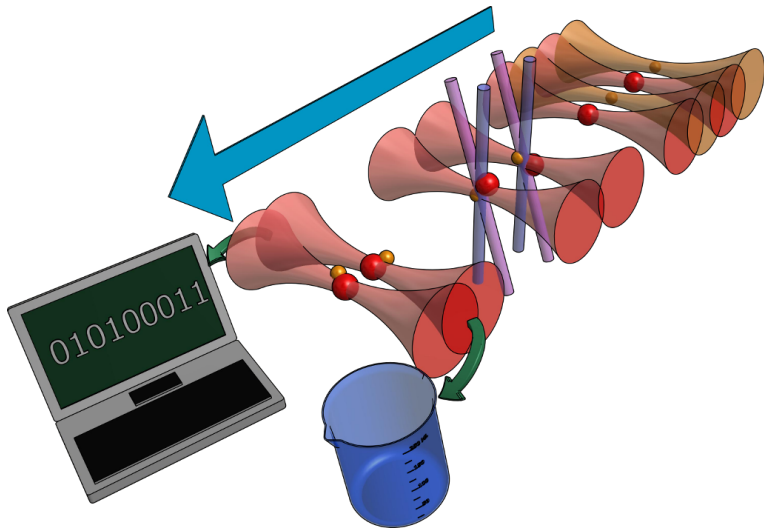


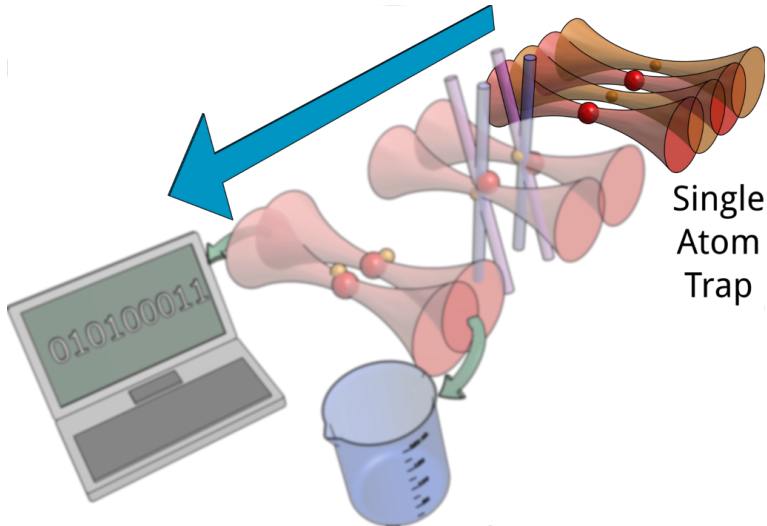
Raman sideband cooling of single sodium atom to 3D ground state

