SAND2014-0552C

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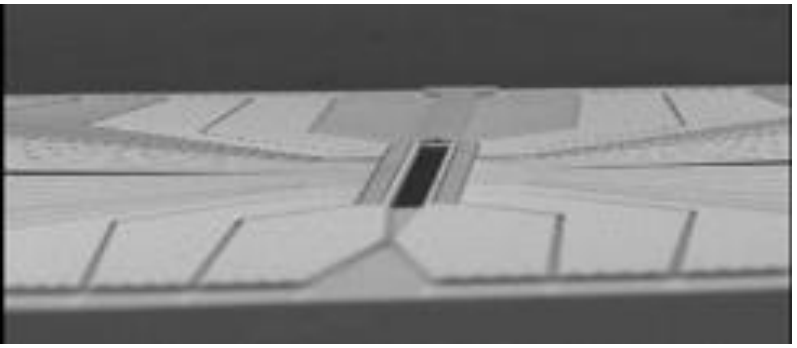

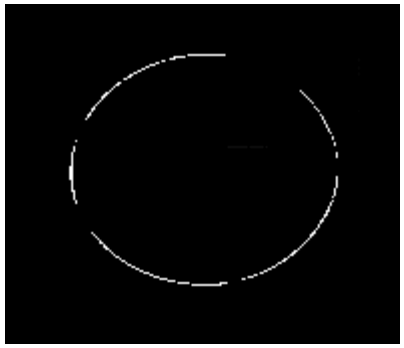

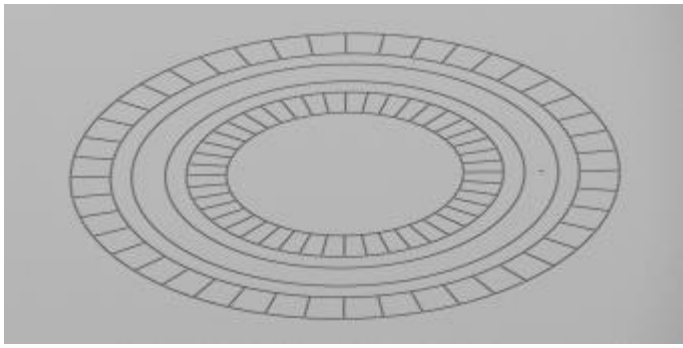

Qubit experiments and characterization of Sandia micro-fabricated ion traps

Craig R. Clark, Susan Clark, Boyan Tabakov, and Peter Maunz

Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY | NNSA

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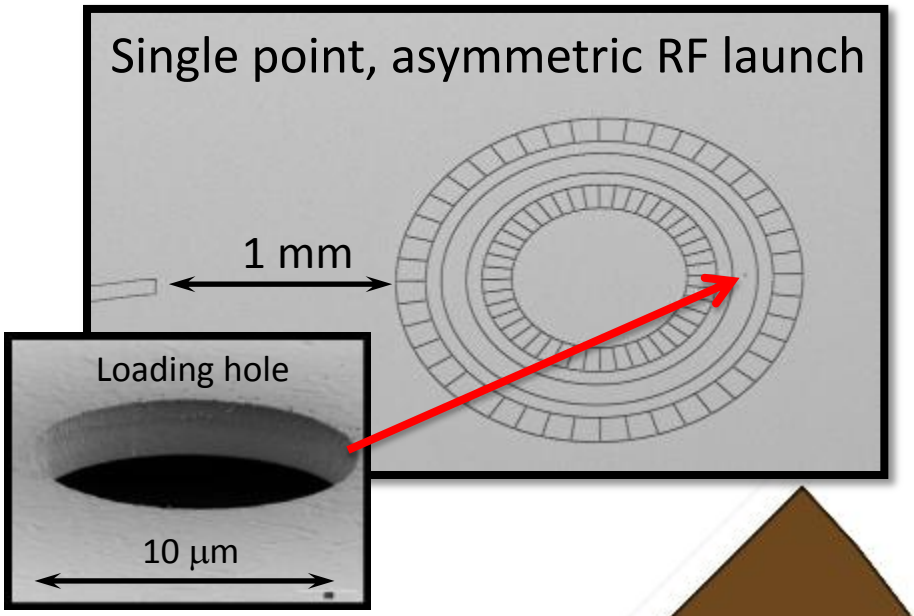
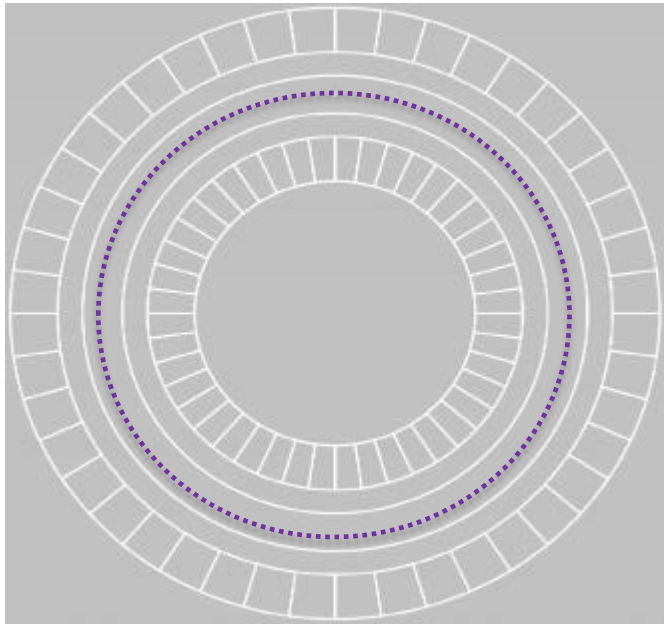
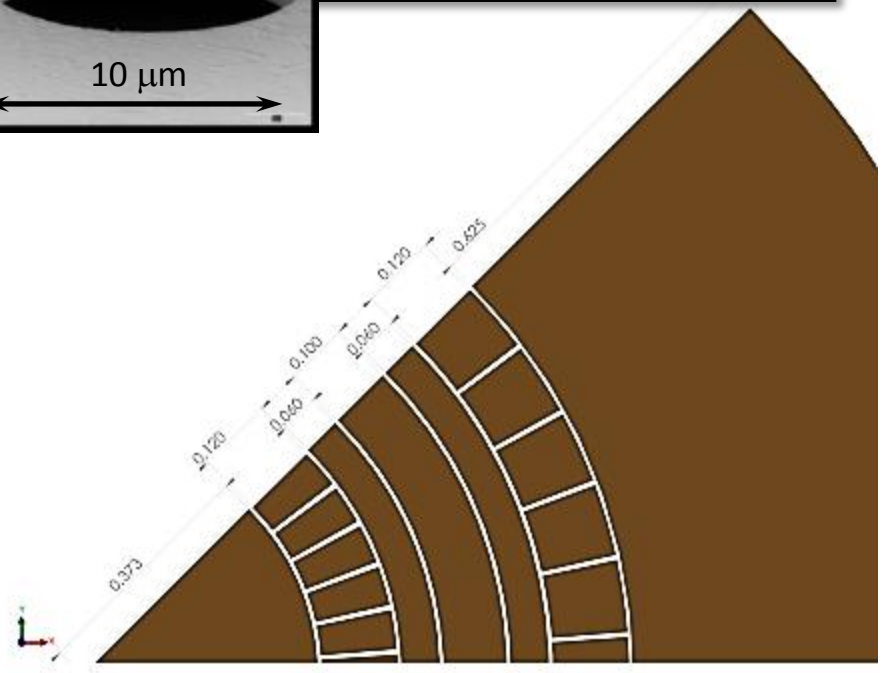
Ring ion Trap

Trap specifics

- 4 metal level fabrication
- 89 control electrodes
- 624 μm ion radius
- Trap designed to minimize perturbations to the rf angular symmetry





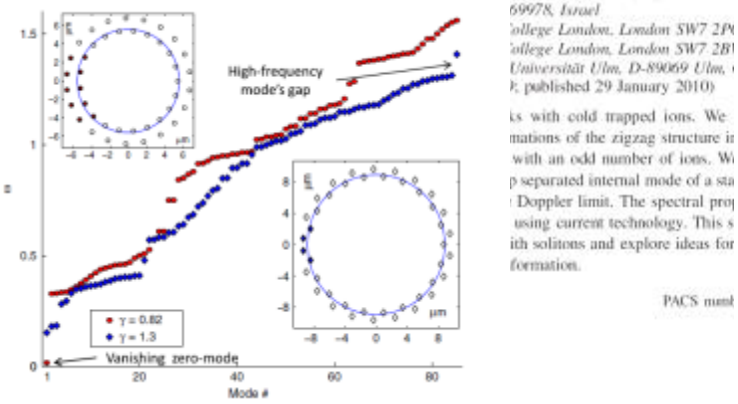


Physics with a ring ion trap

PRL 104, 043004 (2010) PHYSICAL REVIEW LETTERS week ending 29 JANUARY 2010

Quantum Coherence of Discrete Kink Solitons in Ion Traps

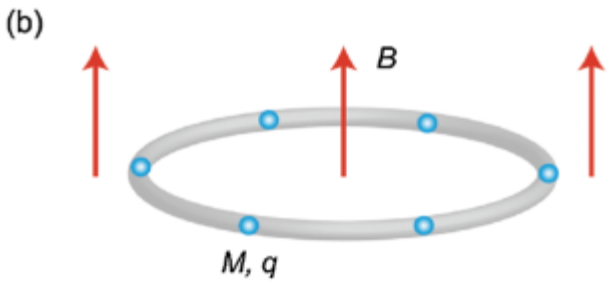
H. Landa,[1] S. Marcovitch,[1] A. Retzker,[2] M. B. Plenio,[2] and B. Reznik[1]



