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Technologies for Portable Optical Clocks

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Optical clocks are among the most accurate measurement devices ever built, now surpassing the 10^{-18} level of precision. Yet these impressive devices still typically occupy the volume of an entire atomic physics lab, being constrained in size by numerous free-space optics required to direct control lasers to the atomic reference sample as well as the bulk-cavity stabilization system required to narrow the interrogation lasers linewidth to the requisite level. Many applications in navigation and communications could benefit from smaller-size, fieldable optical clocks which can still achieve high performance. In this talk, I will discuss two technologies we are developing at Lincoln Laboratory aimed at enabling compact, high-performance optical clocks based on trapped ions. First, I will discuss progress towards chip-based ion array traps able to deliver all necessary ion control wavelengths via on-chip photonics and incorporating on-chip avalanche photodiodes (APDs) for ion state readout . Secondly, I will discuss our recent demonstration of a fiber stimulated-Brillouin-scattering (SBS) laser used to run an optical $^{88}Sr^{+}$ ion clock, achieving short-term stability of $3.9 \times 10^{-14}/\sqrt{\tau}$ via a clock self-comparison measurement.