Invited speaker

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Scaling trapped ion quantum computers

Abstract

Trapped ions are among the most promising paths to realizing quantum computers, having exhibited the highest fidelities and long coherence times. Scaling up will require the adoption of new technologies, and can be facilitated by new approaches. In this talk I will describe recent work from our group in both directions. Firstly I will describe the use of integrated optics to deliver light to multiple zones of an ion trap chip in scalable manner, and give an impression of the new types of control which might be enabled by this approach [1,2,3]. I will then introduce a new concept for scaling trapped-ion quantum computers based on microfabricated Penning traps, introducing flexible 2-dimensional ion transport while removing the need for high-voltage radio-frequency fields and thus improving compatibility with standardized chip fabrication [4,5]. We have used this to perform sensing of both static and oscillating magnetic and electric fields near the chip surface.

References

[1] K. Mehta et al. Nature 586, 533-537.

[2] A. Ricci et al. Phys. Rev. Lett. 130, 133201 (2023).

[3] C. Mordini et al. arXiv:2401.18056 (2024).

[4] S. Jain et al. PRX Physical Review X 10, 031027 (2021).

[5] S. Jain et al. Nature 627, 8004, pp. 510-514 (2024).

About the Author

Jonathan Home has been a Professor at the ETH Zürich since 2010, obtaining tenure in 2017. His group focusses on the precision control of trapped atomic ions, focusing on quantum error correction and dissipation, as well as the exploration of novel methods for scaling. Successes of this research have included the first demonstrations of GKP logical qubits and subsequently error correction, repeated rounds of stabilizer measurements with feedback, the first demonstration of two-qubit ion trap gates using chip-delivered integrated optics chips, and a new platform for quantum computing based on microfabricated Penning traps. Jonathan's work has been recognized by numerous awards, including the Landauer-Bennett award of the APS and the Latsis Prize of ETH Zürich. He is also a Fellow of the APS. Alongside research, Jonathan plays an active role in outreach, and has realized the first museum exhibit worldwide in which visitors can see atoms with the naked eye. He is a TED Fellow and has given talks at both TED and the World Economic Forum.