PRL 109, 163001 (2012) PHYSICAL REVIEW LETTERS
Selected for a Viewpoint in *Physics*

Space-Time Crystals of Trapped Ions

Tongcang Li,[1] Zhe-Xuan Gong,[2,3] Zhang-Qi Yin,[3,4] H. T. Quan,[5] Xiaobo Yin,[1] Peng Zha
L.-M. Duan,[2,3] and Xiang Zhang[1,6,*]
[1]*NSF Nanoscale Science and Engineering Center, 3112 Etcheverry Hall, University of California, Berkeley, Cal*
[2]*Department of Physics, University of Michigan, Ann Arbor, Michigan 48109, USA*



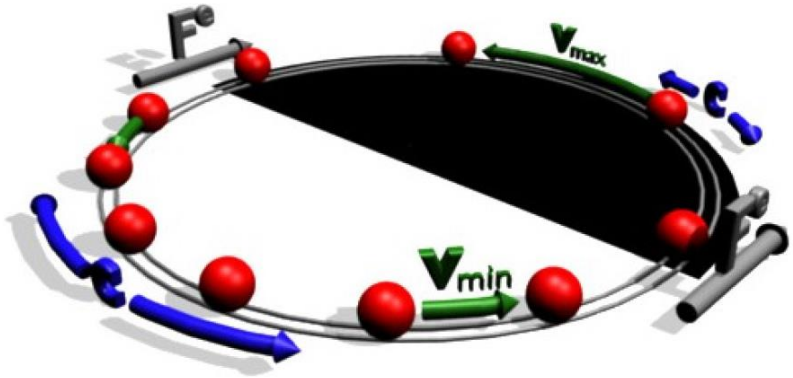
New Journal of Physics
The open-access journal for physics

Erratum

Hawking radiation on an ion ring in the quantum regime

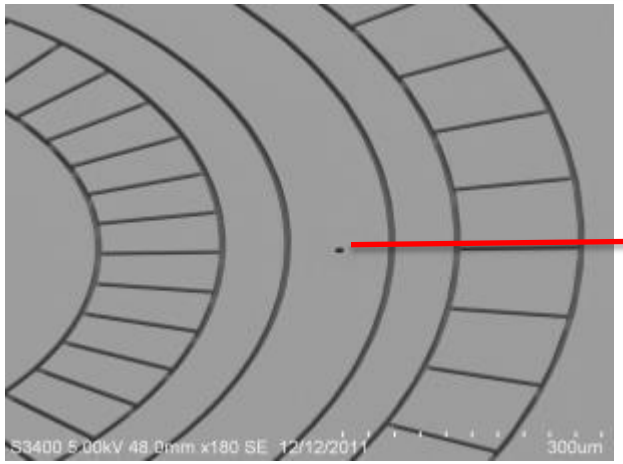
Birger Horstmann, Ralf Schützhold, Benni Reznik, Serena Fagnocchi and J Ignacio Cirac 2011 *New J. Phys.* **13** 045008

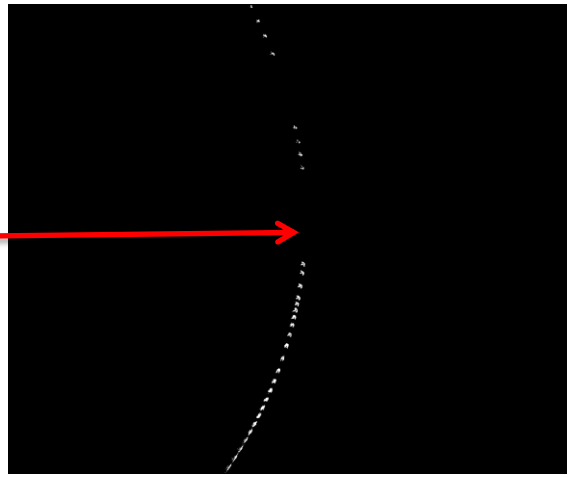
IOP Institute of Physics DEUTSCHE PHYSIKALISCHE GESELLSCHAFT



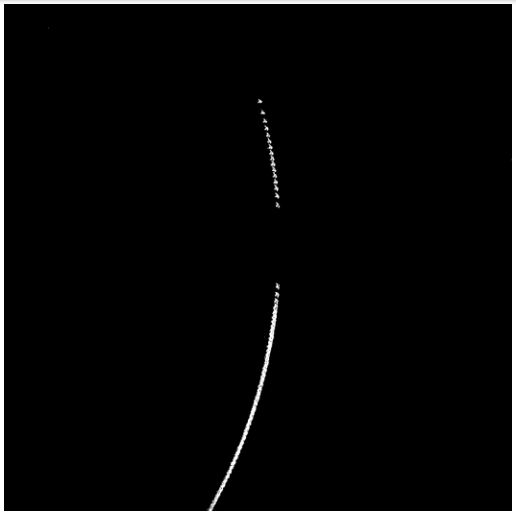
Potential Defects

Loading Hole





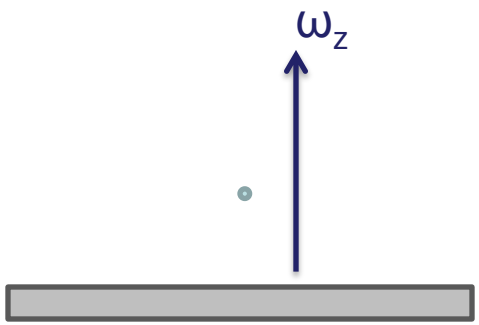
Stray Electric Fields

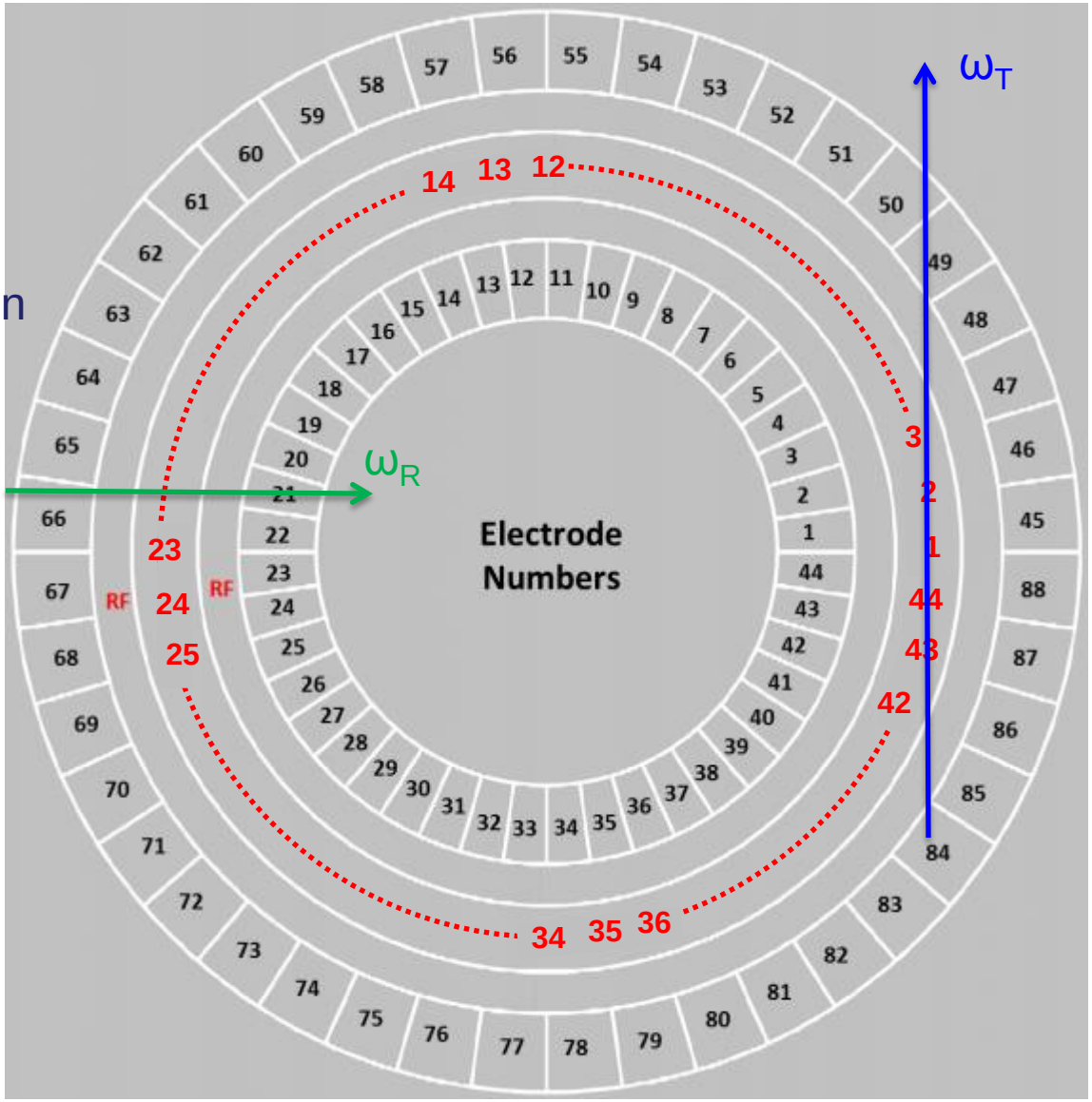


It is no surprise that we can not load a chain of 300 ion without compensating for stray electrics fields.

