U.S. National Science Foundation

Magneto-optical trap for ultracold sodium gas

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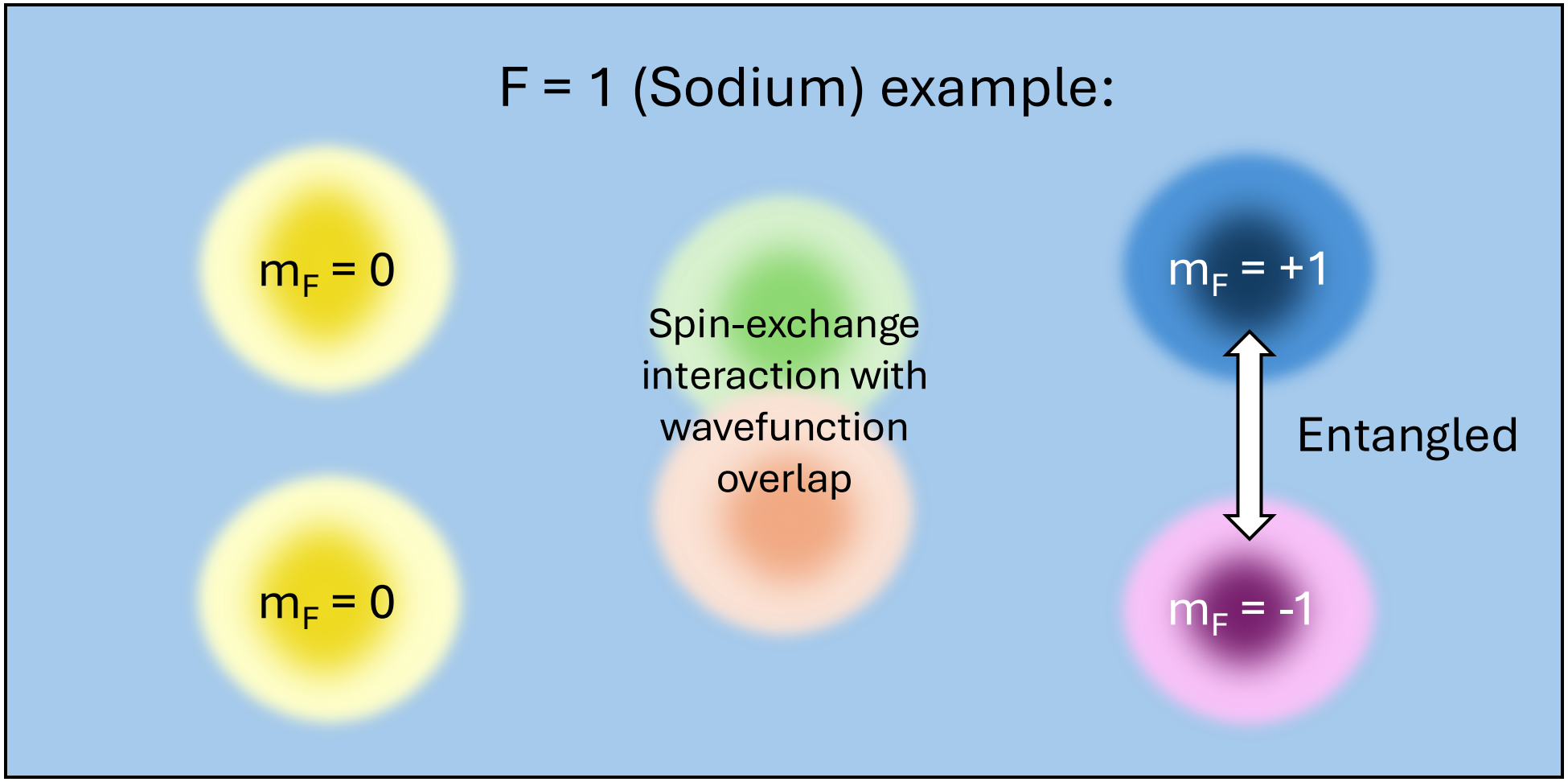
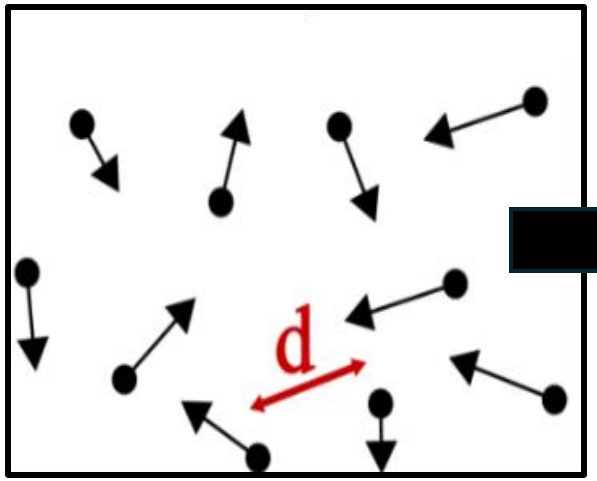
Spin-Exchange Collisions



