



CRC 1227
Designed Quantum States of Matter



GUEST LECTURE

Prof. Dr. David Lucas

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(Guest of Prof. P. Schmidt und Prof. K. Hammerer)

Leibniz Universität Hannover

DQ-mat Colloquium

09 June 2022, 3.00 pm

(via Zoom-Meeting)

**"Quantum networking with trapped ions:
two things to do with two qubits two metres apart"**

I will outline some applications of quantum networking, and describe two recent experiments performed using an elementary two-node network which links two separate ion traps via a single-photon optical fibre interface. Both experiments rely on the ability to generate high-fidelity (>90%) entanglement between trapped-ion qubits, one stored in each trap, at high speed (up to 200 entanglement events per second). In the first experiment [1], we present a realization of a complete quantum key distribution (QKD) protocol immune to the vulnerabilities of the physical devices used in the implementation. In this "device-independent" QKD protocol, we can put a limit on the amount of information accessible to an eavesdropping adversary by using Bell's Theorem, as first proposed 30 years ago by Ekert. In the second [2], we show how the network link can be used to entangle a pair of atomic clocks, enabling entanglement-enhanced frequency comparison. We surpass the "standard quantum limit" which applies to independent systems, and approach the so-called Heisenberg limit, the ultimate measurement precision attainable for entangled particles.

[1] D.P.Nadlinger, P.Drmota et al., arXiv:2109.14600

[2] B.C.Nichol, R.Srinivas et al., arXiv:2111.10336

All DQ-mat members and all interested are cordially invited to attend.