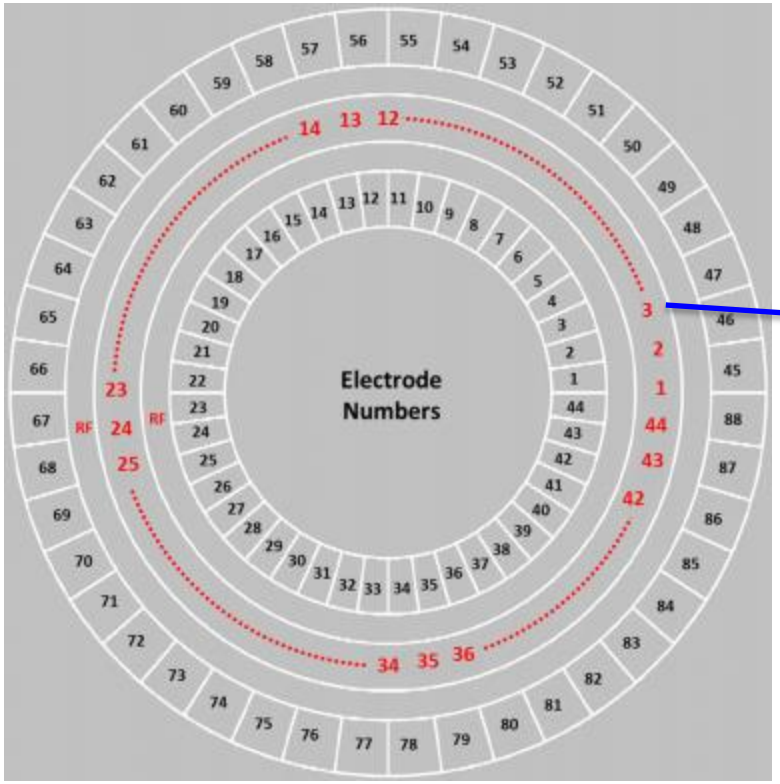
Ring Trap

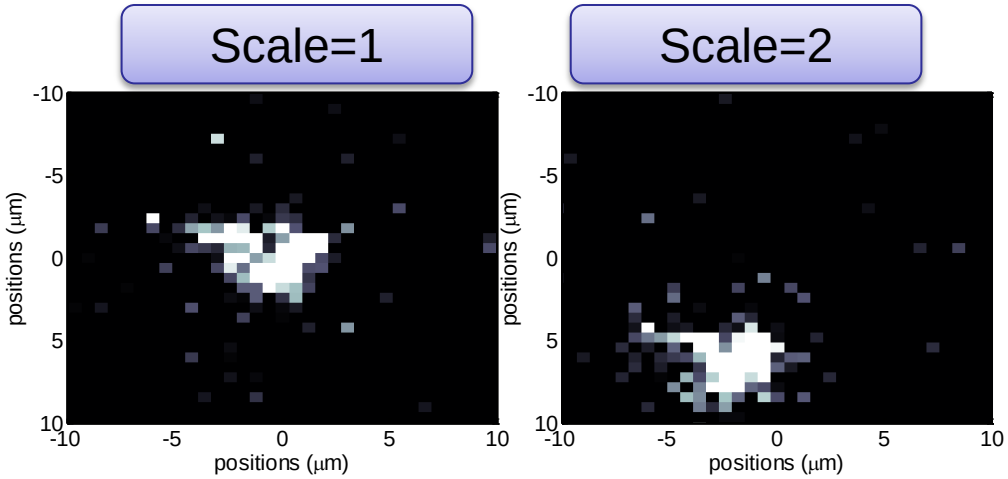
- Electrodes
- Gaps
- ω_T=Tangential motion
- ω_R=Radial motion
- ω_z=Out of plane motion



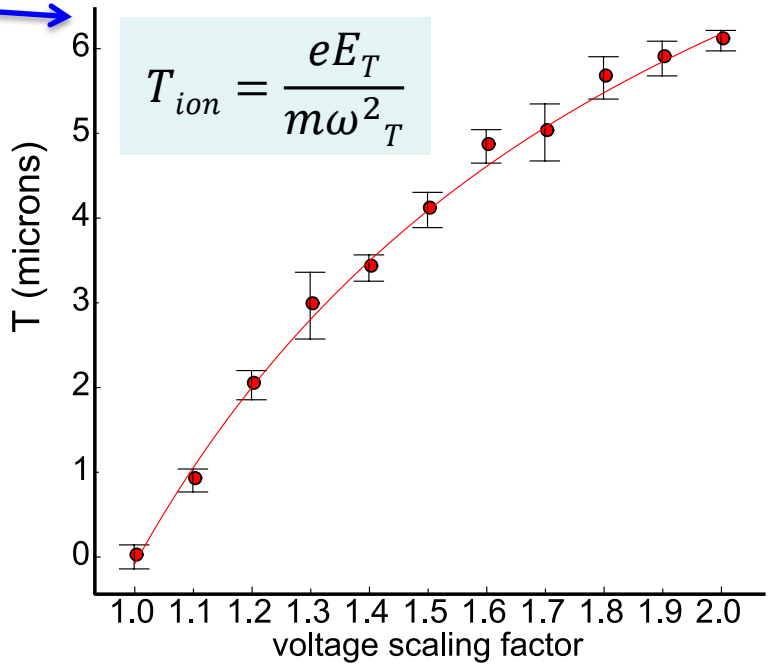


Tangential Compensation





$$T_{ion} = \frac{eE_T}{m\omega^2{}_T}$$



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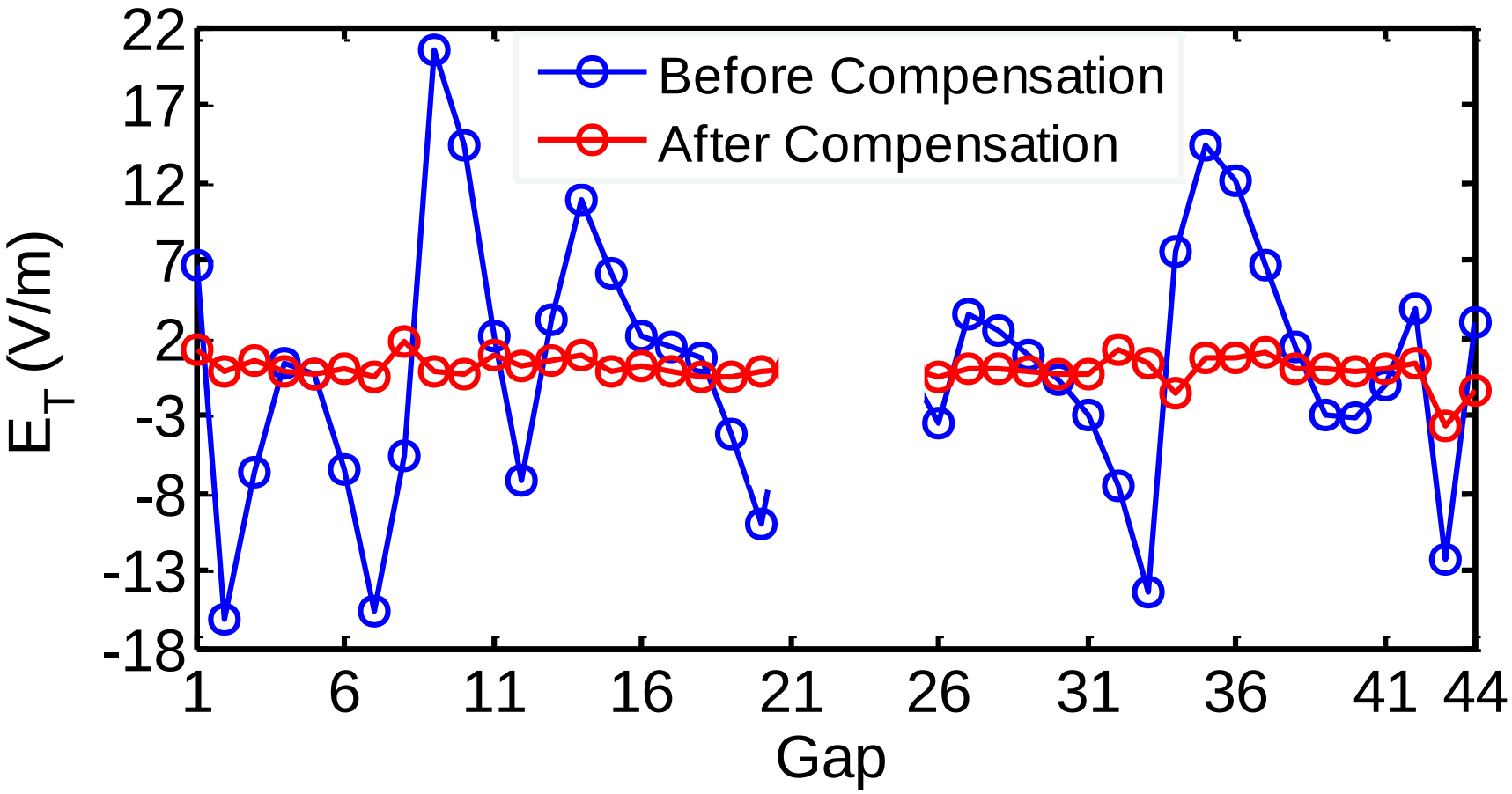
Tangential Compensation