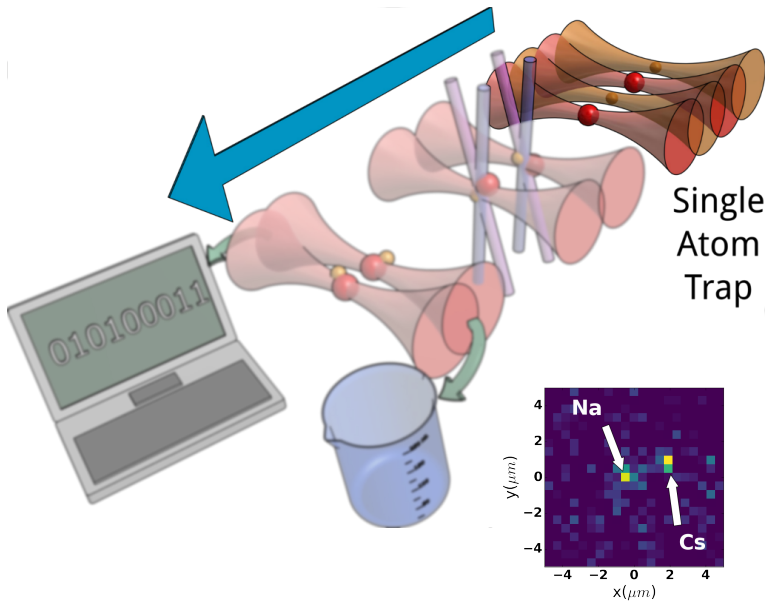
Yichao Yu

Ni Group/Harvard

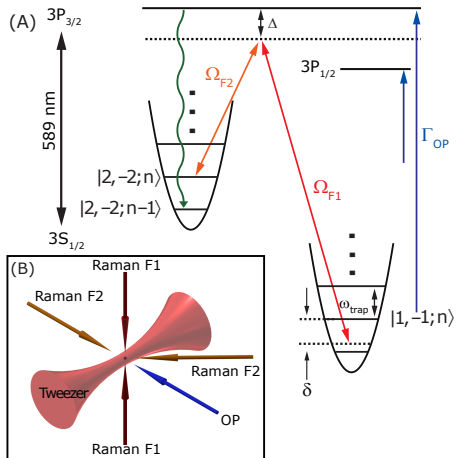
April 19, 2017



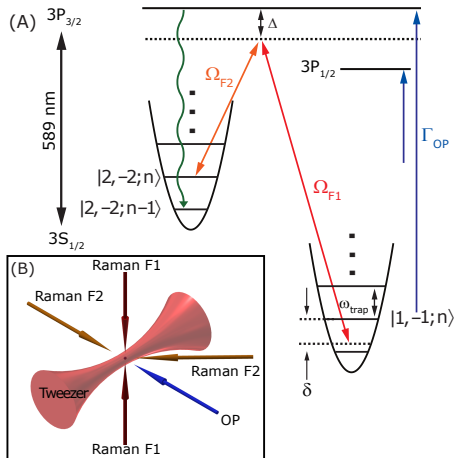




Raman sideband cooling of Sodium



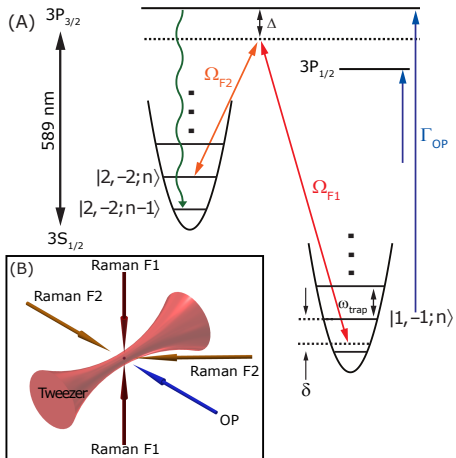
Raman sideband cooling of Sodium



Difficulties

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

