

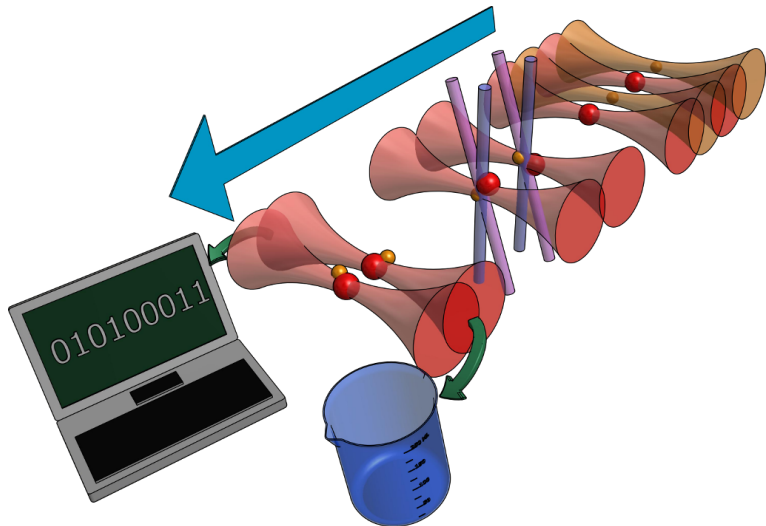
Ultracold molecule assembly

Yichao Yu

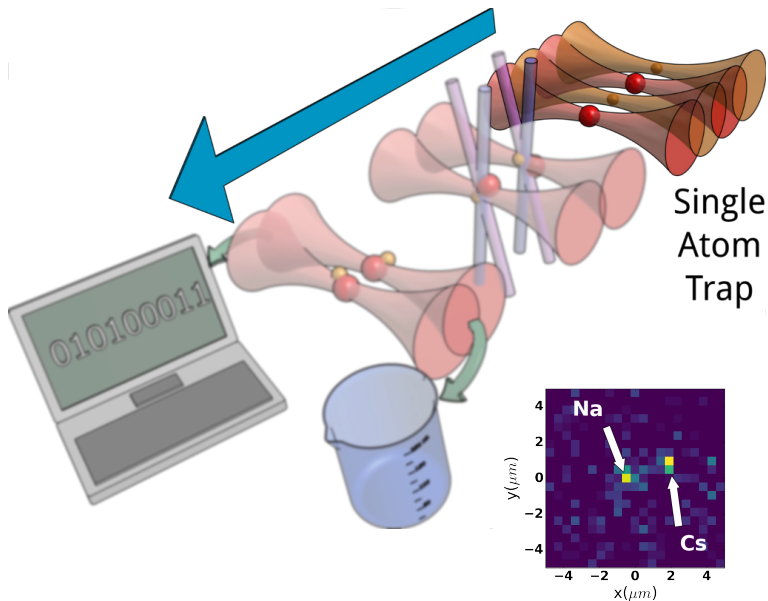
Ni Group/Harvard

Aug 14, 2017

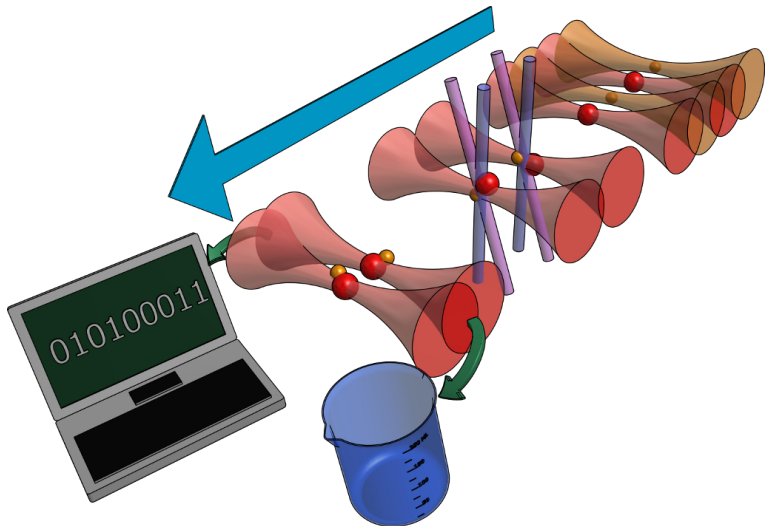
Motivation



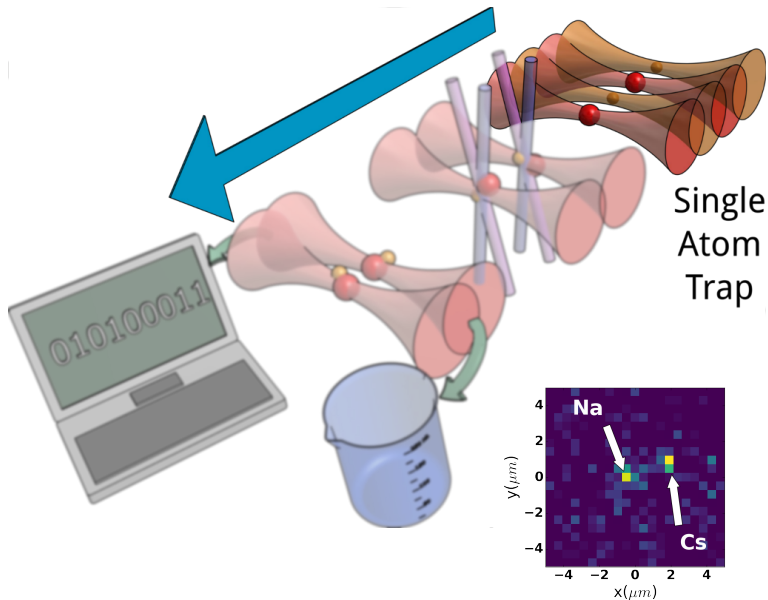
Motivation



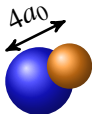
Setup



