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# An end-cap Paul trap for precision spectroscopy

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Trapped ions in radio-frequency Paul traps are one of the leading candidates for precision metrology at optical frequencies [1]. Ions can be confined and laser-cooled to their motional ground state [2], which minimizes the systematic shifts in the transition spectra. Current engineering challenges call for traps that improve the isolation of trapped ions from the environment and reach fractional uncertainties below 10−18 [3][4].
We present our design and indigenous fabrication of an end-cap Paul trap with reduced an-harmonicity in the trapping potential. With the help of COMSOL simulations, we have optimized the electrode dimensions while considering the achievable machining and alignment tolerances. We have developed a low-divergence oven to minimize the coating of the trap electrodes and successfully loaded a cloud of calcium ions into the trap [5]. I will present our trap characterization, custom imaging system, and preliminary results of our experiments with the ion trap.

Fluorescence of a single Calcium ion observed on EMCCD

Quantum jumps of a single Calcium ion

**References**

[1] Andrew D. Ludlow, Martin M. Boyd, Jun Ye, E. Peik, and P.O. Schmidt. Optical atomic clocks. Reviews of Modern Physics, 87(2):637–701, June 2015.
[2] D. Leibfried, R. Blatt, C. Monroe, and D. Wineland. Quantum dynamics of single trapped ions. Reviews of Modern Physics, 75(1):281–324, March 2003.
[3] Moustafa Abdel-Hafiz et al. Guidelines for developing optical clocks with 10−18 fractional frequency uncertainty. https://arxiv.org/abs/1906.11495.
[4] P. B. R. Nisbet-Jones, S. A. King, J. M. Jones, R. M. Godun, C. F. A. Baynham, K. Bongs, M. Doleˇzal, P. Balling, and P. Gill. A single-ion trap with minimized ion-environment interactions. Applied Physics B, 122(3):57, March 2016.
[5] Anand Prakash, Akhil Ayyadevara, E. Krishnakumar, and S. A. Rangwala. Low divergence cold-wall oven for loading ion traps. Review of Scientific Instruments, 95(3):033202, March 2024

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