Hybrid quantum communication and sensing networks

Applicants are invited to undertake a 3.5-year PhD programme in the Department of Physics and Astronomy at the University of Sussex in partnership with DSTL to investigate the theory of quantum communication and sensing networks. A fully funded studentship is available through the SEPnet SME-Doctoral Training Network.

Background

One of the most exciting recent developments in physics has been the application of quantum physics to new technologies and the Sussex Centre for Quantum Technologies is one of the world's leading centres for research in this area. This theory PhD project will extend promising developments on the use of quantum networks of sensors to investigate the potential for new applications in secure remote sensing as well as develop general principles for understanding the power and capability of quantum networks.

Until recently, quantum metrology and quantum communications were viewed as distinct disciplines, but have started to merge as network issues become more important in measurements. This includes scenarios involving unsecured quantum channels [1], delegated measurements to an untrusted party [2] or unwanted eavesdroppers [3]. A disruptive application of this technology is the ability to make incredibly precise measurements at remote strategic platforms that cannot house all the infrastructure needed for quantum measurements and communications. This could include satellites or aircraft, for example, where there is a big advantage to having most of the resources at a central hub. Being able to do this in a way that the measurement results can be received centrally without an eavesdropper gaining any information is vitally important. At Sussex we are developing theoretical results that demonstrate the viability of such an application and have shown it is remarkably secure to the known vulnerabilities of other communication schemes.

This project will investigate how this idea could be extended to multiple parties by building on existing secure multipartite protocols across quantum networks [4]. The idea involves a central node that can prepare entangled quantum states that are then distributed throughout the network to be used in a multiparameter quantum measurement. This setup allows for the possibility of applications such as an extremely precise, secure and robust universal time standard when applied to clocks on a network of satellites [5].

Sussex has pioneered research into quantum sensors and their network capabilities [6,7]. This PhD project is an exciting opportunity to be part of the next stage of developments. The successful applicant will join a team within the Sussex Centre for Quantum Technologies (http://www.sussex.ac.uk/scqt/) and will work with team members at DSTL. They will benefit from being part of the SME-DTN cohort and will receive both academic and transferable skills training at Sussex and through our membership of the South East Physics Network (http://www.sepnet.ac.uk).

The South-East Physics Network (SEPnet) comprises nine universities working together to deliver excellence in physics. The aim of the SME Doctoral Training Network (SME-DTN) is to create a critical mass of research to support both regional industries and national science priorities with funding from Research England Development Fund (RED). The SME-DTN aims to attract applications from diverse backgrounds and non-traditional routes.

All students recruited to the SME-DTN are expected to attend the Graduate Network Summer and Winter Schools and up to 5 advanced physics courses during the course of their PhD. For details of the GRADnet Training Programme 2021-22 see here.

[1] Z. Huang, C. Macchiavello, and L. Maccone, Physical Review A **99**, 022314 (2019)
[2] P. Yin et al., Phys. Rev. Applied **14**, 014 065 (2020)
[3] H. Kasai, Y. Takeuchi, H. Hakoshima, Y. Matsuzaki, and Y. Tokura, arXiv:2105.05585
[4] C.-Y. Huang, N. Lambert, C.-M. Li, Y.-T. Lu, and F. Nori, Phys. Rev. A **99**, 012302, (2019)
[5] P. Kómár et al., Nature Physics **10**, 582 (2014)
[6] T.J Proctor, P.A Knott, J.A. Dunningham, Phys. Rev. Lett. **120**, 080501 (2018)
[7] Jesús Rubio and Jacob Dunningham, PRA **101**, 032114 (2020)

Applicant credentials

- First or good upper second class integrated masters degree in physics or another relevant scientific discipline.
- First rate analytical and numerical skills, with a well-rounded academic background.
- A driven, professional and self-dependent work attitude is essential.
- The ability to produce high quality presentations and written reports.

Funding

The studentship covers tuition fees, a tax-free stipend (currently £15,609 p.a.) and an additional financial study package including travel budget, provided by the Research England Development Fund. Only UK Higher Education "Home Fee" status applicants are eligible.

Deadline

31 July 2022 23:45 (GMT)

How to apply

You should apply through the University of Sussex online system:

https://www.sussex.ac.uk/study/phd/apply/log-into-account

Select the PhD in Physics with an entry date of September 2022. In the Finance & Fees section, state that you wish to be considered for this studentship.

We advise early application as the position will be filled as soon as a suitable candidate is found.

Due to the high volume of applications received, you may only hear from us if your application is successful.

Interested in this studentship?

If you have practical questions about the progress of your on-line application or your eligibility, contact Emma Ransley at mps-pgrsupport@sussex.ac.uk. For academic questions about the project, contact Prof. Jacob Dunningham at j.dunningham@sussex.ac.uk.

SEPnet South East Physics Network

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