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Research interests

Quantum optical receivers for satellite QKD,
Practical implementation (1st gen service),
High-bandwidth (next-gen service),
Photonic devices for QKD,
Addressing implementation practical challenges.

Employment

Associate Professor

School of Engineering & Physical Sciences
Heriot-Watt University
1 Aug 2023 → present

Associate Professor

Institute of Photonics and Quantum Sciences
Heriot-Watt University
1 Aug 2023 → present

Student theses

Quantum-based Security in Optical Fibre Networks

Donaldson, R. J. (Author), Buller, G. S. (Supervisor), Apr 2016

Research outputs

Experimental demonstration of polarization-based decoy-state BB84 quantum key distribution utilizing a single laser and a single detector

Castillo, A. T., Simmons, C. & Donaldson, R., 15 Feb 2025, In: *Optics Letters*. 50, 4, p. 1184-1187 4 p.

The impact of spot-size on single-photon avalanche diode timing-jitter and quantum key distribution

Lee, A., Tello Castillo, A., Whitehill, C. & Donaldson, R. J., Dec 2024, In: *IET Quantum Communication*. 5, 4, p. 443-449 7 p.

Electromagnetic side-channel attack risk assessment on a practical quantum-key-distribution receiver based on multi-class classification

Pantoja, J., Bucheli, V. A. & Donaldson, R. J., 18 Nov 2024, In: *EPJ Quantum Technology*. 11, 78.

Reducing the hardware requirements while mitigating side-channels in polarization-based decoy-state BB84 quantum key distribution

Donaldson, R., Simmons, C. & Castillo, A. T., 15 Nov 2024, *Quantum Technologies for Defence and Security*. Sorelli, G., Ducci, S. & Schwartz, S. (eds.). SPIE, 132020F. (Proceedings of SPIE; vol. 13202).

Information Leakage of a Quantum Receiver Based on Polarization of EM Radiated Emissions

Pantoja, J. J., Anagnostou, D. & Donaldson, R., 9 Oct 2024, *2024 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+SIPI)*. IEEE, 10705557

Enhancements to quantum communication performance utilizing a prototype photonic lantern and multiplexed single-photon detection

Chandrasekharan, H. K., Barrow, P., MacLachlan, D., Thomson, R. R. & Donaldson, R., 15 Sept 2024, In: *Optics Letters*. 49, 18, p. 5252-5255 4 p.

Impact of visibility limiting conditions on satellite and high-altitude platform quantum key distribution links

Eso, E., Simmons, C., Buller, G. S. & Donaldson, R., 15 Jul 2024, In: *Optics Express*. 32, 15, p. 26776-26792 17 p.

Radiofrequency emanations of a single-photon detector

Pantoja, J., Tello, A., Anagnostou, D., Kirrane, J., Stonehouse, M., Koehler-Sidki, A., Natrella, M. & Donaldson, R. J., 17 Jan 2024, *Quantum Engineering and Technology Conference (QET 2023)*. Institution of Engineering and Technology, p. 55-59 5 p.

Beamshaping beacon light for satellite quantum key distribution: Spatial separation and point ahead angle

Simmons, C. & Donaldson, R., 30 Nov 2023, *Quantum Technology: Driving Commercialisation of an Enabling Science IV*. Padgett, M. J., Fedrizzi, A., Holynski, M. & Politi, A. (eds.). SPIE, 1279508. (Proceedings of SPIE; vol. 12795).

Investigation on the Electromagnetic Radiated Emissions of a Single- Photon Avalanche Diode

Pantoja, J. J., Tello, A., Anagnostou, D. E., Kirrane, J., Stonehouse, M., Koehler-Sidki, A., Natrella, M. & Donaldson, R., 30 Nov 2023, *Quantum Technology: Driving Commercialisation of an Enabling Science IV*. Padgett, M. J., Fedrizzi, A., Holynski, M. & Politi, A. (eds.). SPIE, 1279509. (Proceedings of SPIE; vol. 12795).

Experimental demonstration of a reconfigurable free-space receiver implementing polarization routing and filtering for daytime quantum key distribution

Tello Castillo, A., Zanforlin, U., Buller, G. S. & Donaldson, R. J., 20 Nov 2023, In: *Optics Express*. 31, 24, p. 40317-40327 11 p.

Multicore fiber beacon system for reducing back-reflection in satellite quantum key distribution

Simmons, C. & Donaldson, R. J., 3 Jul 2023, In: *Optics Express*. 31, 14, p. 23382-23392 11 p.

Multimode fiber influence on single-photon avalanche diode timing jitter

Lee, A., Donaldson, R. J., Whitehill, C. & Tello, A., 6 Jun 2023, *Quantum Optics and Photon Counting 2023*. SPIE, 1257007. (Proceedings of SPIE; vol. 12570).