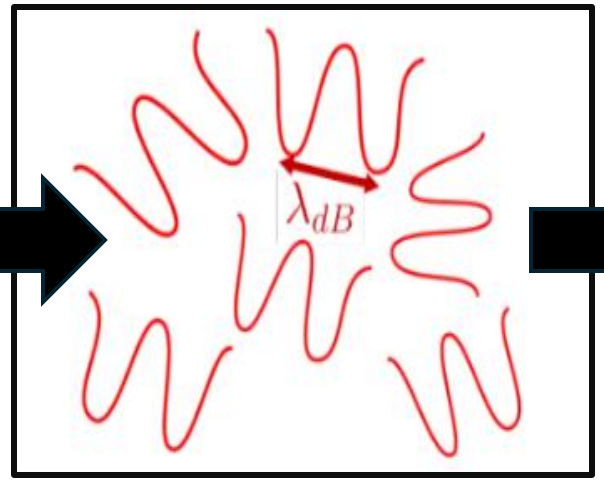
Applications: Spin-squeezed magnetometry, quantum interferometry, polarons, and many more!

The Bose-Einstein Condensate

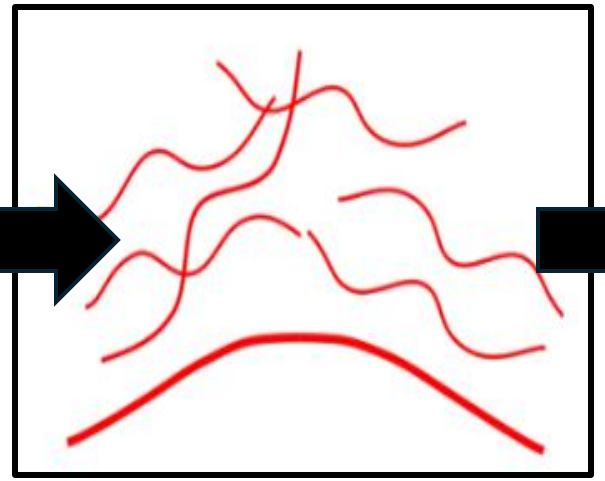


Room temperature: billiard ball model

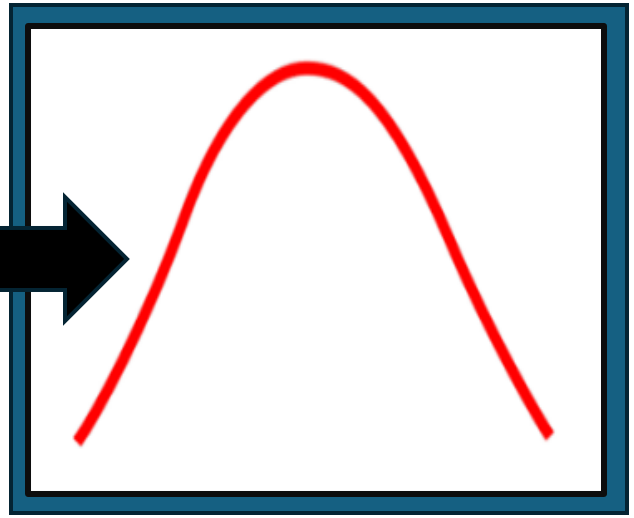
Spin-mixing collisions are incoherent, uncontrollable, and random



Low temperature: “wavepackets”



