Contribution ID: **110** Type: **Invited Speaker**

Quantum networking and computing with trapped ions

Tuesday, 26 September 2023 10:00 (30 minutes)

I will describe recent work at Oxford on quantum networking applications using trapped-ion qubits. Our apparatus consists of two independent ion traps, separated by 2 metres, linked via a single-photon optical fibre interface. We can generate high-fidelity (>90%) entanglement between trapped-ion qubits, one stored in each trap, at high speed (up to 200 entanglement events per second). Using this setup we have made demonstrations of several quantum technological applications in the areas of cryptography, metrology and information processing [1,2,3].

Firstly, we achieved a full implementation of a "device-independent" QKD protocol [1]; that is, the generation of a shared secret key between Alice and Bob, reliant only on their possession of a pair of entangled particles - entanglement which no eavesdropper can share [4]. Secondly, we demonstrated entanglement-enhanced frequency comparison of two optical atomic clocks [2], with precision approaching the Heisenberg limit (the ultimate measurement precision allowed by quantum mechanics). Recently, we have added robust quantum memory to our network [5], which has enabled a demonstration of verifiable blind quantum computing [3]; that is, the ability of a "client" to run and verify a simple protocol on the "server's" quantum processor, without the server being able to see the client's data or algorithm.

[1] D.P.Nadlinger et al., Nature 2022.
[2] B.C.Nichol, R.Srinivas et al., Nature 2022.
[3] P.Drmota et al., arXiv 2023.
[4] A.Ekert, Phys.Rev.Lett. 1991.
[5] P.Drmota et al., Phys.Rev.Lett. 2023.

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