

Dear Editor,

We are pleased to submit the attached manuscript, titled “Surface-electrode ion trap with integrated light source”, in consideration for publication in Applied Physics Letters.

Trapped ion systems are promising candidates for implementing quantum information processing (QIP), and significant progress has been made in realizing quantum operations using a small number of ions as qubits. However, the realization of large-scale QIP at the level of tens and hundreds of ions strongly motivates the integration of optical elements in scalable surface-electrode trap designs.

In this work, we report the demonstration of integrated light delivery through a single-mode fiber in a surface-electrode trap, to address the quadrupole (qubit) transition of $^{88}\text{Sr}^+$. We address two challenges involved in optics integration with ion traps, namely: (1) we quantify the magnitude and timescale of trapping-field perturbation by the nearby dielectric, and (2) we demonstrate a general, *in situ* positioning technique that allows the trapped ion to be precisely positioned with respect to on-chip integrated devices, and measure the integrated mode profile using the ion as a probe. We explore the theoretical limits in precision of the positioning technique, and find it suitable for QIP applications. Beyond the ion quantum computing community, we believe our result and technique will be of considerable interest to the readers of Applied Physics Letters, as it highlights the potential use of trapped ions as sensors, e.g. for surface science.

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