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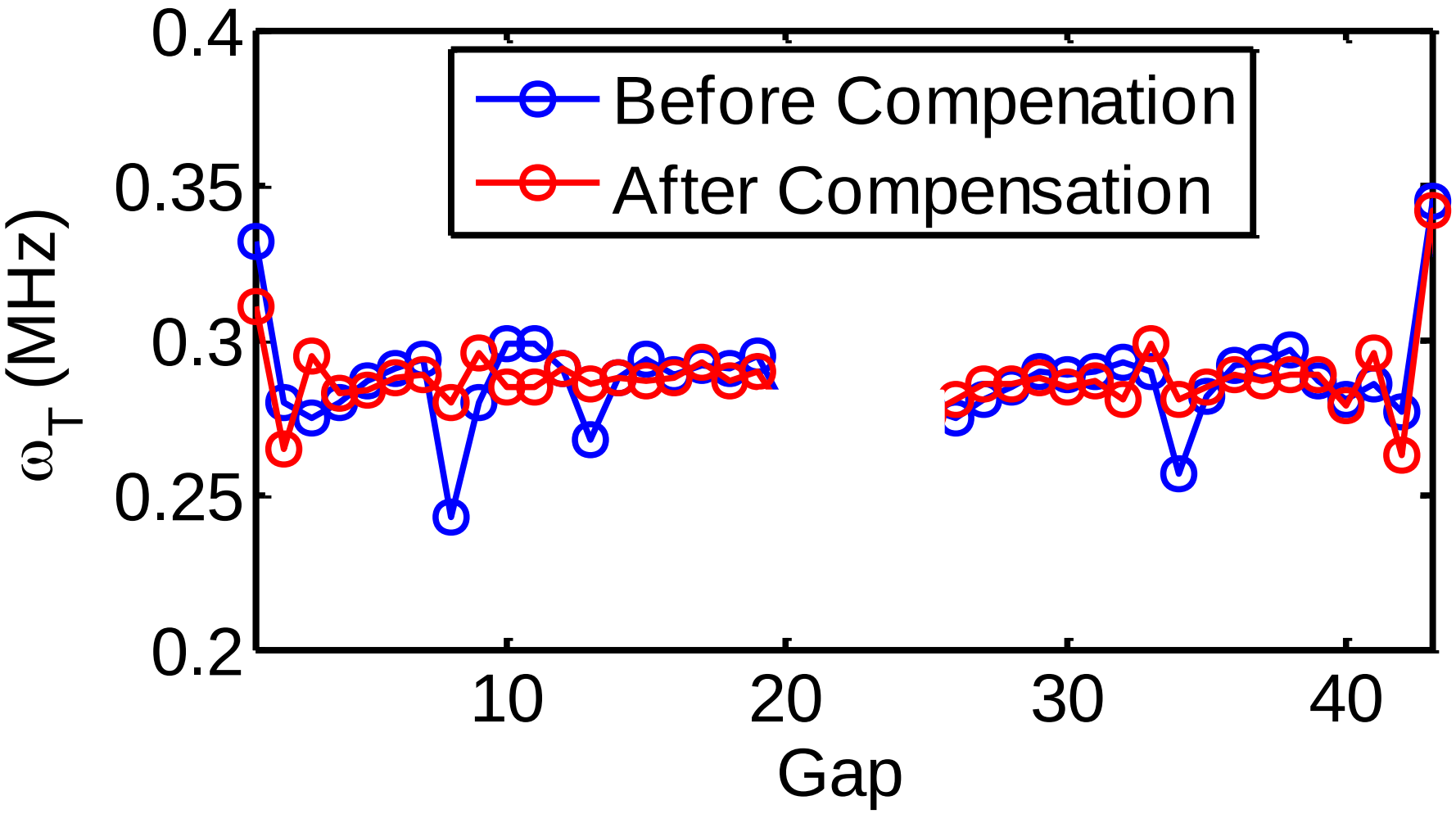
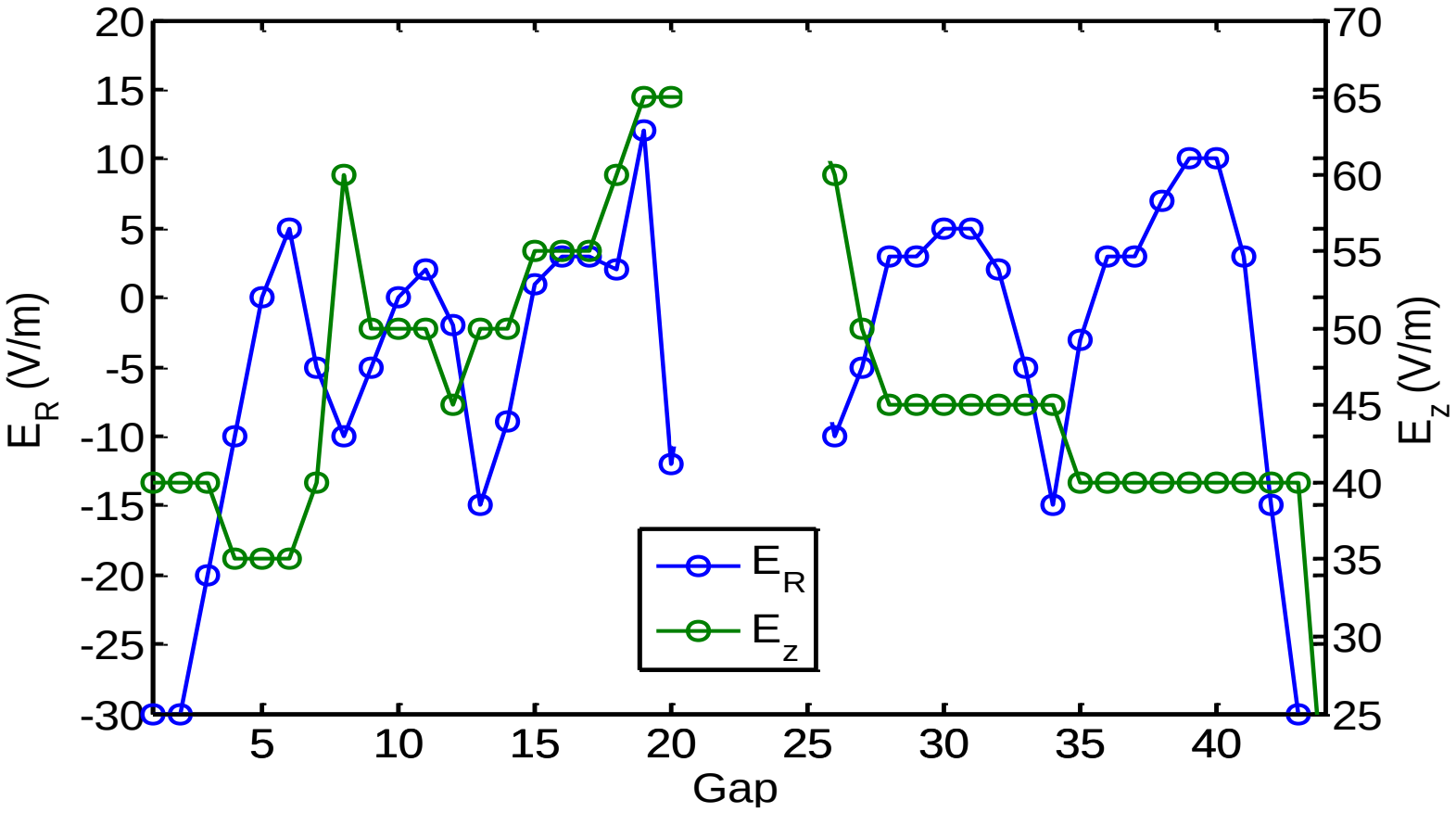
Tangential Secular Freq.



