridge, Heriot-Watt, Leeds, Royal Holloway, Sheffield, Strathclyde and York) and industrial partners including BT, the National Physical Laboratory (NPL), ID Quantique (IDQ) and Toshiba Research Europe Ltd (TREL). The role of the Hub is to develop new quantum communications technologies as part of the UK National Quantum Technologies Programme.

The importance of quantum random number generators (QRNGs) is widely acknowledged, as component level devices to be incorporated into small systems, e.g. mobile phones; for authentication purposes e.g. in IoT; and as essential components in quantum communication systems.

An outstanding issue for QRNGs is authoritative accreditation of the output. Current tests are based on numerical analysis of the output sequence, which cannot provide a confident bound on the degree of randomness. Stronger certification is possible for physical QRNGs (PQRNGs), since the physical process used to create the output sequence can be theoretically analysed and physically tested.

This experimental and technology development position is seconded from York to work at the NPL, Teddington, UK, another Hub partner, based in the Group led by Dr Alastair Sinclair. The PDRA will develop the necessary experimental understanding, expertise and techniques to test quantum photonic PQRNGs. The developed approach will be applied to one or two selected implementations, and contribute to the development of a UK assurance process for these devices.
Main purpose of the role

The PDRA will apply traditional statistical tests to the QRNG outputs, develop and apply instrumentation to test their physical performance, and contribute to the development of a UK framework for assurance testing of such devices.

Public-domain statistical test suites (e.g. DIEHARDER, NIST SP-800, TESTU01, ENT) will be used to test the QRNG output strings. Failures may indicate aspects of device operation for investigation. Even if a device passes all the statistical tests, stronger confidence can be provided by physically testing the process used to create the output sequence.

The PDRA will work with experts in data science at NPL to implement and perform the numerical testing. The University of York, together with device manufacturers, will develop theoretical models for the operation of the QRNGs to be tested. This will identify the physical tests to be performed.

NPL has developed a suite of bespoke instrumentation to perform measurements at the single-photon level. The PDRA will adapt this capability, by developing new techniques and bespoke instrumentation, to perform the tests identified by the theoretical models.

The PDRA will also contribute to developing a UK assurance process for QRNG devices. This necessarily involves detailed interactions with project members.

To conduct research under the supervision of senior colleagues and to contribute to the production of research

To assist in the identification and development of potential areas of research and the development of proposals for independent or collaborative research projects

Key responsibilities

(Role holders will be required to undertake some or all of the duties below)

- To conduct individual and collaborative research projects, duties to include: performance of experiments and collection of data; analysis and interpretation of research data; use of appropriate research techniques and methods; writing up of research results and dissemination through publications, seminar and conference presentations and public engagement and outreach activities; contributing to the identification of possible new areas of research

- To contribute to the preparation of research proposals and applications to external bodies

- To undertake appropriate organisational and administrative activities connected to the research project, including conference organisation, and the development of promotional or educational material including website maintenance and development

- To develop and initiate collaborative working internally and externally, duties to include: the building of internal contacts and participation in internal networks; collaboration with colleagues on joint projects as required; participation in and identification of external networks in order to share information and identify potential opportunities for collaboration and possible sources of funding; attendance at and contribution to relevant meetings

- To provide guidance to other staff and students, as required, as well as co-ordination
## PERSON SPECIFICATION

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Essential / Desirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>First degree in Physics, Mathematics, Computer Science, Engineering or a related subject relevant for quantum optical technologies</td>
<td>Essential</td>
</tr>
<tr>
<td>PhD in a research area relevant for quantum and/or classical optical technologies</td>
<td>Essential</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Essential / Desirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge relevant for quantum and/or classical optical R&amp;D</td>
<td>Essential</td>
</tr>
<tr>
<td>Knowledge of a range of research techniques and methodologies applicable for high quality research and development in quantum and/or classical optical technologies</td>
<td>Essential</td>
</tr>
<tr>
<td>Expertise in an area that will complement and enhance the Hub’s R&amp;D strategy and goals. See <a href="https://www.quantumcommshub.net/">https://www.quantumcommshub.net/</a></td>
<td>Desirable</td>
</tr>
<tr>
<td>Knowledge across a broad spectrum of quantum technology areas, additional to specific R&amp;D role</td>
<td>Desirable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skills, abilities and competencies</th>
<th>Essential / Desirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly developed communication skills to engage effectively with a wide ranging audience, both orally and in writing, using a range of media</td>
<td>Essential</td>
</tr>
<tr>
<td>Competency to make presentations at conferences or exhibit work in other appropriate events</td>
<td>Essential</td>
</tr>
<tr>
<td>Ability to write up research work for publication in high profile journals and engage in public dissemination</td>
<td>Essential</td>
</tr>
<tr>
<td>Ability to develop research objectives, projects and proposals for own and joint research, with the assistance of a mentor if required</td>
<td>Essential</td>
</tr>
<tr>
<td>Competency to conduct individual and collaborative research projects</td>
<td>Essential</td>
</tr>
<tr>
<td>Ability to identify sources of funding and contribute to the process of securing funds, with collaborators if required</td>
<td>Essential</td>
</tr>
<tr>
<td>Experimental, optical, electronic and engineering skills appropriate to quantum and/or classical optical communications technologies R&amp;D</td>
<td>Desirable</td>
</tr>
<tr>
<td>Experience working with quantum optical devices and technologies, and/or classical optical devices and technologies and their metrology and calibration</td>
<td>Desirable</td>
</tr>
</tbody>
</table>
# PERSON SPECIFICATION

