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A Miniature Room Temperature Trapped Ion System[1] GEERT VRIJSEN, YUHI AIKYO, Duke University, TOM NOEL, ColdQuanta, Inc., ALEX KATO, University of Washington, JUNGSANG KIM, Duke University — Trapped ion systems are among the leading platforms for practical quantum computers thanks to their long coherence times, high-fidelity gates, and potential for full connectivity of qubits. The main limitations on the gate fidelities of current state-of-the-art systems come from systematic control errors in the laser beam delivery, primarily due to mechanical and temperature instabilities. We are addressing these problems by designing and building a miniaturized ($3\,\mathrm{cm}^3$ internal volume) ultra-high-vacuum (UHV) system with an integrated surface ion trap and $0.2\,\mathrm{L/s}$ ion pump. The final seal between the trap and vacuum lid is performed under UHV conditions, which enables processing capabilities such as argon-ion sputtering to clean trap electrodes in order to reduce anomalous heating effects. Neutral ytterbium (Yb) atoms are generated from a metallic sample by laser ablation with a pulsed Nd:YAG laser, are subsequently photo-ionized, and then trapped. The vacuum level was characterized by placing a single trapped ion in a double well potential and monitoring the collision-driven well-to-well hopping rate. Lastly, the ion re-ordering rate in a 6-ion chain was measured by including several ions of a different non-fluorescing Yb isotope.

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