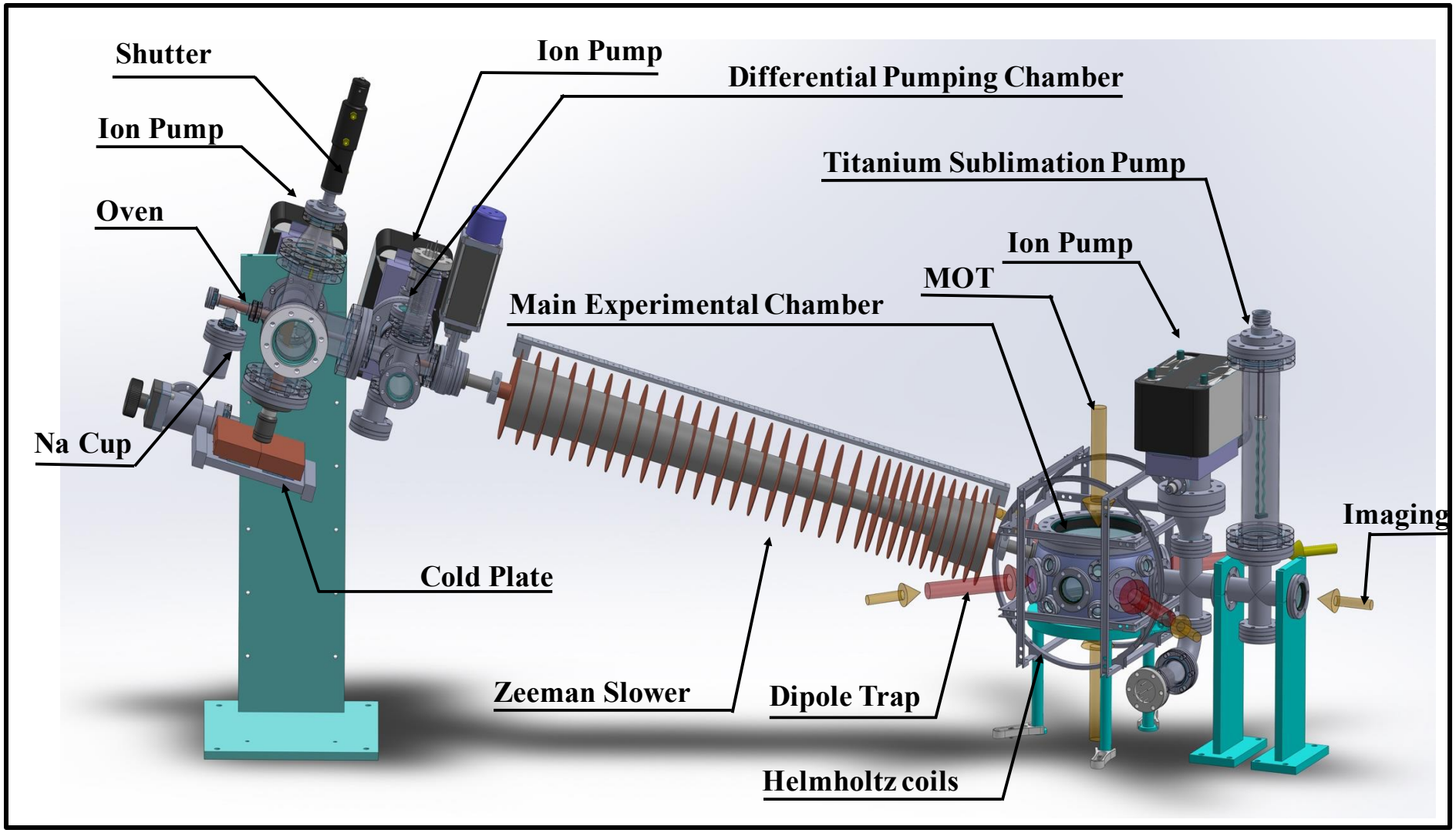
Ultracold: Bose-Einstein Condensate forms