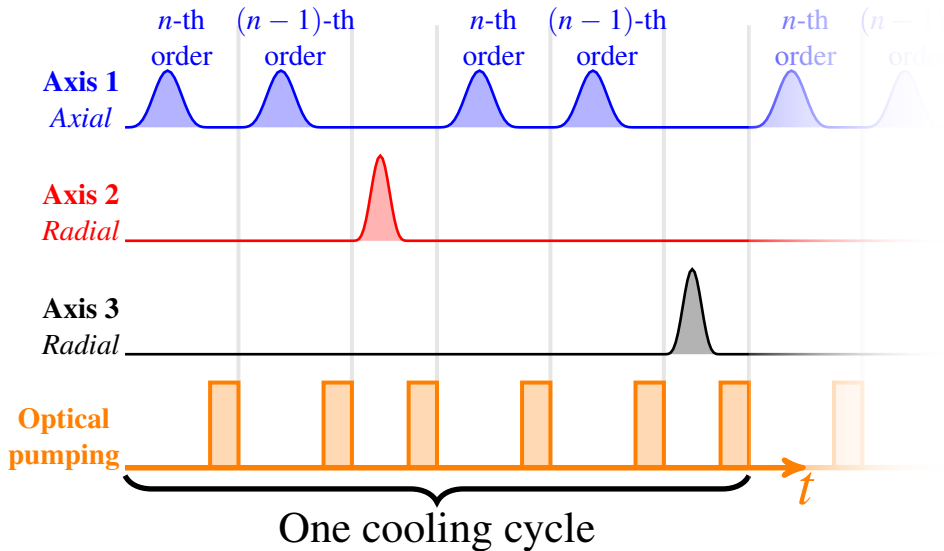
Raman sideband cooling of Sodium



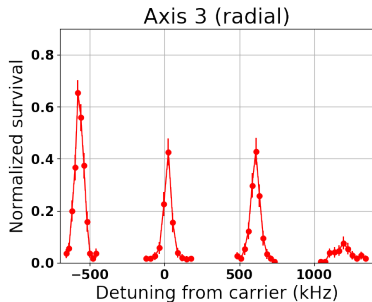
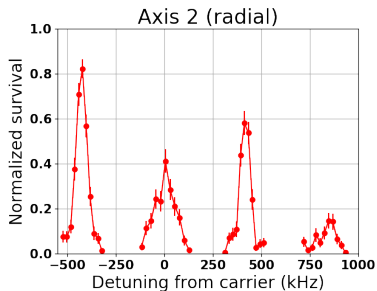
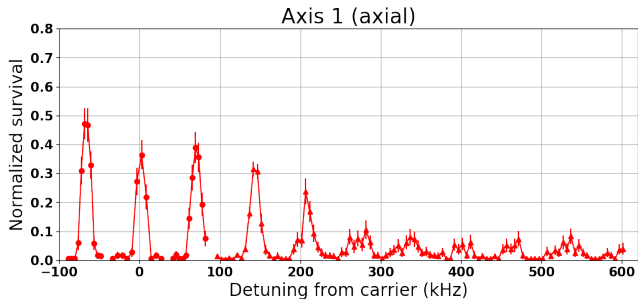
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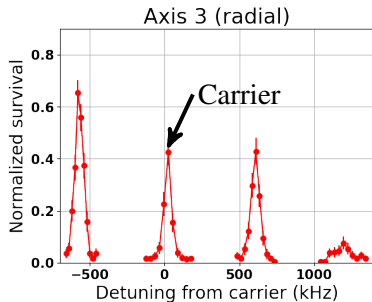
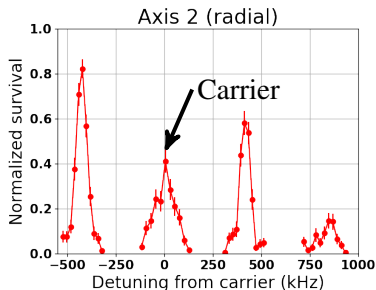
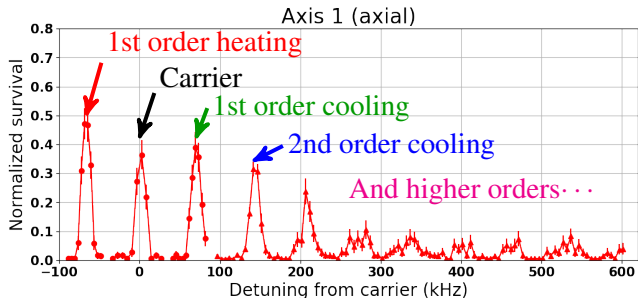
Cooling sequence



