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A Multi-Ion Photonic Integrated Optical Clock DAVID REENS, JULES STUART, ROBERT NIFFENEGGER, COLIN BRUZEWICZ, CHERYL SORACE-AGASKAR, DAVE KHARAS, JEREMY SAGE, JOHN CHIAVERINI, ROBERT MCCONNELL, MIT Lincoln Labs — Optical atomic clocks based on single trapped ions boast impressive stability and accuracy, but extension to multiple co-trapped ions is hindered by their strong Coulomb repulsion and associated quadrupole shifts. An alternative path is to multiplex the entire trapping apparatus, a feat made accessible by chip scale traps with photonic integration. This multiplicity brings new opportunities for improved short-term stability, Dick-noise suppression, and simultaneous Zeeman sublevel interrogation. While chip traps bring challenges for clock operation, particularly with regard to motional excitation, they also offer greater control over blackbody radiation and a clearer path towards portability. We explore these new opportunities with multiple $^{88}Sr^{+}$ ions loaded in separate zones of a fully photonic integrated chip trap and clocked on the $^{5}S_{1/2}$ to $^{4}D_{5/2}$ forbidden optical transition.

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