100 nanoKelvin: coherent matter wave

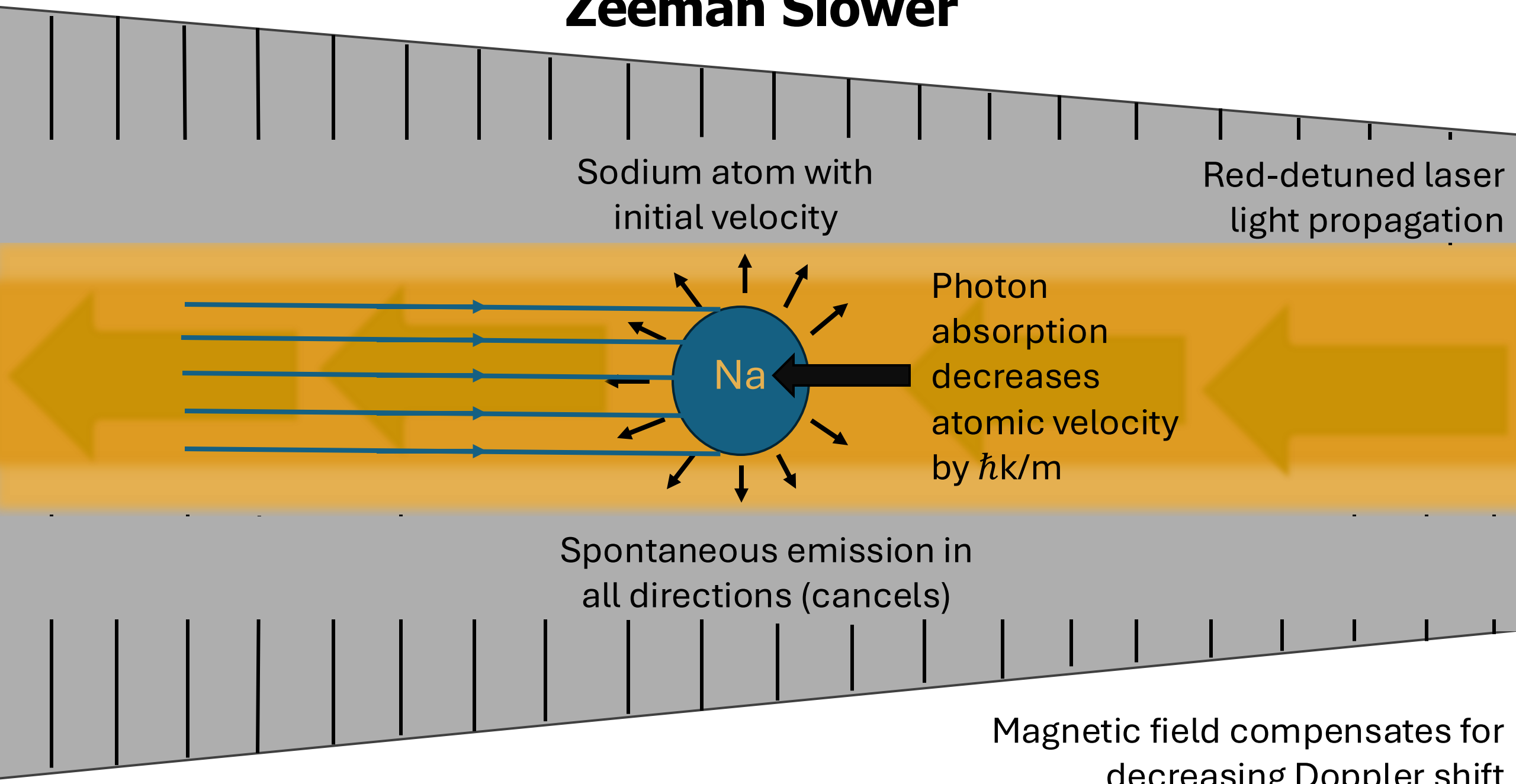
Spin-mixing collisions are coherent, tunable, and in lock-step