## Experience

<table>
<thead>
<tr>
<th>Essential / Desirable</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential</td>
<td>Experience of carrying out both independent and collaborative research</td>
</tr>
<tr>
<td>Essential</td>
<td>Experience of writing up research work for publication</td>
</tr>
<tr>
<td>Essential</td>
<td>Ability to work as part of a team and also to work independently using own initiative</td>
</tr>
</tbody>
</table>

## Personal attributes

<table>
<thead>
<tr>
<th>Essential / Desirable</th>
<th>Personal attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential</td>
<td>Attention to detail and commitment to high quality</td>
</tr>
<tr>
<td>Essential</td>
<td>Collaborative ethos</td>
</tr>
<tr>
<td>Essential</td>
<td>Interest in and enthusiasm for the subject matter of the project(s)</td>
</tr>
<tr>
<td>Essential</td>
<td>Positive attitude to colleagues and students</td>
</tr>
<tr>
<td>Essential</td>
<td>Willingness to work proactively with colleagues in other work areas/institutions</td>
</tr>
<tr>
<td>Essential</td>
<td>Ability to plan and prioritise own work in order to meet deadlines, including using initiative to plan research programmes</td>
</tr>
<tr>
<td>Essential</td>
<td>Commitment to personal development and updating of knowledge and skills</td>
</tr>
</tbody>
</table>
The Department of Physics

The Department of Physics at York has 56 academic staff members (52.2 FTE), more than 40 postdoctoral Research Fellows and visitors, and 40 support staff. The student population comprises around 475 undergraduates and 110 postgraduates (mostly PhD). The department has expanded considerably in the last five years, with both staff and student numbers increasing significantly, accompanied by an on-going rise in research funding.

The Department has a lively and expanding research programme in several areas of physics, organised within three large research areas: Condensed Matter Physics, Nuclear Physics and Plasma Physics and Fusion. The Department leads several inter-departmental ventures, including the Biological Physical Sciences Institute (BPSI), the York Quantum Technologies Centre (YQTC) and the recently established EPSRC Quantum Communications Hub. There has been significant major investment in laboratories and facilities including the York-JEOL Nanocentre and the York Plasma Institute. There are excellent mechanical, computing and electronic workshop facilities, which support our research and teaching activities.

The Department offers both three year BSc and four year MPhys degree programmes in Physics, Theoretical Physics and Physics with Astrophysics; and joint degree programmes in Maths and Physics and Physics with Philosophy. For postgraduates it offers a taught MSc in Fusion Energy, an MSc by Research and PhD degrees, including leading the EPSRC Centre for Doctoral Training in the Science and Technology of Fusion Energy.

The Department of Physics fully endorses and adheres to the University’s policies on equality of opportunity, and in particular:

- has flexible working arrangements which exceed those stipulated by the University;
- has demonstrated commitment to the University’s policy on job sharing;
- has been awarded both Athena Swan Silver and Champion status within the Institute of Physics’ Juno programme, the intention of which is to recognise and reward departments that can demonstrate they have taken action to address the under-representation of women in university physics and to encourage better practice for both women and men.

Further information about the department is available at: http://www.york.ac.uk/physics
THE DEPARTMENT

The National Physical Laboratory

NPL, the UK’s national measurement institute, sits at the intersection between scientific discovery and real world application as one of the world’s top three National Measurement Institutes. Our mission is to provide the measurement capability that underpins the UK’s prosperity and quality of life.

The Quantum Metrology Institute (QMI) brings together all of NPL’s leading-edge quantum science and metrology research and provides the expertise and facilities needed for academia and industry to test, validate, and ultimately commercialise new quantum research and technologies. The Institute comprises 60 scientists, together with around 60 students and guest workers, and provides the measurement expertise and facilities needed to underpin the £350M National Quantum Technology Programme.

Quantum information technologies based on individual photons are now reaching the marketplace. NPL leads the development of metrological techniques and standards to quantify the performance of such technologies; a principal example is quantum key distribution. This involves accurate and precise characterisation of optical sources, detectors, components and systems at the single-photon level. Extending this capability to address quantum random number generators is a new and exciting direction for NPL. Scientists in NPL’s QMI participate in projects aimed at developing this capability, in collaboration with UK and European industry and academia, and European National Measurement Institutes. NPL is a partner in the UK Quantum Communications Hub, applying this expertise to technology developed in partner research groups.

