Optics integration in ion traps

Peter F. Herskind, Molu Shi, Amira Eltony, Tony H. Kim, Michael Gutierrez,
Shannon X. Wang, Yufei Ge, Isaac L. Chuang.
Research Laboratory of Electronics, Massachusetts Institute of Technology

As ion trappers we are taught early on that, in designing our devices, we should take great care to ensure that all material surfaces in the proximity of the ions can be kept at well-defined potentials. This typically implies that the sensible thing to do is to avoid the presence of dielectrics in the trapping region.

This approach is at odds with the potential benefits of optics integration with ion traps. Trapped ion quantum information science, e.g., faces grand challenges related to scalable light delivery, light collection, and photon-mediated entanglement generation, where integrated optics holds significant promise [1].

In this talk I will review recent experimental efforts in the quanta research lab at MIT to integrate optics into ion traps. I will present results on the successful incorporation of optical fibers [2] and optical micro mirrors [3] as well as on ion traps with electrodes made out of transparent conductors. I will also talk about our work towards gaining a better understanding of some of the fundamental challenges to optics integration, such as light-induced charging of the dielectrics [4,5] and anomalous ion heating [6].

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