Experimental Apparatus



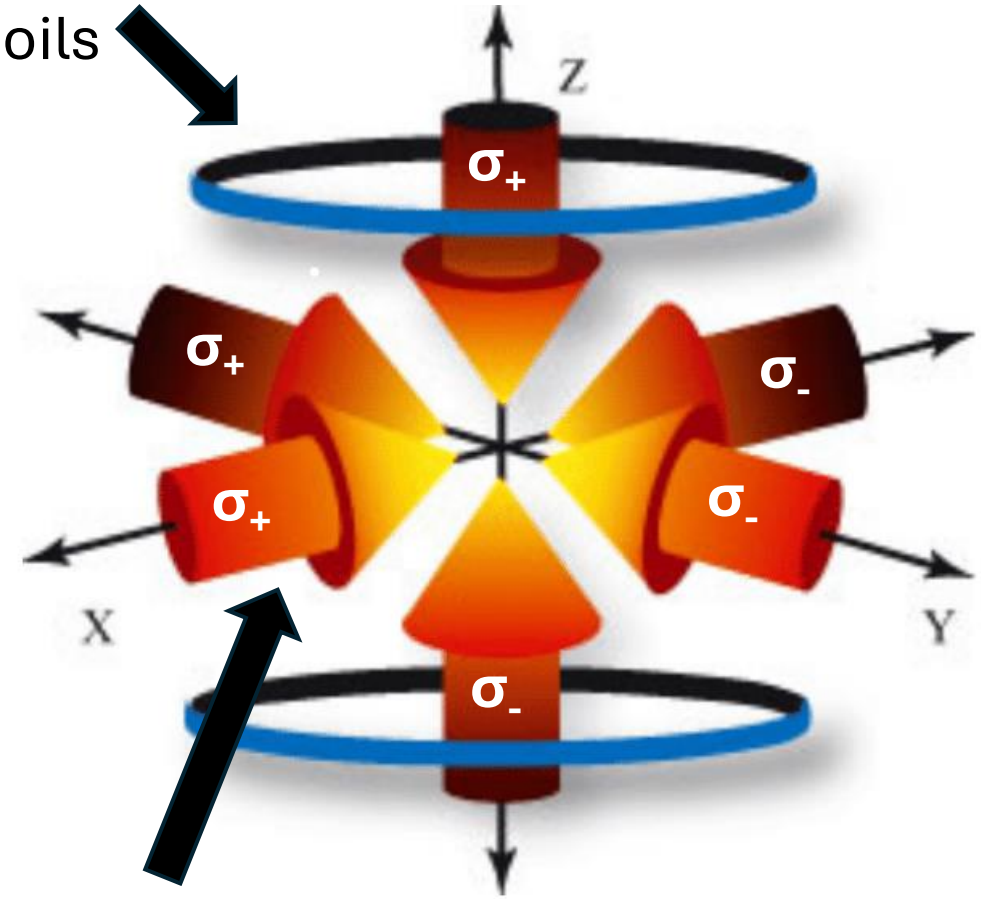
Experimental Apparatus Mock-Up

Zeeman Slower

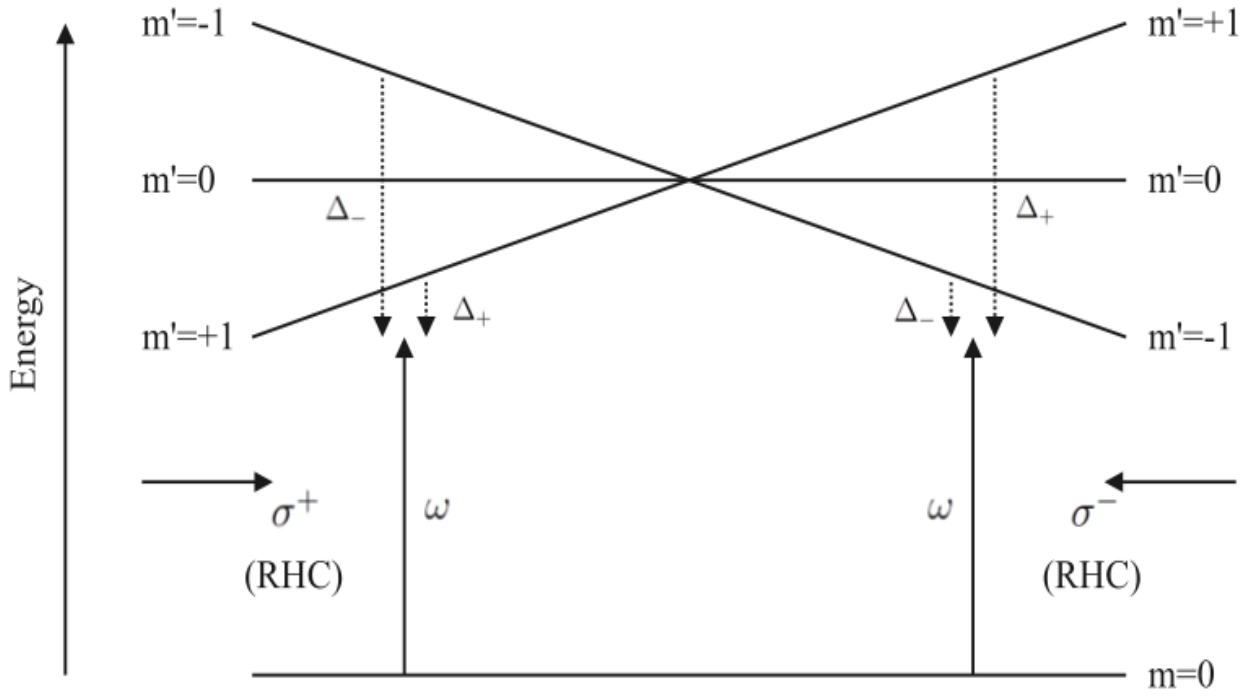


The Magneto-Optical Trap (MOT)

