Plenary Talks - abstract

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HIGH-FIDELITY TRAPPED-ION QUANTUM LOGIC OPERATIONS FOR SCALABLE QIP

ABSTRACT

I will report on progress in improving the fidelity of elementary quantum logic operations using trapped ions, concentrating on recent results from experiments at Oxford. We have recently demonstrated all elementary operations at fidelities significantly beyond the minimum threshold levels required for fault-tolerant QIP [1, 2]. These have been achieved using so-called "atomic clock" qubit states stored within the hyperfine ground level of calcium-43, where memory coherence times are limited only by technical considerations. We have implemented both laser-driven logic gates in 3D macroscopic traps, and microwave-driven logic gates in micro-fabricated 2D traps. We have also used a two-qubit gate to entangle two different isotopes of calcium stored in the same trap, and performed a CHSH-type test of Bell's inequality with this novel state [3]. I will discuss prospects for scalability using a network of traps connected by photonic interfaces [4].

[1] T.P.Harty et al., Phys.Rev.Lett. 113, 220501 (2014).
[2] C.J.Ballance et al., arXiv:1406.5473 (2014).
[3] C.J.Ballance et al., arXiv:1505.04014 (2015).
[4] L.-M.Duan et al., Nature 414, 413 (2001).