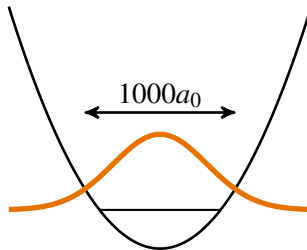
Setup



Wave function size mismatch



Molecule



Atom

Goal of cooling

- Single initial state
- Shrink wavefunction size

Raman sideband cooling of Sodium

Raman sideband cooling of Sodium

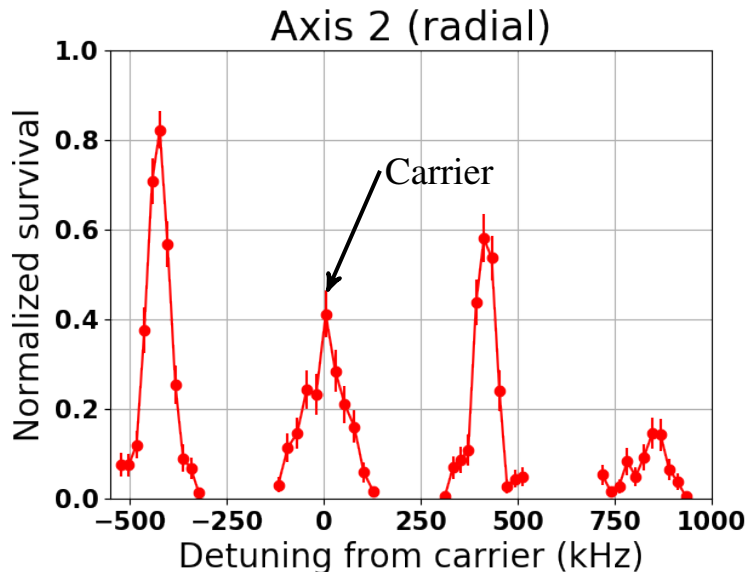
Difficulties

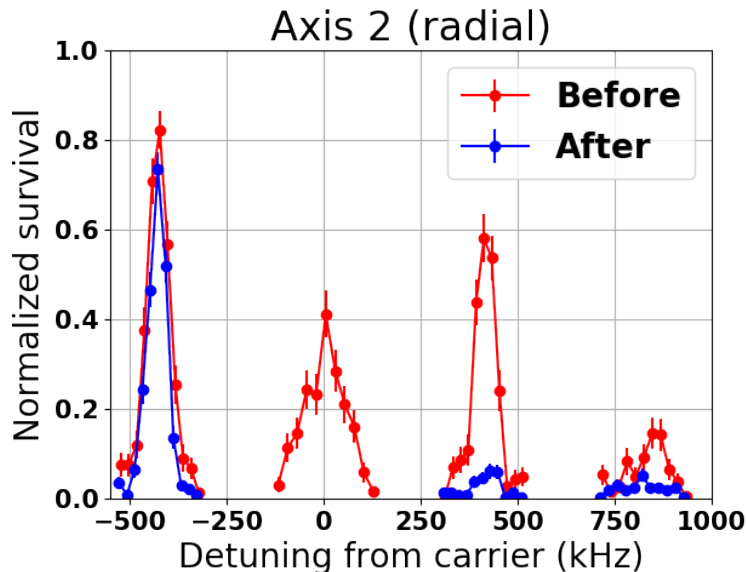