Anti-Helmholtz Coils

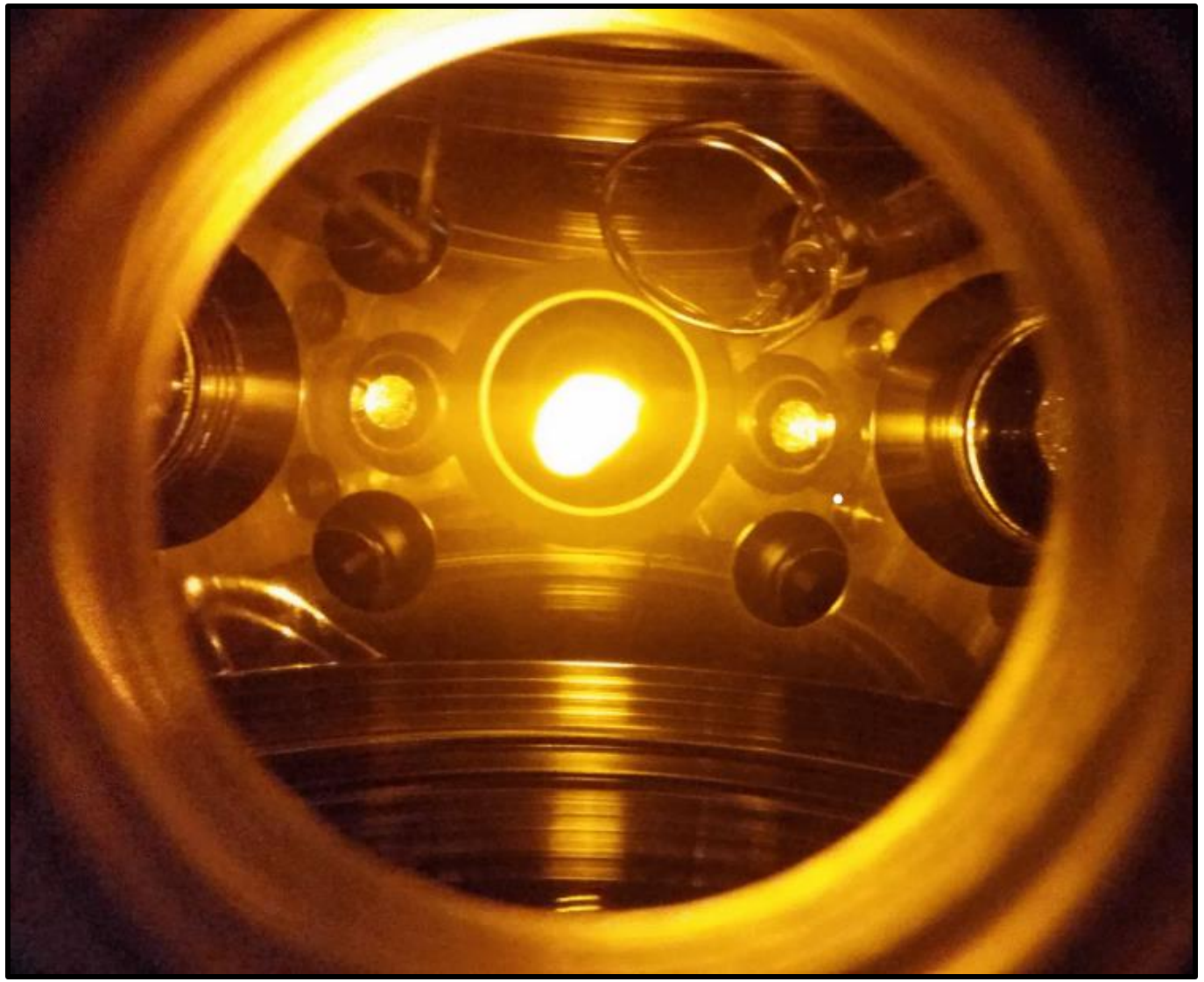


Red-detuned lasers



The energy of the magnetic sublevels with position along any given laser axis (Schwettmann 2012).