BB84 quantum key distribution transmitter utilising broadband sources and a narrow spectral filter

Noblet, Y. & Donaldson, R. J., 21 Apr 2023, In: *Optics Express*. 31, 9, p. 15145-15155 11 p.

Quantum bit error rate timing jitter dependency on multi-mode fibers

Lee, A., Tello, A., Whitehill, C. & Donaldson, R. J., 13 Feb 2023, In: *Optics Express*. 31, 4, p. 6076-6087 12 p.

An investigation of jamming in free-space quantum key distribution

Simmons, C., Noblet, Y., Tello, A. & Donaldson, R. J., 11 Jan 2023, *Quantum Technology: Driving Commercialisation of an Enabling Science III*. Padgett, M. J., Bongs, K., Fedrizzi, A. & Politi, A. (eds.). SPIE, 123350C. (Proceedings of SPIE; vol. 12335).

Multiprotocol Quantum Key Distribution Receiver for Free Space

Tello Castillo, A., Zanforlin, U., Buller, G. S. & Donaldson, R. J., 11 Jan 2023, *Quantum Technology: Driving Commercialisation of an Enabling Science III*. Padgett, M. J., Bongs, K., Fedrizzi, A. & Politi, A. (eds.). SPIE, 123350B. (Proceedings of SPIE; vol. 12335).

Multimode fiber influence on time response of single-photon avalanche diodes used in QKD

Lee, A., Castillo, A. T., Donaldson, R. & Whitehill, C., 2023, *Quantum 2.0*. OSA Publishing, QW2A.7

Time-division technique for quantum optical receivers utilizing single-photon detector array technology and spatial-multiplexing

Castillo, A. T. & Donaldson, R., 5 Dec 2022, In: *Optics Express*. 30, 25, p. 44365-44374 10 p.

Utilizing broadband wavelength-division multiplexing capabilities of hollow-core fiber for quantum communications

Nasti, U., Sakr, H., Davidson, I. A., Poletti, F. & Donaldson, R. J., 20 Oct 2022, In: *Applied Optics*. 61, 30, p. 8959-8966 8 p.

Time bin quantum key distribution protocols for free space communications

Tello, A., Eso, E. & Donaldson, R. J., 4 Oct 2022, *Quantum Communications and Quantum Imaging XX*. Deacon, K. S. & Meyers, R. E. (eds.). SPIE, 122380E. (Proceedings of SPIE; vol. 12238).

In-lab demonstration of coherent one-way protocol over free space with turbulence simulation

Tello Castillo, A., Eso, E. & Donaldson, R. J., 28 Mar 2022, In: *Optics Express*. 30, 7, p. 11671-11683 13 p.

Towards free-space quantum key distribution with a 2D single-photon sensor

Tello Castillo, A. & Donaldson, R. J., 6 Oct 2021, *Quantum Technology: Driving Commercialisation of an Enabling Science II*. Padgett, M. J., Bongs, K., Fedrizzi, A. & Politi, A. (eds.). SPIE, 1188109. (Proceedings of SPIE; vol. 11881).

Feasibility of quantum key distribution from high altitude platforms

Chu, Y., Donaldson, R., Kumar, R. & Grace, D., Jul 2021, In: *Quantum Science and Technology*. 6, 3, 035009.

Towards combined quantum bit detection and spatial tracking using an arrayed single-photon sensor

Donaldson, R., Kundys, D., Maccarone, A., Henderson, R., Buller, G. S. & Fedrizzi, A., 15 Mar 2021, In: *Optics Express*. 29, 6, p. 8181-8198 18 p.

Link loss analysis for a satellite quantum communication down-link

Zhang, C., Tello Castillo, A., Zanforlin, U., Buller, G. S. & Donaldson, R. J., 20 Sept 2020, *Emerging Imaging and Sensing Technologies for Security and Defence V; and Advanced Manufacturing Technologies for Micro- and Nanosystems in Security and Defence III*. SPIE, 1154007. (Proceedings of SPIE; vol. 11540).

Prospects of time-bin quantum key distribution in turbulent free-space channels

Tello Castillo, A., Novo, C. & Donaldson, R., 20 Sept 2020, *Emerging Imaging and Sensing Technologies for Security and Defence V; and Advanced Manufacturing Technologies for Micro- and Nanosystems in Security and Defence III*. SPIE, 1154006. (Proceedings of SPIE; vol. 11540).

On-chip implementation of the probabilistic quantum optical state comparison amplifier

Canning, D. W., Donaldson, R. J., Mukherjee, S., Collins, R. J., Mazzarella, L., Zanforlin, U., Jeffers, J., Thomson, R. R. & Buller, G. S., 28 Oct 2019, In: *Optics Express*. 27, 22, p. 31713-31726 14 p.