Radial Fields Uncompensated

1. Time-of-Arrival compensation methods to determine E_R
2. Parametric RF tickle compensation methods to determine E_z



1) D. J. Berkeland, J. D. Miller, J. C. Bergquist, W. M. Itano, and D. J. Wineland, J. Appl. Phys. 83, 5025 (1998).
2) Y. Ibaraki, U. Tanaka, and S. Urabe, Appl. Phys. B 105, 219 (2011).

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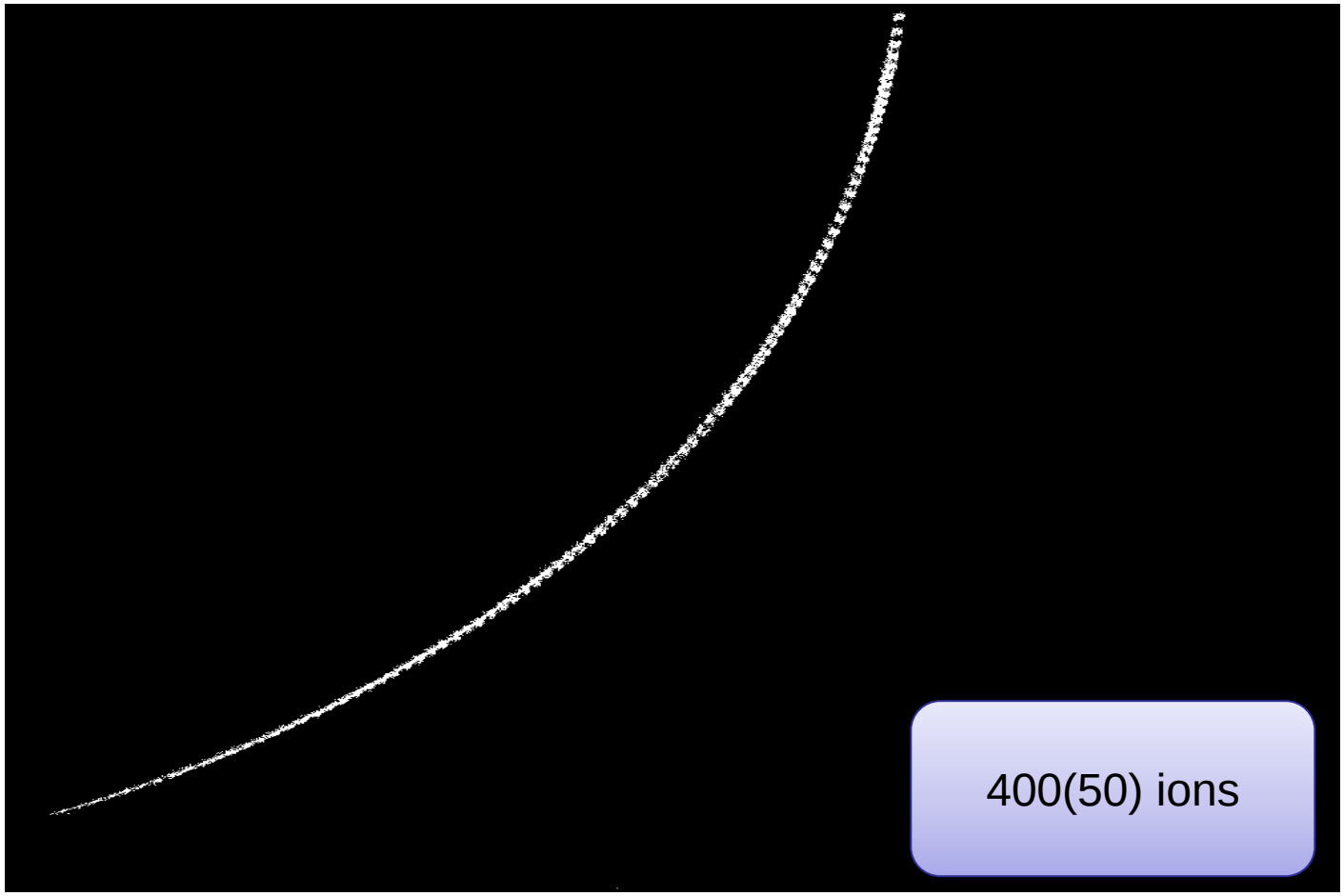
Compensated Ring Trap

Plug the tangential stray field data for each gap into the CPO simulation to determine a solution to fill the ring trap with single chain of ions.



