Postdoctoral Research Associate in Quantum Communications Systems

Department of Physics

Closing date: 15 July 2018

Interview date: To be confirmed

Vacancy reference: 6756
INTRODUCTION

A Postdoctoral Research Associate (PDRA) position is available in the area of R&D of quantum communication systems, 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, National Physical Laboratory (NPL), 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.

Measurement Device Independent Quantum Key Distribution (MDI-QKD) is a recently developed protocol that is secure from attacks on the photon detectors, which are often deemed to be the most vulnerable components in a QKD system. Although attractive from a security viewpoint, the technology for MDI-QKD is much less mature than for conventional QKD. So far, there have been only a limited number of proof-of-concept experiments with high rates and no real keys were extracted in these cases. The main goal of this project is to develop a practical system for high bit rate MDI-QKD, advancing the technology towards real world deployment.

This experimental and technology development position is seconded from the University of York to work at Toshiba Research Europe Limited, Cambridge in the group of Dr Andrew Shields and under the supervision of Dr Zhiliang Yuan. The PDRA will develop the necessary understanding, expertise and techniques to develop an experimental system for high bit rate MDI-QKD. The target will be to realise an autonomous prototype that operates continuously in a realistic environment.

The Department of Physics in York is at the forefront of pioneering global research and technological advancement in our world leading research centres, focused around condensed matter physics, nuclear physics, and plasma physics and fusion energy at the York Plasma Institute. This is combined with a commitment to teaching and outstanding student satisfaction. As a Department, we strive to provide a working environment, which allows all staff and students to contribute fully, to flourish, and to excel. We aim to ensure that there is a supportive and egalitarian culture at all levels and across all staff groups. We promote good practice and a strong culture of equality in higher education, and are proud of our Juno Champion Award and Athena SWAN Silver Award. Further information can be found within this brief and on our website: www.york.ac.uk/physics
Main purpose of the role

MDI-QKD is based on two-photon interference of encoded pulses from the communicating parties (Alice and Bob) at an intermediate station that does not need to be trusted or placed at a secure location. In order to create the desired two-photon interferences, it is essential that the pulses from the two parties are identical in every degree of freedom, except that used to encode the quantum information. This means the two sources must be identical spectrally despite being separated by 100’s of km. They must also present no (or little) timing jitter, as this would also degrade the two-photon interference visibility.

Recently TREL demonstrated that indistinguishable, low jitter pulses can be generated at GHz rates from separate laser diodes, at least in a lab environment. This experimental demonstration was enabled by reducing the natural timing jitter of a gain switched laser diode by optical seeding with a second pulsed laser diode. It was thereby possible to obtain high visibility two-photon interference between pulses from distinct sources and demonstrate MDI-QKD at high rates.

This project will extend these studies to realise a prototype for MDI-QKD that can operate continuously and with spatial separation of the two communicating parties. The key challenges will be the realisation of high-speed, real-time modulation of indistinguishable pulses from remote locations, as well as the synchronisation of those remote locations.

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 writing reports, presenting results 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

## Qualifications

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

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<th>Essential / Desirable</th>
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<tr>
<td>Knowledge relevant for quantum and/or classical optical R&amp;D</td>
<td>Essential</td>
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<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>
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<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>
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<tr>
<td>Knowledge across a broad spectrum of quantum technology areas, additional to specific R&amp;D role</td>
<td>Desirable</td>
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## Skills, abilities and competencies

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<th>Skills, abilities and competencies</th>
<th>Essential / Desirable</th>
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<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>
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<td>Competency to make presentations at conferences or exhibit work in other appropriate events</td>
<td>Essential</td>
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<td>Ability to write up research work for publication in high profile journals and engage in public dissemination</td>
<td>Essential</td>
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<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>
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<td>Competency to conduct individual and collaborative research projects</td>
<td>Essential</td>
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<td>Ability to identify sources of funding and contribute to the process of securing funds, with collaborators if required</td>
<td>Essential</td>
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<tr>
<td>Experimental, optical, electronic and engineering skills appropriate to quantum and/or classical optical communications technologies R&amp;D</td>
<td>Essential</td>
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<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>
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## PERSON SPECIFICATION

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<th>Experience</th>
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<tr>
<td>Experience of carrying out both independent and collaborative research</td>
<td>Essential</td>
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<td>Experience of writing up research work for publication</td>
<td>Essential</td>
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<td>Ability to work as part of a team and also to work independently using own initiative</td>
<td>Essential</td>
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<th>Personal attributes</th>
<th>Essential / Desirable</th>
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<tr>
<td>Attention to detail and commitment to high quality</td>
<td>Essential</td>
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<td>Collaborative ethos</td>
<td>Essential</td>
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<td>Interest in and enthusiasm for the subject matter</td>
<td>Essential</td>
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<td>Positive attitude to colleagues and students</td>
<td>Essential</td>
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<td>Willingness to work proactively with colleagues in other work areas/institutions</td>
<td>Desirable</td>
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<td>Ability to plan and prioritise own work in order to meet deadlines, including using initiative to plan research programmes</td>
<td>Essential</td>
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<td>Commitment to personal development and updating of knowledge and skills</td>
<td>Desirable</td>
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The Department of Physics: http://www.york.ac.uk/physics is a department at the forefront of pioneering global research and technological advancement in our world leading research centres, focused around condensed matter physics, nuclear physics, and plasma physics and fusion energy at the York Plasma Institute.

