Contribution ID: **94** Type: **Talk 22min**

Towards High-Fidelity Microwave Gates on Microfabricated Ion-Traps

Friday 12 July 2024 12:08 (22 minutes)

Trapped ions have proved to be the leading quantum computing platform, due to their long coherence times and simple reproducibility. The design of modular architectures is also facilitated, which is crucial for a scalable, universal quantum computer. Our blueprint for a trapped-ion based quantum computer outlines operating with global microwave (MW) fields to dress the ground-state hyperfine manifold of $^{171}Yb^{+}$ ions [1]. By applying individually controlled static (DC) voltages, ions can be effectively shuttled around and between modules [2], while modulated radio-frequency (RF) signals are utilised to implement quantum logic gate operations [3].

We have further developed microfabricated surface traps featuring X-junction arrays with embedded current-carrying wires (CCWs) able to provide a controllable magnetic field gradient [4]. The imminent way forward is the characterisation of these novel chips which serve as the modules of our scalable architecture. In addition, demonstration of high-fidelity single and two-qubit gate operations will be enabled by quantum control techniques designed for more robust entanglement gates [5].

[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] M. Akhtar, F. Bonus, F. R. Lebrun-Gallagher et al., "A high-fidelity quantum matter-link between ion-trap microchip modules", Nature Communications 14, 531 (2023).

[3] S. Weidt, J. Randall, S. C. Webster et al., "Trapped-ion quantum logic with global radiation fields", Physical Review Letters 117 (2016).

[4] Z. D. Romaszko, S. Hong, M. Siegele et al. "Engineering of microfabricated ion traps and integration of advanced on-chip features", Nat Rev Phys 2, 285–299 (2020).

[5] C. H. Valahu, I. Apostolatos, S. Weidt and W. K. Hensinger, "Quantum control methods for robust entanglement of trapped ions", J. Phys. B: At. Mol. Opt. Phys. 55 204003 (2022).

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

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

Session Classification: Quantum Information & Computing

Track Classification: Quantum Information & Computing