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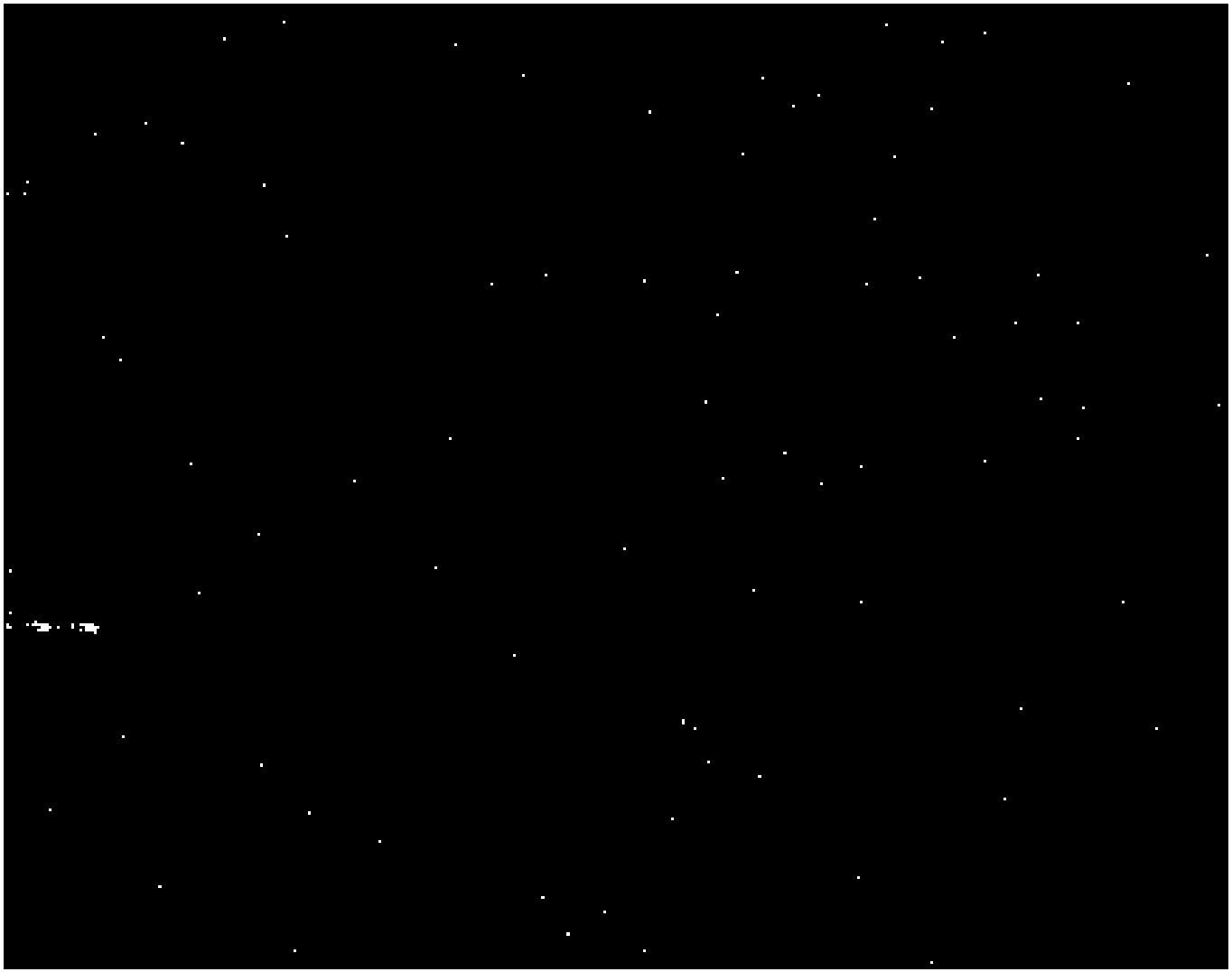
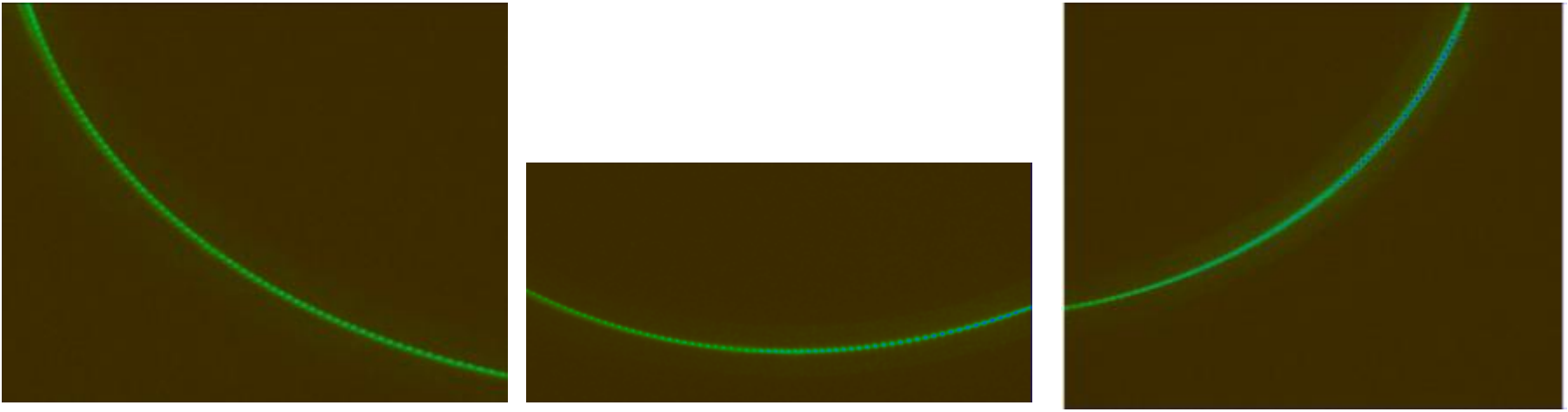
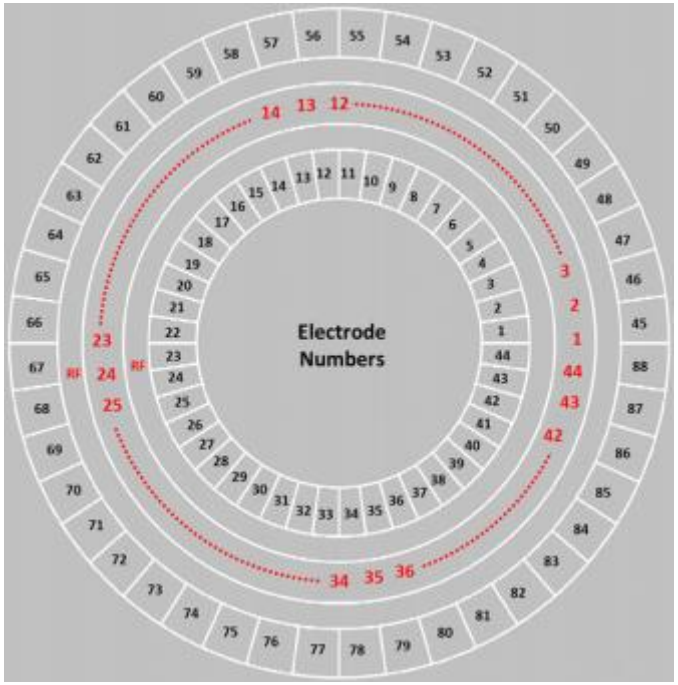
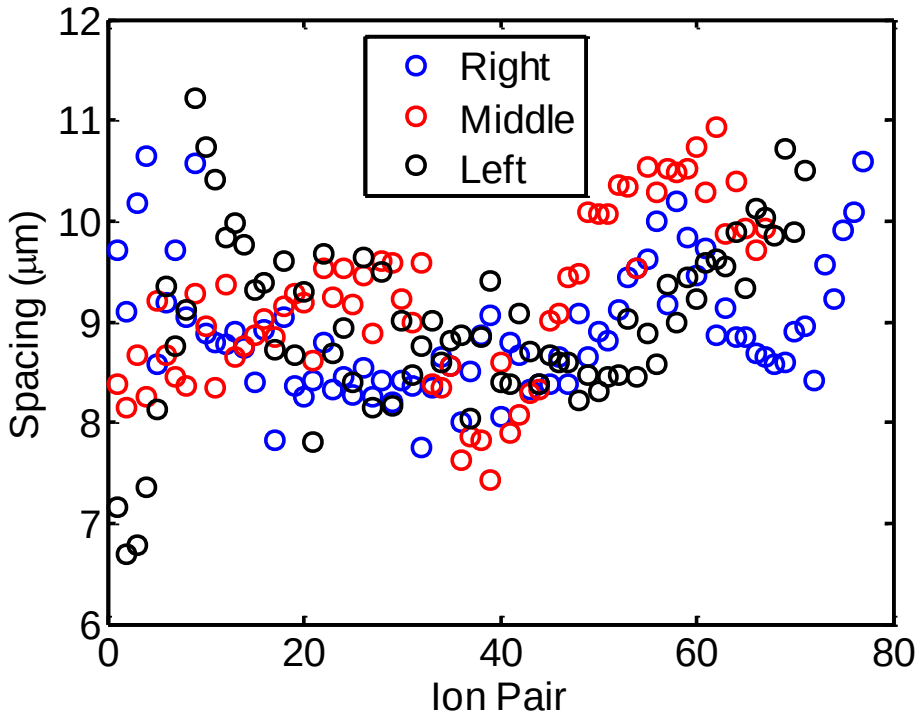
Compensating the trap