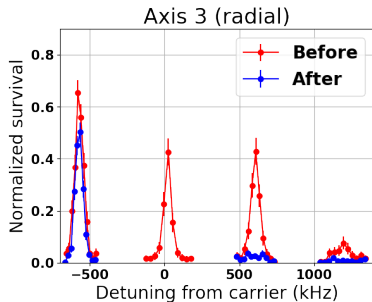
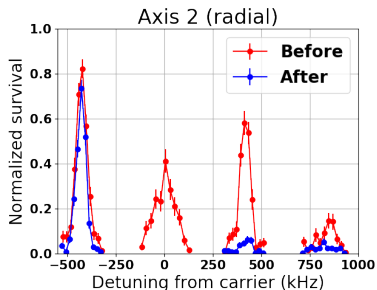
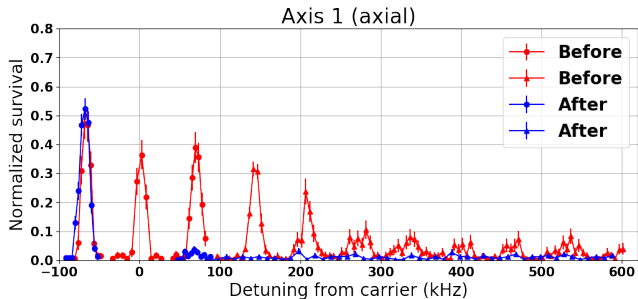
Raman sidebands



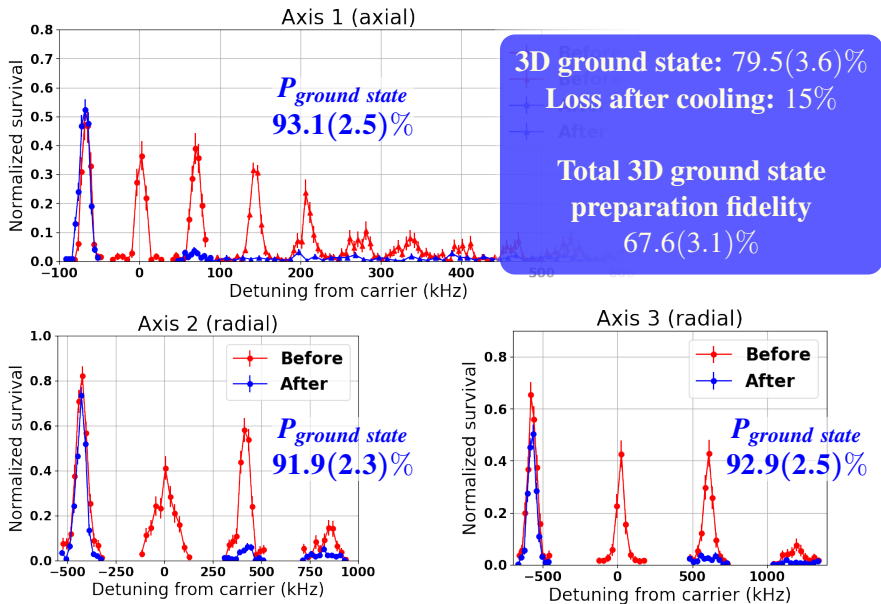
Raman sidebands



Raman sidebands



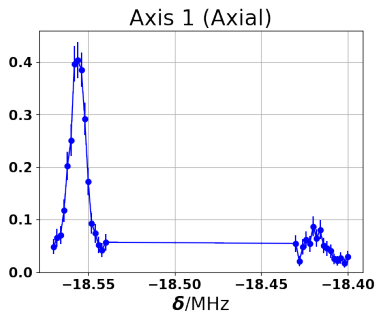
Raman sidebands



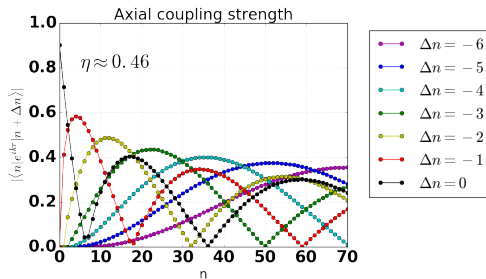
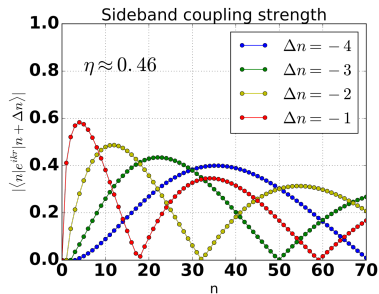
- Radial-only cooling
- Axial-only cooling
- 3D cooling
(Survival: $\approx 89\%$)

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Axial matrix element



Radial matrix element