Quantum state correction using a measurement-based feedforward mechanism

Donaldson, R. J., Mazzarella, L., Zanforlin, U., Collins, R. J., Jeffers, J. & Buller, G. S., 26 Aug 2019, In: *Physical Review A*. 100, 2, 023840.

Analysis of the effects of imperfections in an optical heterodyne quantum random-number generator

Zanforlin, U., Donaldson, R. J., Collins, R. J. & Buller, G. S., 6 May 2019, In: *Physical Review A*. 99, 5, 052305.

Progress in experimental quantum digital signatures

Collins, R. J., Donaldson, R. J. & Buller, G. S., 18 Sept 2018, *Quantum Communications and Quantum Imaging XVI*. Meyers, R. E., Shih, Y. & Deacon, K. S. (eds.). SPIE, 107710F. (Proceedings of SPIE; vol. 10771).

A high-gain and high-fidelity coherent state comparison amplifier

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Quantum optical state comparison amplification of coherent states

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Mazzarella, L., Donaldson, R. J., Collins, R. J., Zanforlin, U., Tatsi, G., Buller, G. S. & Jeffers, J., 21 May 2018, *Quantum Technologies 2018*. Stuhler, J., Shields, A. J. & Padgett, M. J. (eds.). SPIE, 106741D. (Proceedings of SPIE; vol. 10674).

Quantum-based security in optical fibre networks

Donaldson, R. J., Apr 2016, Heriot-Watt University. 246 p.

Experimental demonstration of kilometer-range quantum digital signatures

Donaldson, R. J., Collins, R. J., Kleczkowska, K., Amiri, R., Wallden, P., Dunjko, V., Jeffers, J., Andersson, A. E. E. & Buller, G. S., 19 Jan 2016, In: Physical Review A. 93, 1, 012329.

Experimental implementation of a quantum optical state comparison amplifier

Donaldson, R. J., Collins, R. J., Eleftheriadou, E., Barnett, S. M., Jeffers, J. & Buller, G. S., 27 Mar 2015, In: Physical Review Letters. 114, 12, 120505.

Realization of quantum digital signatures without the requirement of quantum memory

Collins, R. J., Donaldson, R. J., Dunjko, V., Wallden, P., Clarke, P. J., Andersson, A. E. E., Jeffers, J. & Buller, G. S., 21 Jul 2014, In: Physical Review Letters. 113, 4, 5 p., 040502.

An in fiber experimental approach to photonic quantum digital signatures that does not require quantum memory

Collins, R. J., Donaldson, R. J., Dunjko, V., Wallden, P., Clarke, P. J., Andersson, E., Jeffers, J. & Buller, G. S., 2014, *Emerging Technologies in Security and Defence II; and Quantum-Physics-Based Information Security III*. Gruneisen, M., Dusek, M., Rarity, J., Lewis, K., Hollins, R., Merlet, T. & Toet, A. (eds.). Bellingham : SPIE, 10 p. (Proceedings of SPIE; vol. 9254).

Photonic quantum digital signatures: An experimental test-bed

Collins, R. J., Clarke, P. J., Dunjko, V., Donaldson, R. J., Jeffers, J., Andersson, E. & Buller, G. S., 18 Nov 2013, *CLEO: Science and Innovations, CLEO_SI 2013*.

An approach to experimental photonic quantum digital signatures in fiber

Donaldson, R. J., Collins, R. J., Dunjko, V., Clarke, P. J., Andersson, E., Jeffers, J. & Buller, G. S., 2013, *Emerging Technologies in Security and Defence; and Quantum Security II; and Unmanned Sensor Systems X*. Lewis, K. L., Hollins, R. C., Merlet, T. J., Gruneisen, M. T., Dusek, M., Rarity, J. G. & Carapezza, E. M. (eds.). SPIE, 10 p. 88990X. (Proceedings of SPIE; vol. 8899).

Time-resolved photoelectron imaging of excited state relaxation dynamics in phenol, catechol, resorcinol and hydroquinone

Livingstone, R., Thompson, J. O. F., Iljina, M., Donaldson, R. J., Sussman, B., Paterson, M. & Townsend, D., 2012, In: The Journal of Chemical Physics. 137, 18, 17 p., 184304.

Press/Media

Cutting the 'key' to an unhackable 5G network

Donaldson, R. J.

27/05/21 → 28/05/21

7 items of Media coverage, 1 Media contribution

HOGS press release

Donaldson, R. J.

30/06/22

5 items of Media coverage, 1 Media contribution

Quantum communications for space

Donaldson, R. J.

19/09/18

2 items of Media coverage

Satellite QKD project promotion

Donaldson, R. J.

24/05/23

1 item of Media coverage

Start of HOGS site work

Donaldson, R. J.

28/08/24

15 items of Media coverage, 2 Media contributions

State-of-the-art telescope paves way for space tech cluster at Heriot-Watt

Donaldson, R. J.

24/01/24

5 items of Media coverage