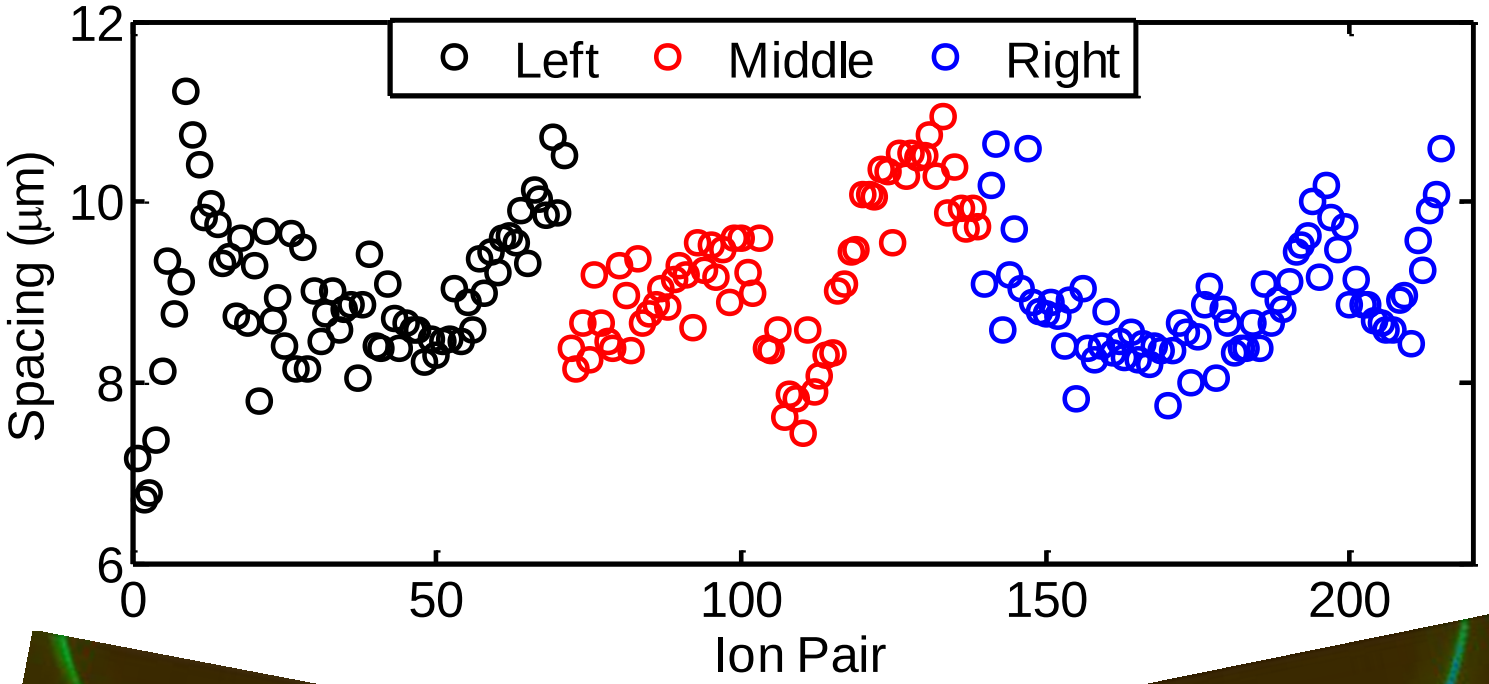
Average ion distance

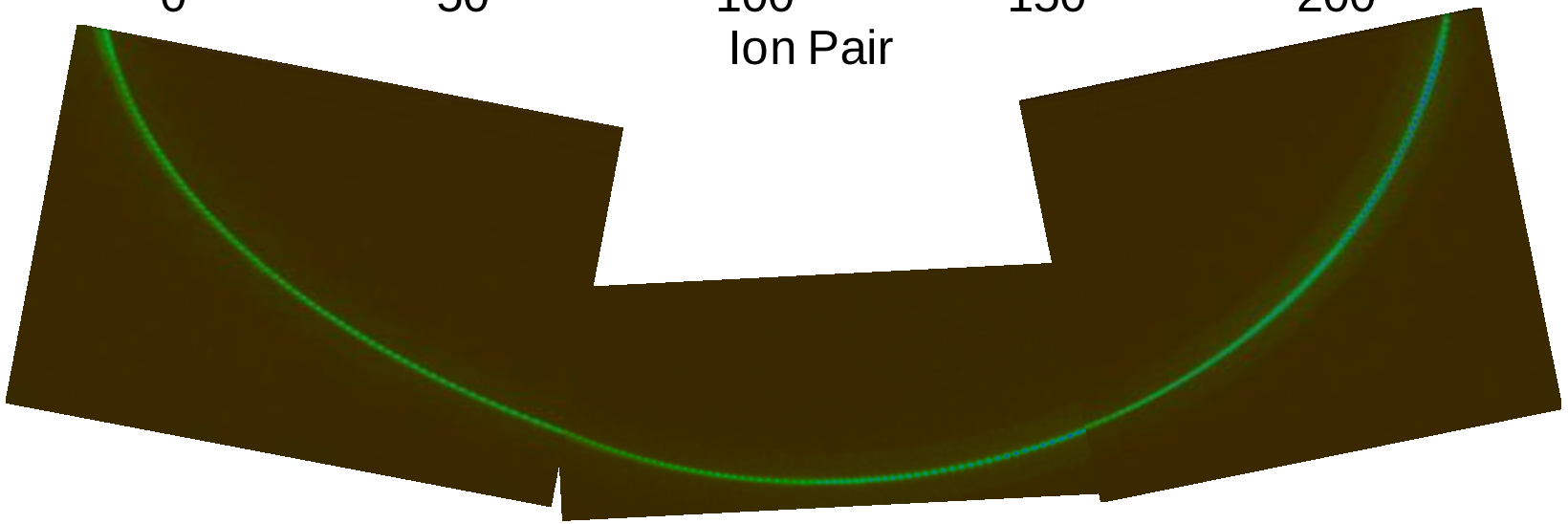






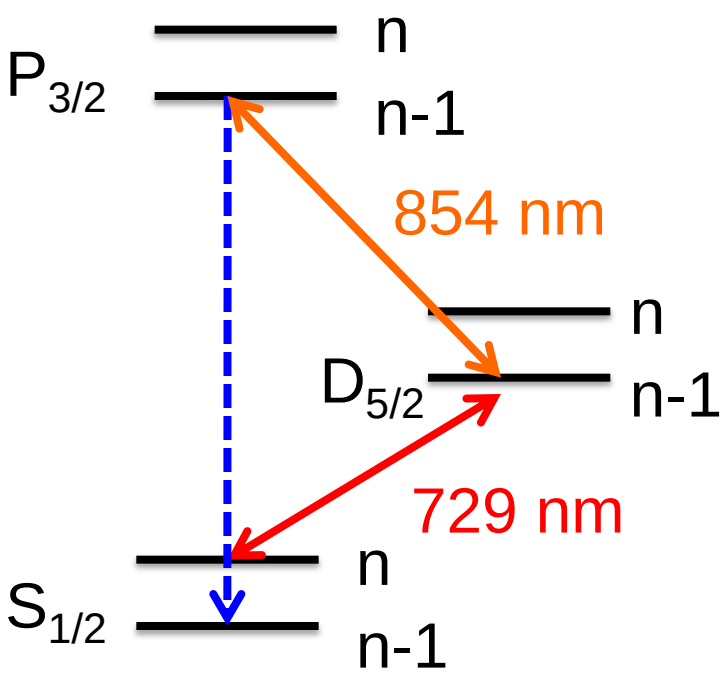
Average ion distance





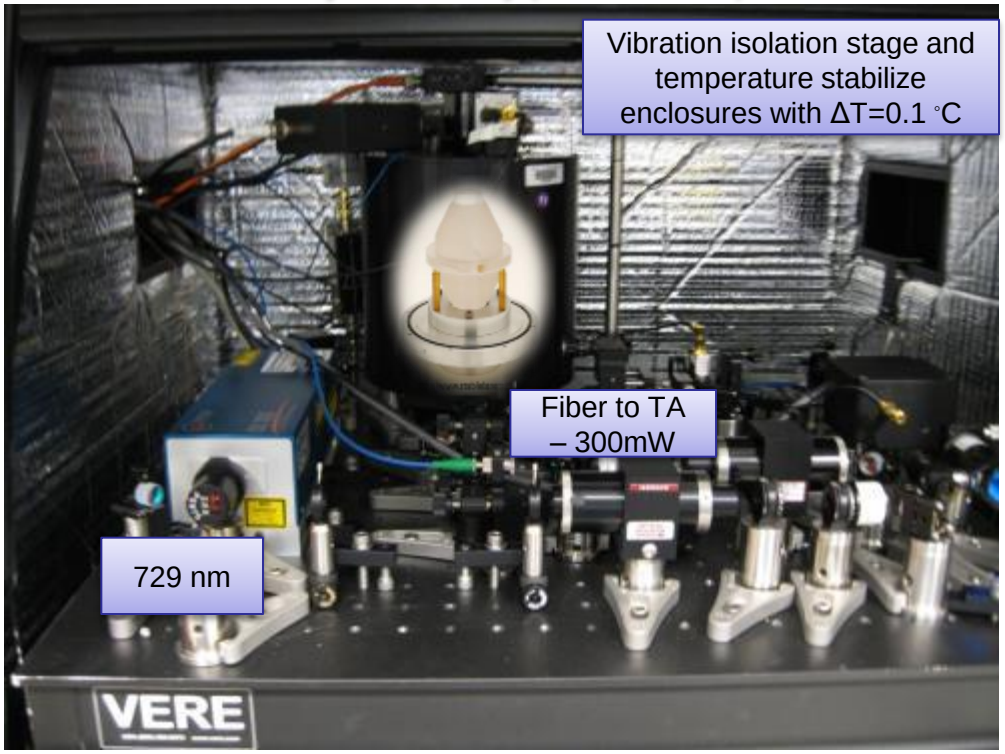
729 nm laser system

Calcium Optical Quibit



ULE Optical Cavity

Fabry-Perot cavity (ATFilms 6030)