The Department has a lively and expanding research programme, and the research interests span a wide range, within both physics and the interactions of physics with other disciplines. We have benefited from substantial investment in these research groups, to help them play a leading role on the national and international stage, collaborating with major research institutions and industries. The research groups have international recognition, and each group regularly publishes papers in major journals and presents papers at international conferences.

The Department has many collaborations with other research groups in the UK and abroad, and contacts with industrial researchers. The Department also leads several interdepartmental ventures, including the Biological Physical Sciences Institute (BPSI), the York Centre for Quantum Technologies Centre (YCQT) and the EPSRC Quantum Communications Hub. There has been significant major investment in laboratories and facilities including the York-JEOL Nanocentre and the York Plasma Institute, and we have excellent mechanical, computing and electronic workshop facilities, which support our research and teaching activities.

We have developed a range of undergraduate and postgraduate programmes that provide all our students with the skills to succeed in careers across a broad range of scientific, technological, and related disciplines, and provide opportunities for students to spend a year at one of a number of overseas universities or in industry as an integral part of their degree programme. 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 has 55 academic staff members (including teaching-only staff) and amongst our academic staff we have Fellows of the Royal Society and the Institute of Physics, many national and international prize winners, contributing to a dynamic and thriving department. We also have an increasing number of postdoctoral Research Fellows and visitors, and 40 support staff (technical and administrative). The student population comprises around 450 undergraduates and 115 postgraduates (mostly PhD).

The Department of Physics operates a set of family-friendly policies and welcomes applications that are made on a part-time and job-share basis, and we will do our best to accommodate such requests where possible. Staff working patterns are flexible and a formal flexitime system is also in operation. We provide support and advice for staff taking maternity, paternity, adoption and parental leave, and the University has a nursery and a Child Care voucher scheme.

The Department provides support for all categories of staff in their applications for promotion, role reviews, awards, prizes and rewarding excellence nominations. Staff are encouraged to attend training events and take up opportunities for professional development including those offered by the award-winning University Learning and Development Team: http://www.york.ac.uk/admin/hr/training/. The Department is committed to establishing a culture of environmental good practice and all staff are asked to go about their duties in a resource efficient way and minimise impacts to the environment wherever possible. Social events are also held regularly for members of staff.

The Department strives to address diversity inequalities to ensure that there is a culture that supports equality and encourages better representation throughout the Department. The Department of Physics fully endorses and adheres to the University’s policies on equality of opportunity, and support for staff at all stages of their career is recognised as being extremely important. In recognition of our commitment to equality, the Department has been awarded both Athena Swan Silver (the Athena SWAN Charter recognises and celebrates good employment practice for women working in science, engineering and technology (SET) in higher education and research) 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). We have a well-established Equality Committee in the department which regularly reviews

Further information about the department is available at: http://www.york.ac.uk/physics
TOSHIBA RESEARCH EUROPE LIMITED (TREL)

TREL, based in Cambridge UK, has played a leading role in quantum cryptography R&D for over 18 years. Their significant achievements in this field include the first demonstration of QKD over 100km of fibre, the first continuous operation of one-way QKD, the first demonstration of fibre-based QKD using a true single photon source, the first demonstration of a secure bit rate exceeding 1 Mbit/sec, the first upstream quantum access network, record distances and bit rates for QKD/data multiplexing, and the first demonstration of quantum-secured WDM transmission through a single installed fiber. TREL pioneered two key technologies in the field: (1) self-differencing InGaAs APDs that have allowed 100-fold improvement in the QKD secure bit rate over conventional detectors and (2) active-stabilisation technology that enable continuous operation of a one-way QKD system. They have gained extensive field trial experience in a number of large QKD networks, including SECOQC in Europe, the Quantum Communications Hub in the UK and UQCC in Japan.

The Quantum Information Group is one of the largest industry-based groups interested in quantum technologies in the UK. They have expertise in quantum optics, quantum theory, optical communications, electronics, and system control software. There are state-of-the-art laboratories for development, assembly and testing of QKD systems and high speed single photon detectors.

Further information about TREL is available at: http://www.quantum.toshiba.co.uk
THE UNIVERSITY

Founded on principles of excellence, equality and opportunity for all, the University of York opened in 1963 with just 230 students. In 2018 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 are ranked 16th in the Times & Sunday Times league table (2017). 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 is committed to promoting a diverse and inclusive community - a place where we can all be ourselves and succeed on merit. We offer a range of family friendly, inclusive employment policies, flexible working arrangements, staff engagement forums, campus facilities and services to support staff from different backgrounds.

For further information please visit our employee benefit pages.
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 6756
- Complete the online application form

You will need to submit your completed application by midnight (local UK time) on 15 July 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

Informal technical enquiries regarding this post may be made to: Dr Andrew Shields (QComm@crl.toshiba.co.uk).

Informal enquiries regarding the Quantum Communications Hub may be made to: Professor Tim Spiller (timothy.spiller@york.ac.uk). If you have any questions about your application, contact the HR Services team:

recruitment@york.ac.uk
+44 (0)1904 324835