Contribution ID: **14** Type: **Poster**

How to wire a 1000-qubit trapped ion quantum computer

Monday, 25 September 2023 19:30 (2 hours)

One of the most formidable challenges of scaling up quantum computers is that of control signal delivery. Today's small-scale quantum computers typically connect each qubit to one or more separate external signal sources. This approach is not scalable due to the I/O limitations of the qubit chip, necessitating the integration of control electronics. However, it is no small feat to shrink control electronics into a small package that is compatible with qubit chip fabrication and operation constraints without sacrificing performance. This so-called "wiring challenge" is likely to impact the development of more powerful quantum computers even in the near term.

In this work, we address the wiring challenge of trapped-ion quantum computers. We describe a control architecture called WISE (Wiring using Integrated Switching Electronics), which significantly reduces the I/O requirements of ion trap quantum computing chips without compromising performance. Our method relies on judiciously integrating simple switching electronics into the ion trap chip – in a way that is compatible with its fabrication and operation constraints – while complex electronics remain external. To demonstrate its power, we describe how the WISE architecture can be used to operate a fully connected 1000-qubit trapped ion quantum computer using ~ 200 signal sources at a speed of $\sim 40-2600$ quantum gate layers per second.

Primary author: MALINOWSKI, Maciej (Oxford Ionics)

Co-authors: ALLCOCK, David (Oxford Ionics, Univeristy of Oregon); BALLANCE, Chris (Oxford Ionics, University of Oxford)

Presenter: MALINOWSKI, Maciej (Oxford Ionics)

Session Classification: Monday Poster