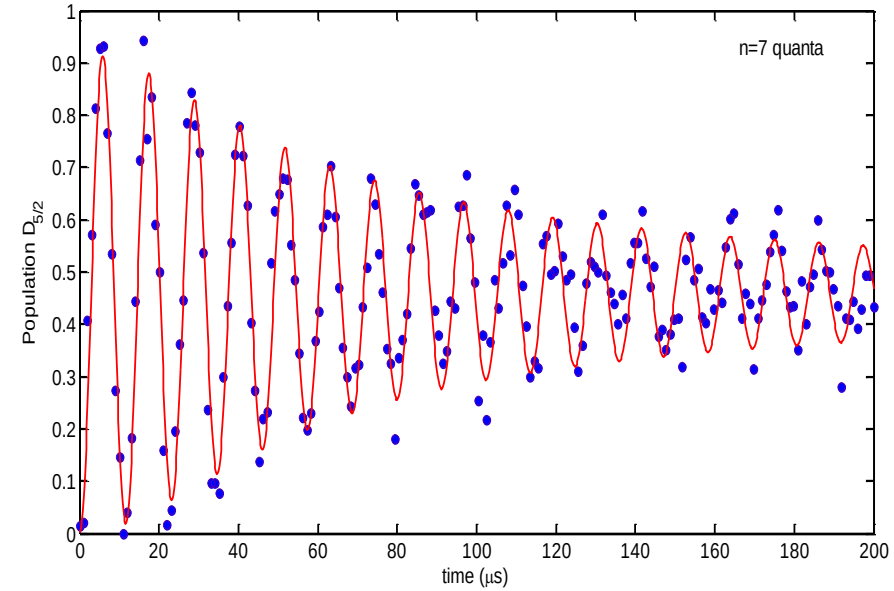
F = 200000

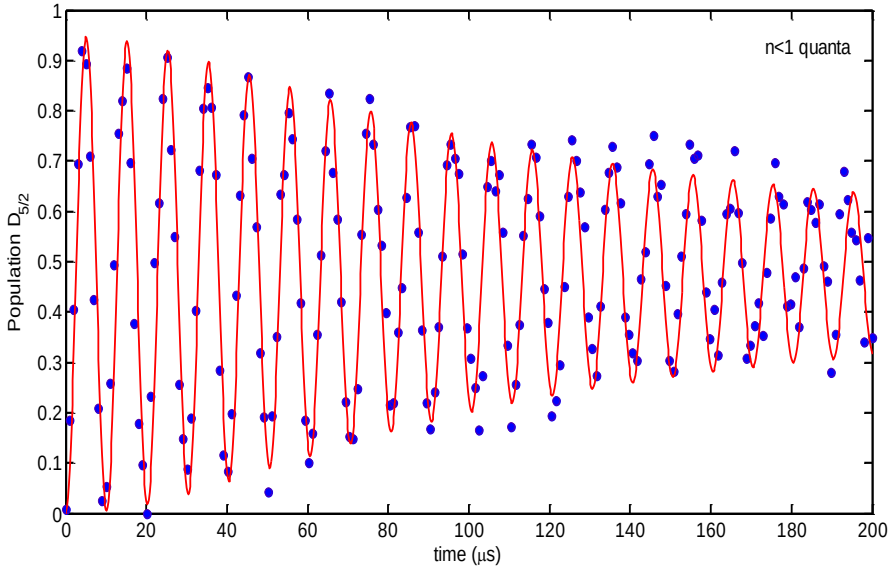
ν_F = 1.93 GHz

$\delta_\nu = \frac{\nu_F}{F}$ = 9.65 kHz

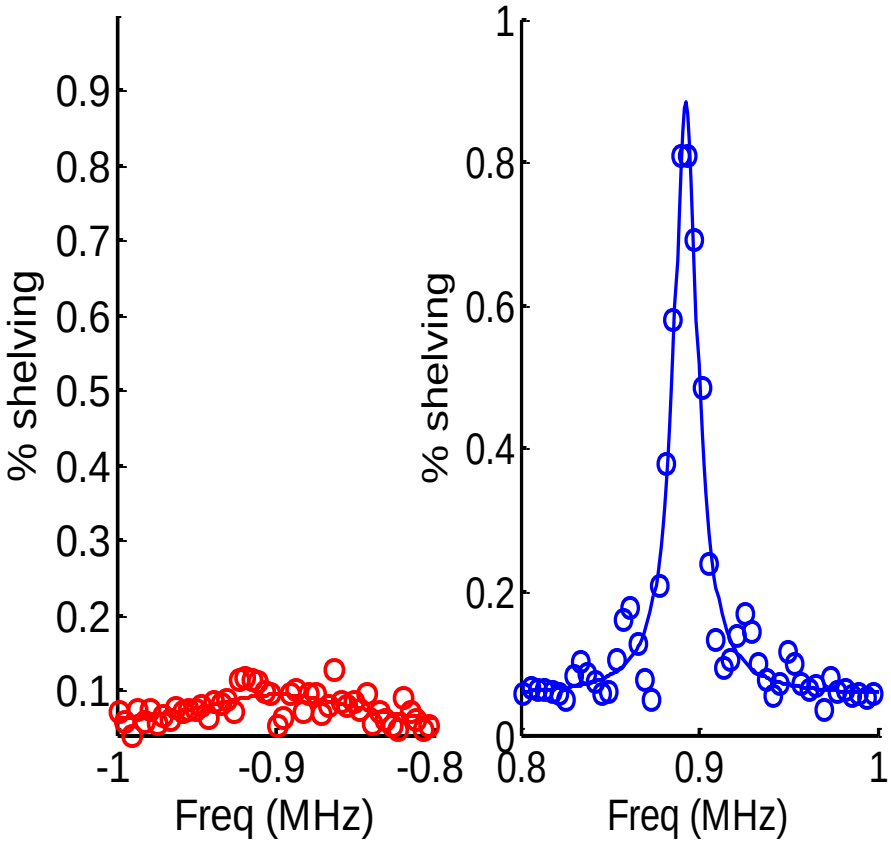
T_c = 24.2 °C

Sideband cooling

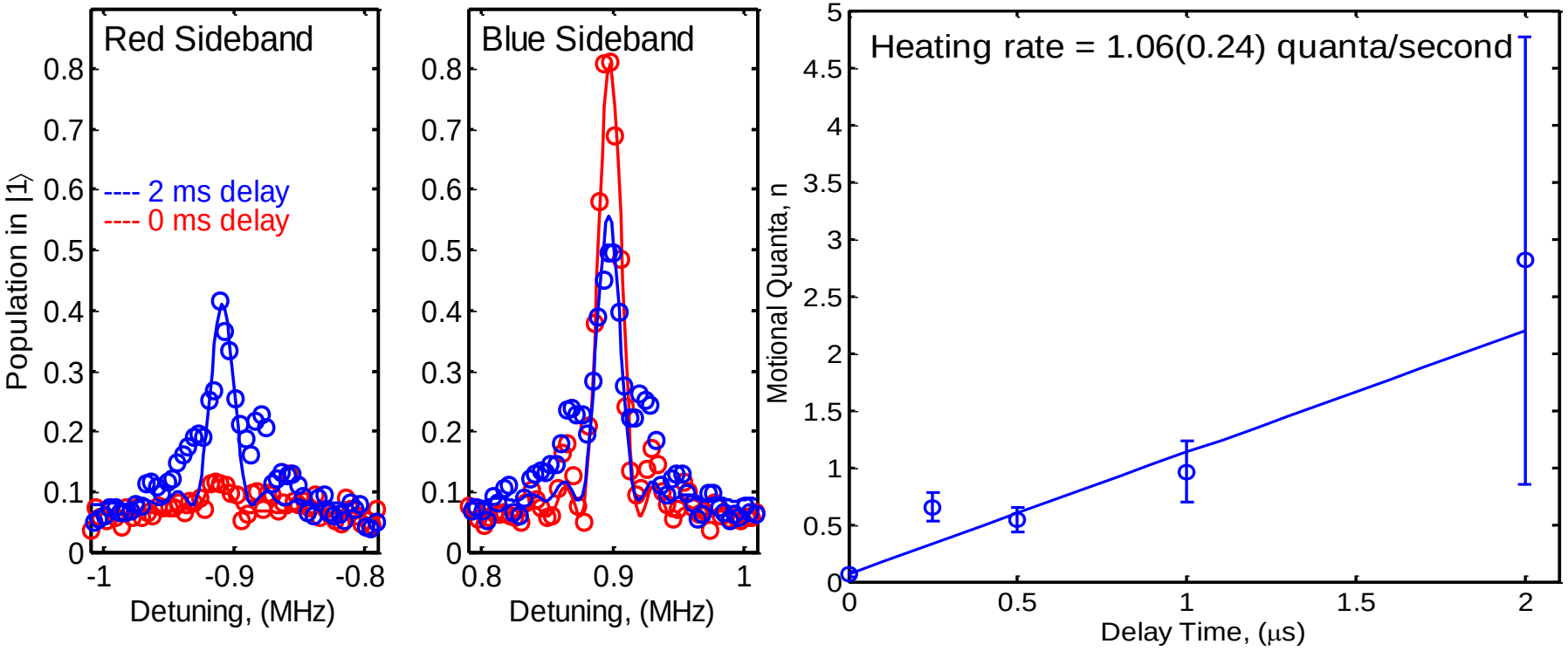




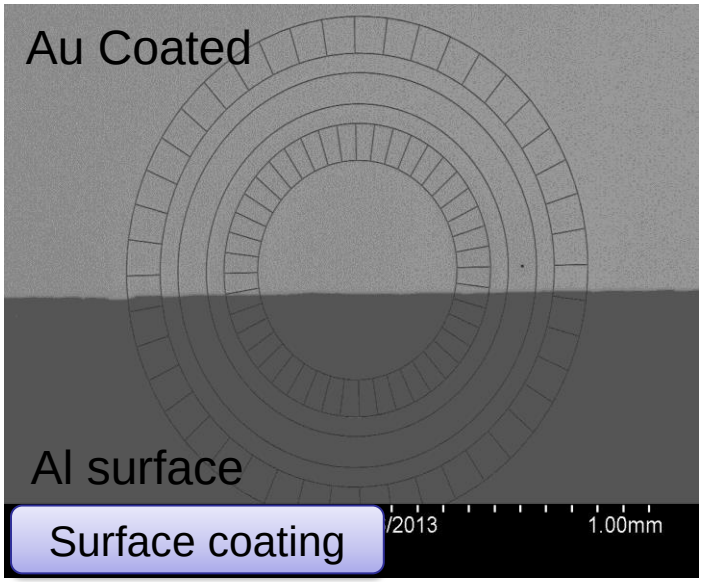
$\bar{n}$=0.12 quanta



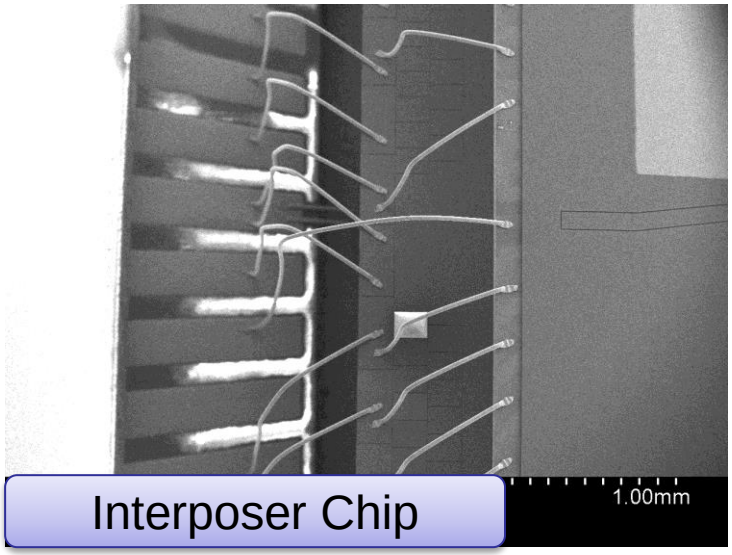
Heating rate Measurements



Future of the Ring Trap



Surface coating



Interposer Chip

Improved Setup