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Research interests

My research involves investigating foundational areas in quantum physics (such as interaction-free measurement, weak values, and statistical independence violation), with a view to evaluating and leveraging the effects these novel phenomena/areas have for the development of quantum technologies. It falls within EPSRC research themes in Quantum Technologies and Physics research area Quantum Optics and Information.
This work initially focussed on counterfactual/interaction-free effects –both looking at philosophical/foundational issues, and potential practical applications. While this research is still ongoing the scope has expanded onto the question of how we define the presence/path of a quantum particle. This covers philosophical aspects and interactions with an environment which could cause information leakage/decoherence. This naturally led into looking at weak values/measurement of path projection operators, as well as to what extent the wavefunction just represents our (incomplete) knowledge of a system, rather than really representing the way the world is.
Alongside this, I have been working on looking at extensions of quantum mechanics which allow us to regain Bell-locality by weakening statistical independence. These interpretations – which could act as a path to unifying quantum mechanics with general relativity – also lead to different predictions to standard quantum mechanics on scales we are only now beginning to probe (e.g. using noisy intermediate-scale quantum devices), and could very much affect claims being made by the quantum community.
The project contributes to the underpinning science of quantum technologies, adapting quantum foundational ideas into quantum technological applications, and evaluating current quantum technologies (e.g. quantum key distribution, quantum computing) in light of potential extensions of quantum mechanics.

Employment

Doctor of Philosophy, Department of Electrical &Electronic Engineering
Faculty of Engineering
United Kingdom
7 Oct 2019 → present

Member, Bristol Doctoral College
United Kingdom
7 Oct 2019 → present

Research outputs

Data for "Do the Laws of Physics Prohibit Counterfactual Communication"
Hance, J., 10 Nov 2021

Comment on ``Scheme of the arrangement for attack on the protocol BB84"
Hance, J. R., Oct 2021, In: Optik. 243, 3 p., 167451.

Does the weak trace show the past of a quantum particle in an unperturbed system?
Hance, J. R., Rarity, J. & Ladyman, J., 28 Sep 2021, (Submitted) 8 p.

Exchange-Free Ghost Imaging
Hance, J. R. & Rarity, J. G., 23 Jul 2021, *OSA Optical Sensors and Sensing Congress 2021 (AIS, FTS, HISE, SENSORS, ES).* Optical Society of America (OSA), 2 p. (OSA Technical Digest; vol. 2021, no. SW5F.5).

Code for "Deterministic Teleportation and Universal Computation Without Particle Exchange"
Hance, J., 17 Jun 2021

Counterfactual Ghost Imaging
Hance, J. & Rarity, J., 2 Jun 2021, In: npj Quantum Information. 7, 1, 7 p., 88.

Ghost Imaging Counterfactually
Hance, J. R. & Rarity, J. G., 14 May 2021, *CLEO: Science and Innovations 2021: Joint Poster Session I (JTu3A).* San Jose, California, United States: Optical Society of America (OSA), 2 p.

Backscatter and spontaneous four-wave mixing in micro-ring resonators
Hance, J., Sinclair, G. F. & Rarity, J. G., 8 Apr 2021, In: Journal of Physics: Photonics. 3, 2, 025003.

Correction to: How Quantum is Quantum Counterfactual Communication? (Foundations of Physics, (2021), 51, 1, (12), 10.1007/s10701-021-00412-5)
Hance, J. R., Ladyman, J. & Rarity, J., Apr 2021, In: Foundations of Physics. 51, 2, 40.

Experimental Tests of Invariant Set Theory
Hance, J. R., Palmer, T. N. & Rarity, J., 15 Feb 2021, (Submitted) In: arXiv. 6 p.

How Quantum is Quantum Counterfactual Communication?
Hance, J. R., Ladyman, J. & Rarity, J., 4 Feb 2021, In: Foundations of Physics. 51, 1, 17 p., 12.

Exchange-Free Computation on an Unknown Qubit at a Distance
Salih, H., Hance, J. R., McCutcheon, W., Rudolph, T. & Rarity, J., 19 Jan 2021, In: New Journal of Physics. 23, 1, 10 p., 013004.

Wavefunctions can Simultaneously Represent Knowledge and Reality
Hance, J. R., Rarity, J. & Ladyman, J., 16 Jan 2021, (Submitted) In: arXiv. 6 p.

Deterministic Teleportation and Universal Computation Without Particle Exchange
Salih, H., Hance, J. R., McCutcheon, W., Rudolph, T. & Rarity, J., 11 Sep 2020, (Submitted) In: arXiv. 7 p.

How Quantum is Quantum Counterfactual Communication?
Hance, J. R., 27 Apr 2020, (Submitted).

Counterfactuality, Definiteness, and Bell's Theorem
Hance, J. R., 14 Sep 2019, (Submitted) In: arXiv. 8 p.

Modal, Truly Counterfactual Communication with On-Chip Demonstration Proposal
Hance, J., McCutcheon, W., Yard, P. & Rarity, J., 6 Apr 2019. 2 p.

Do the laws of physics prohibit counterfactual communication?
Salih, H., McCutcheon, W., Hance, J. & Rarity, J., 4 Jun 2018, (Submitted) In: arXiv.

Activities

Samy Maroun Center for Space, Time and the Quantum (External organisation)
Jonte R Hance (Member)
1 Nov 2020

BQIT:20
Jonte R Hance (Participant)
27 Apr 2020 → 30 Apr 2020

QuICC Summer School 2019
Jonte R Hance (Participant)
19 Aug 2019 → 23 Aug 2019

IONS Exeter
Jonte R Hance (Speaker)
9 Jul 2019 → 12 Jul 2019

QMATH Masterclass 2019
Jonte R Hance (Participant)
17 Jun 2019 → 21 Jun 2019

Quantum Information and Measurement V
Jonte R Hance (Participant)
4 Apr 2019 → 6 Apr 2019

BQIT:19
Jonte R Hance (Participant)
1 Apr 2019 → 3 Apr 2019

IONS KOALA 2018
Jonte R Hance (Participant)
3 Dec 2018 → 8 Dec 2018

Prizes

Best Poster Presentation
Hance, Jonte R (Recipient), 7 Dec 2018

Travel Grant
Hance, Jonte R (Recipient), 3 Dec 2019

Projects

QComms2: 8031 EP/T001011/1 Quantum Communication Hub via York
Rarity, J. G., Nejabati, R., Simeonidou, D., Sahin, D., Kanellos, G., Aktas, D. V. C., Joshi, S. K., Lowndes, D. L. D., Venkatachalam, N., Hugues Salas, E., Woodland, E. M., Erven, C., Zhang, P., Hance, J. R., Clark, M., Rosenfeld, L. M., Hastings, E. M. J., Johlinger, F. B., Wang, R., Stange Tessinari, R., Solomons, N. R., Fasoulakis, T. & Alia, O.
1/12/19 → 30/11/24