Contribution ID: **105** Type: **Poster**

High-Fidelity Entanglement Gates on Microfabricated Ion-Traps

Tuesday, 28 June 2022 17:44 (3 minutes)

Trapped ions have proved to be a promising way of realising a large-scale quantum computer, due to their long coherence times and reproducibility, while also allowing for modular architectures which is key for a scalable, universal quantum computer. A blueprint for a trapped-ion based quantum computer outlines operating with global microwave fields to dress the ground-state hyperfine manifold of 171Yb+ ions, and demonstrates a maximally entangled state using a Mølmer-Sørensen type gate with fidelity 0.985(12) [1].
Building on that work, we present novel approaches to performing entanglement gates, which feature microfabricated ion traps with current-carrying wires (CCWs) embedded in the chips to provide a controllable magnetic field gradient [2]. A great obstacle for high-fidelity gates is voltage noise, current noise from the CCWs and anomalous heating, which couple to the qubits and lead to spin and motional decoherence.
We simulate and analyse these various noise sources, and use our models to optimise the experiment parameters for maximising fidelity, which in turn will allow for logic operations within the fault-tolerant regime. Current estimates of the threshold are around 1% for surface code [3], a quantum error correction scheme, thus guiding us towards the aim of achieving at least 99% fidelity on these new chips.

[1] B. Lekitsch, S. Weidt, A. G. Fowler, K. Mølmer, S. J. Devitt, C. Wunderlich, and W. K.Hensinger, "Blueprint for a microwave trapped ion quantum computer", Science Advances 3 (2017).
[2] Romaszko, Z.D., Hong, S., Siegele, M. et al. "Engineering of microfabricated ion traps and integration of advanced on-chip features", Nat Rev Phys 2, 285–299 (2020)
[3] A. G. Fowler, A. M. Stephens, and P. Groszkowski, "High-threshold universal quantum computation on the surface code", Physical Review A. 80, (2009).

Primary author: ZANTIS, Petros (Ion Quantum Technology group - University of Sussex)

Presenter: ZANTIS, Petros (Ion Quantum Technology group - University of Sussex)

Session Classification: Posters