- High initial temperature ($40\mu K$)
- High recoil heating (High Lamb Dicke parameter)

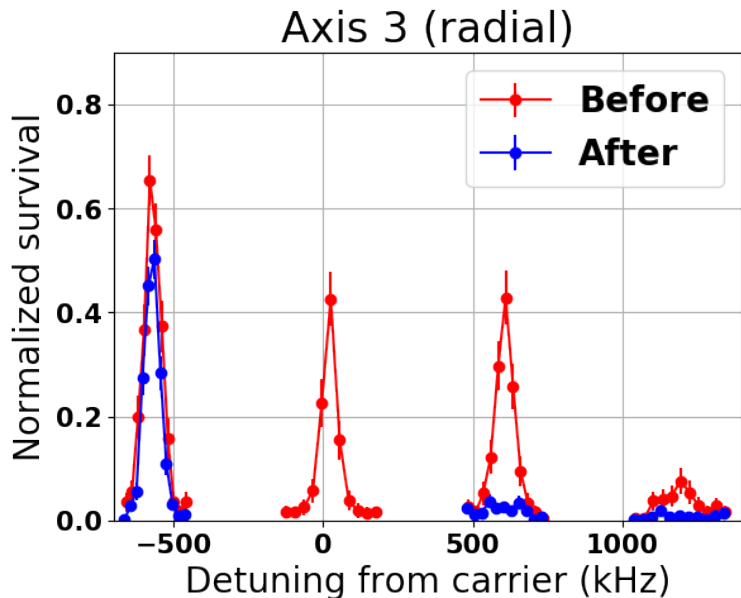
Raman sideband cooling of Sodium

Difficulties

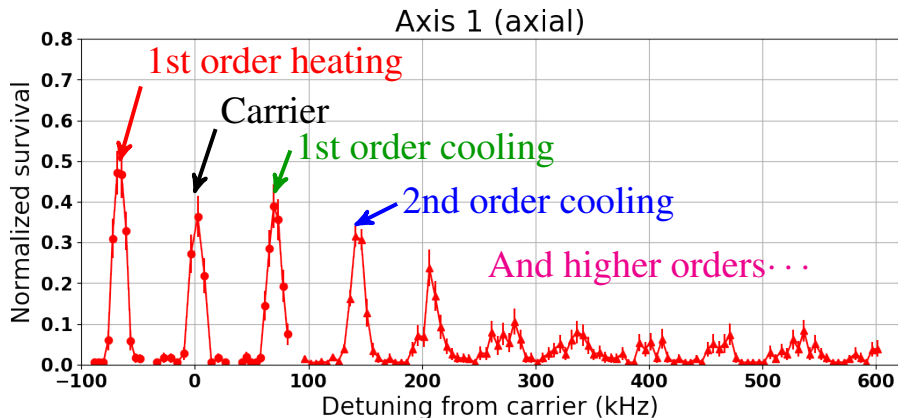
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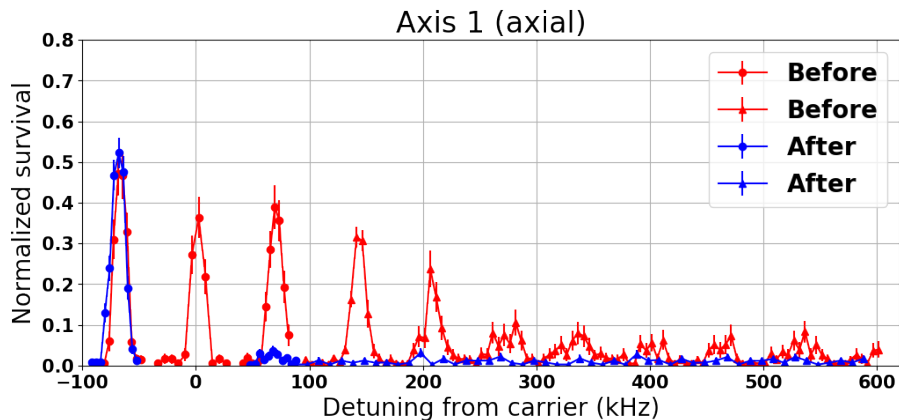