Further information about NPL is available at:
http://npl.co.uk/science-technology/quantum-detection and http://npl.co.uk/about/quantum-metrology-
Founded on principles of excellence, equality and opportunity for all, the University of York opened in 1963 with just 230 students. In 2017 it is the home of more than 17,000 students across more than 30 academic departments and research centres. Since opening over fifty years ago, we have become one of the world’s leading universities and a member of the prestigious Russell Group.

We are consistently recognised as one of the leading Higher Education Institutes and one of just six post-war universities which appear in the world top 100 (2013-14) and 15th in the Times & Sunday Times league table (2016). The University of York has won six Times Higher Education (THE) Awards and five Queen’s Anniversary Prizes.

The University is proud of its association with Athena SWAN, holding 12 awards in support of gender equality, representation and success for all, with gold awards for Chemistry and Biology and a University-wide bronze award.

Of 154 universities that took part in the Research Excellence Framework (REF) in 2014, The University of York ranked 14th overall and 10th for the impact of our research. The University is consistently in the top ten UK research universities and attracts over £60m a year of funding from research alone.

Our vision is to make the University of York a world leader in the creation of knowledge through fundamental and applied research, the sharing of knowledge by teaching students from varied backgrounds and the application of knowledge for the health, prosperity and well-being of people and society.
Attractive workplace

Centred around the picturesque village of Heslington on the edge of the city of York, our colleges are set in an attractive landscaped campus. York enjoys a safe, friendly atmosphere with facilities including bars, shops, theatres and concert halls all within easy walking distance.

The University has undergone an unprecedented period of expansion and renewal since 2000. We have invested in twenty new buildings on the original campus and have completed the first and second phases of a £750m campus expansion. Our investment in new colleges, teaching and learning spaces, laboratories, research facilities and a new sports village mean there has never been a better time to join us.

During this period of change we've worked hard to retain our friendly, informal and collegiate atmosphere, which is important to our core values of inclusivity and interdisciplinarity.

We have a thriving international community and are committed to providing staff moving to York with as much support as possible through our Relocation Package and Welcome Officers.

The University aims to offer a nurturing and supportive environment as an employer. Flexible working hours, nursery facilities, childcare vouchers, cycle to work scheme, generous holidays and an attractive pension scheme all make the University of York one of the region’s leading employers.

For further information please visit our employee benefit pages
THE CITY AND THE REGION

The City of York

Internationally acclaimed for its rich heritage and historic architecture, York’s bustling streets are filled with visitors from all over the world. Within its medieval walls you will find the iconic gothic Minster, Clifford’s Tower and the Shambles - just a few of the many attractions.

But York isn’t just a great place to visit - it’s also a great place to live and work. While nourishing a vibrant cosmopolitan atmosphere, York still maintains the friendly sense of community unique to a small city.

Visit www.visityork.org for more information on the city of York.

Shopping, culture and entertainment

York boasts specialist and unique boutiques but also all the high street stores on its busy shopping streets. Alongside them you will find cinemas, theatres, an opera house, art galleries, a vast range of restaurants, live music venues and clubs. York is particularly renowned for its multitude of pubs and bars, from the modern to the medieval.

Housing and schools

Whether you choose to live close to the city, in one of the surrounding villages or further afield, you will find a wide range of housing within comfortable distance of York and the University. For families, the area has a range of excellent schools both in the state and independent sector.

Great location

York is one of Britain’s best-connected cities. Halfway between London and Edinburgh on the East Coast mainline, on intercity trains you can reach London King’s Cross in less than two hours and Edinburgh in two and a half hours. York is also well served by road links, and it is easily accessible from the A1, M1 and the M62.

For those travelling from overseas, Manchester Airport is two hours away and Heathrow Airport just three and a half. Flights from nearby Leeds Bradford Airport provide easy access to mainland Europe. By Eurostar from London St Pancras, Paris is just over six hours away.

Yorkshire

The Lonely Planet guide recently declared Yorkshire the third best region in the world to visit. There is something to cater to every taste, whether it be the rugged landscapes of the Moors or the Dales, the picturesque seaside towns of Scarborough and Robin Hoods Bay, the gothic architecture of Whitby or the vibrancy of cosmopolitan Leeds.
Apply online
- Go to https://jobs.york.ac.uk
- Find this job using reference 6437
- Complete the online application form

You will need to submit your completed application by midnight (local UK time) on 21 March 2018

What will I need?
You will need to upload:
- your CV
- a letter describing how you meet the requirements of the job

You will also need details of 2 referees.

Help and assistance
Direct any informal queries to Dr Christopher Chunnilall
christopher.chunnilall@npl.co.uk

If you have any questions about your application, contact the HR Services team:
recruitment@york.ac.uk
+44 (0)1904 324835