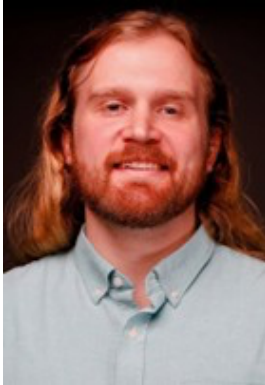


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Friday, October 30, 2026, 11:00 am. Osborne A204

Integrating Photonics into Trapped-Ion Architectures



Trapped-ion platforms are being developed for use in applications such as atomic clocks, quantum sensing, quantum networking, and quantum information processing. The use of trapped ions in these applications comes from their long coherence times, reproducibility, and high-fidelity operations. However, to fully utilize these systems, efforts need to be made to minimize the technical challenges related to interfacing bulk optical systems with atomic particles. In this talk I will describe experiments which utilize integrated photonic systems to improve the stability and scalability of trapped ion platforms used for quantum information processing.

By implementing optical routing on chip, the relative phase stability of different optical paths can be maintained, which allows for the demonstration of phase stable polarization gradient cooling [1,2], a cooling technique that can be used for fast motional state preparation. To address challenges of scalability, we develop integrated diffractive emitters to drive electronic transitions in trapped-ions and diffractive collectors to collect the light scattered from the ion [3]. Further, I will describe how these structures can be used to generate entanglement through the application of spin dependent forces and through photon-mediated entanglement generation [4]. Integrating photonic circuits into trapped-ion architectures could offer new capabilities to scale up the complexity of these systems while also offering avenues for making these systems more compact.

Short Bio

Ethan Clements received his B.Sc. and M.Sc. in Physics from Miami University and was awarded a Ph.D. in physics in 2022 from the University of Colorado Boulder where he studied comparison techniques for optical atomic clocks that utilize correlations in laser phase noise to improve the stability of the measurement. Ethan is currently technical staff at MIT Lincoln Laboratory where he is studying the use of integrated photonics in trapped-ion quantum computers and optical atomic clocks.

[1] Clements, Ethan, et al. "Sub-Doppler cooling of a trapped ion in a phase-stable polarization gradient." *Physical Review Letters* 136.2 (2026): 023201.

[2] Corsetti, Sabrina M., et al. "Integrated-photonics-based systems for polarization-gradient cooling of trapped ions." *Light: Science & Applications* 15.1 (2026): 57.

[3] Knollmann, Felix W., et al. "Collection of fluorescence from an ion using trap-integrated photonics." *Light: Science & Applications* 15.1 (2026): 95.

[4] Knollmann, Felix W., et al. "Integrated photonic structures for photon-mediated entanglement of trapped ions." *Optica Quantum* 2.4 (2024): 230-244.