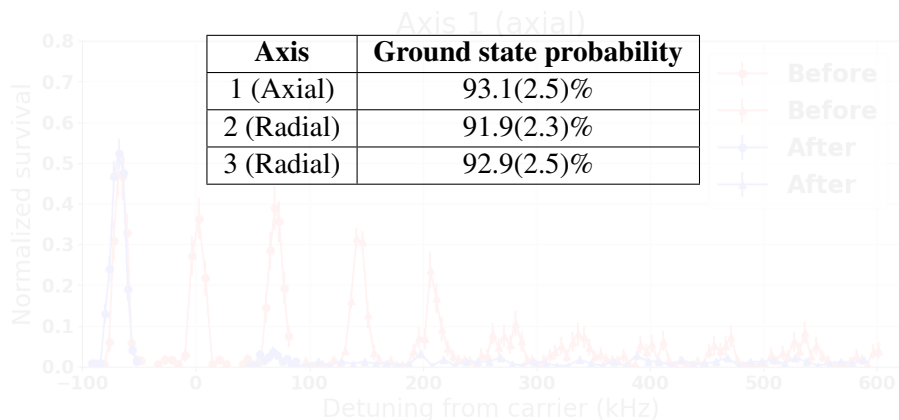
Raman sidebands



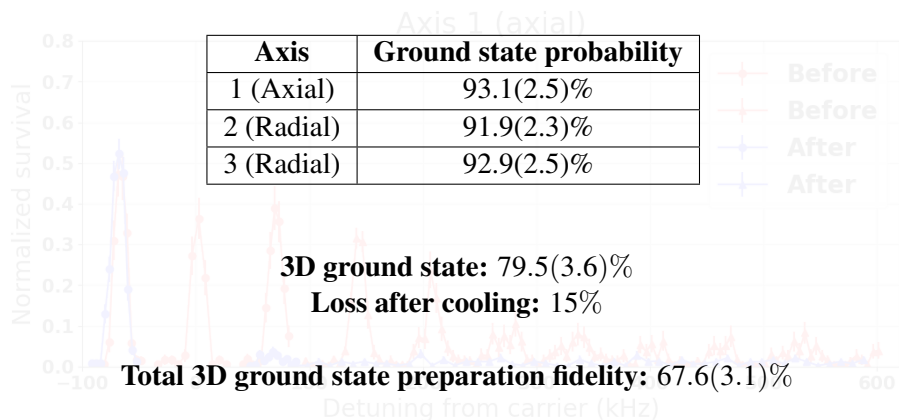
Raman sidebands



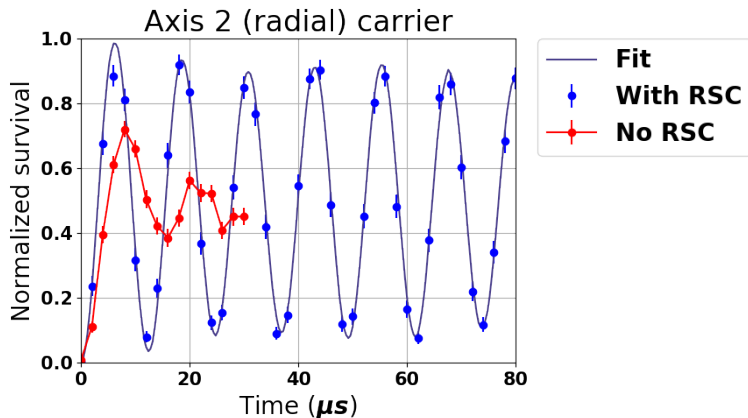
Raman sidebands



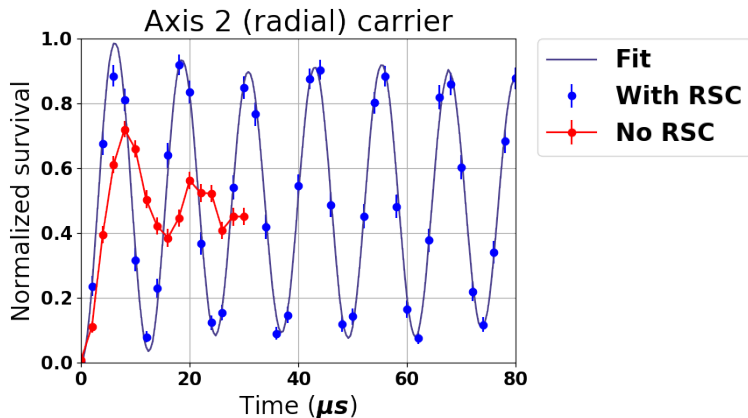
Raman sidebands



Rabi flopping (radial)

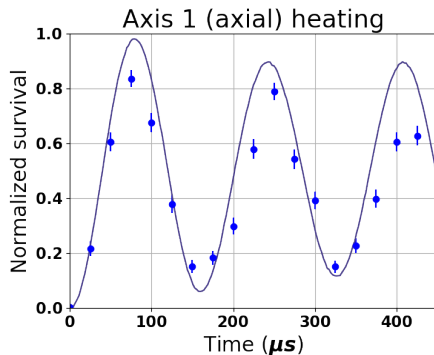
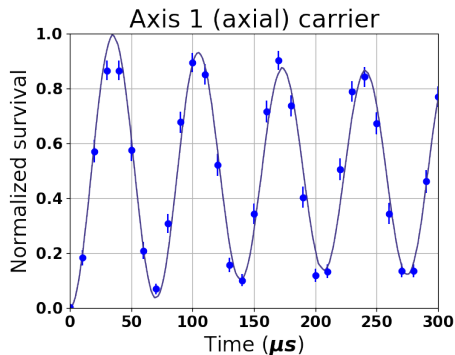


Rabi flopping (radial)



Good agreement in ground state probability between spectrum and Rabi flopping data.

Rabi flopping (axial)



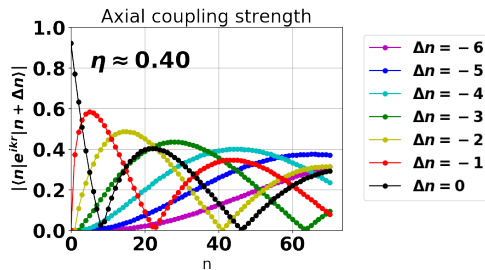
Conclusion

67.6(3.1)% ground state preparation fidelity (79.5(3.6)% without loss)

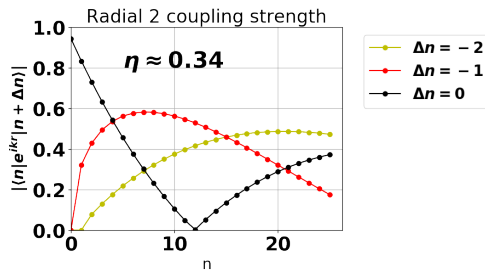
Improvements

- Reduce off-resonance scattering from Raman beams
- Reduce magnetic field fluctuation
- Reduce loss during cooling

Axial matrix element



Radial 2 matrix element



Radial 3 matrix element

