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(G*) An individual optical addressing scheme for trapped Ba+ ions in an open-access quantum information processor

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Trapped ions are a leading platform for noisy intermediate-scale quantum (NISQ) computing with high gate fidelities, long coherence times, and natural long range ion-ion interactions. QuantumION is a project which aims to scale trapped ion quantum computing to 16 Ba+ qubits while providing an open-access resource to the whole research community. High fidelity control over each ion is crucial to scalability and direct access to the hardware level is needed to make a useful community resource. This talk presents the synthesis of these two concepts exemplified by the individual addressing scheme at the heart of QuantumION. A femtosecond laser direct write (FLDW) waveguide is used to split a single laser source into 16 path-length matched and fibre coupled beams. Intensity, phase, and frequency can be controlled independently with commercial fibre AOMs. The fibre tip of each beam is imaged onto a chain of ions aided by a micro-machined array of lenses to provide individual control over 16 ions with projected 10^{-4} overall crosstalk. This scheme could also allow operation at multiple wavelengths opening the door to individual state readout of the ion chain with the same beam path.

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