Quantum-enhanced radar systems

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 focus on the use of quantum effects in radar systems to improve their sensitivity or allow them to operate covertly.

Radar has been a truly transformative technology and so any new advantages are keenly anticipated. Theoretical schemes have shown how quantum radar could operate in principle and ground breaking experiments have demonstrated entanglement distribution over thousands of kilometres via satellites [1]. These results are very promising but the performance limits for quantum radar are not yet known, especially in realistic operating scenarios where things like bad weather will destroy the entanglement. Until recently the mathematical framework for quantum metrology has not been able to answer this question adequately because it is only valid for large data, whereas quantum radar is likely to rely on limited data due to the low return rate of photons. New theory developed at Sussex will allow us to rigorously treat the low data regime and properly understand the fundamental limits to quantum radar [2,3]. This project will explore this and also use quantum metrological techniques to optimise the information that can be extracted in read-out schemes thereby giving advantages without needing entanglement at all [4]. This should lead to simpler and more practical quantum-enhanced devices.

The successful applicant will join a team within the Sussex Centre for Quantum Technologies (http://www.sussex.ac.uk/scqt/). During the PhD the student 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) as well as project-specific skills through project supervision.

Candidates should have (or expect to achieve) at least an upper second class integrated masters in physics or a related subject.

Essential Background: A strong background in physics including experience of quantum mechanics and optics. Some experience of numerical simulations is also desirable.

Please submit applications electronically via the University of Sussex website:
https://www.sussex.ac.uk/study/phd/apply

Informal enquiries can be made to Professor Jacob Dunningham
(j.dunningham@sussex.ac.uk)

Funding Notes

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References

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[2] Jesús Rubio, Paul Knott and Jacob Dunningham, J. Phys. Comm. **2** 015027 (2018).
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[4] M. Kritsotakis, S.S. Szigeti, J. A. Dunningham and S.A. Haine, Phys. Rev. A **98**, 023629 (2018).