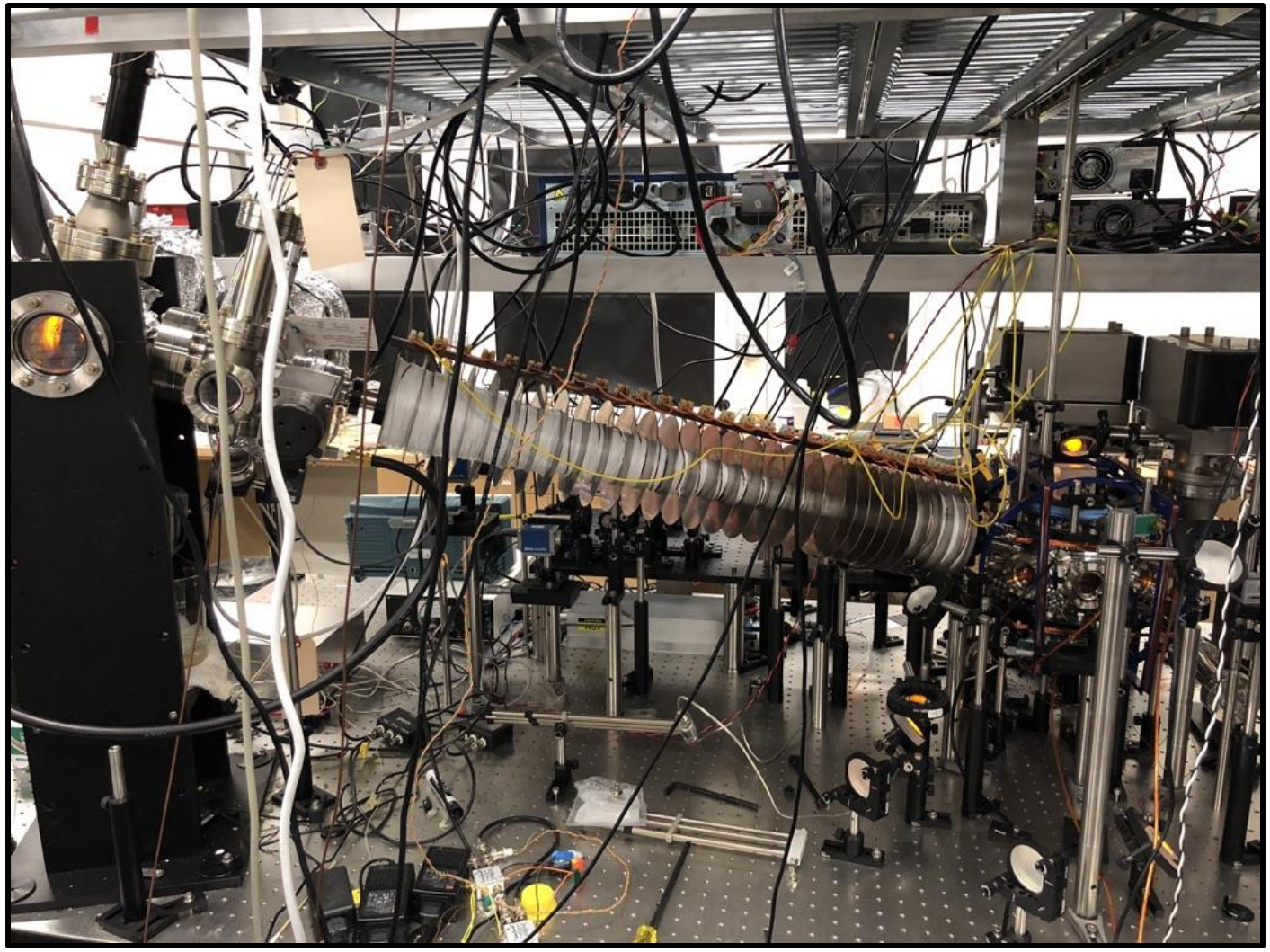
The Magneto-Optical Trap



Sodium MOT, radius 5 mm

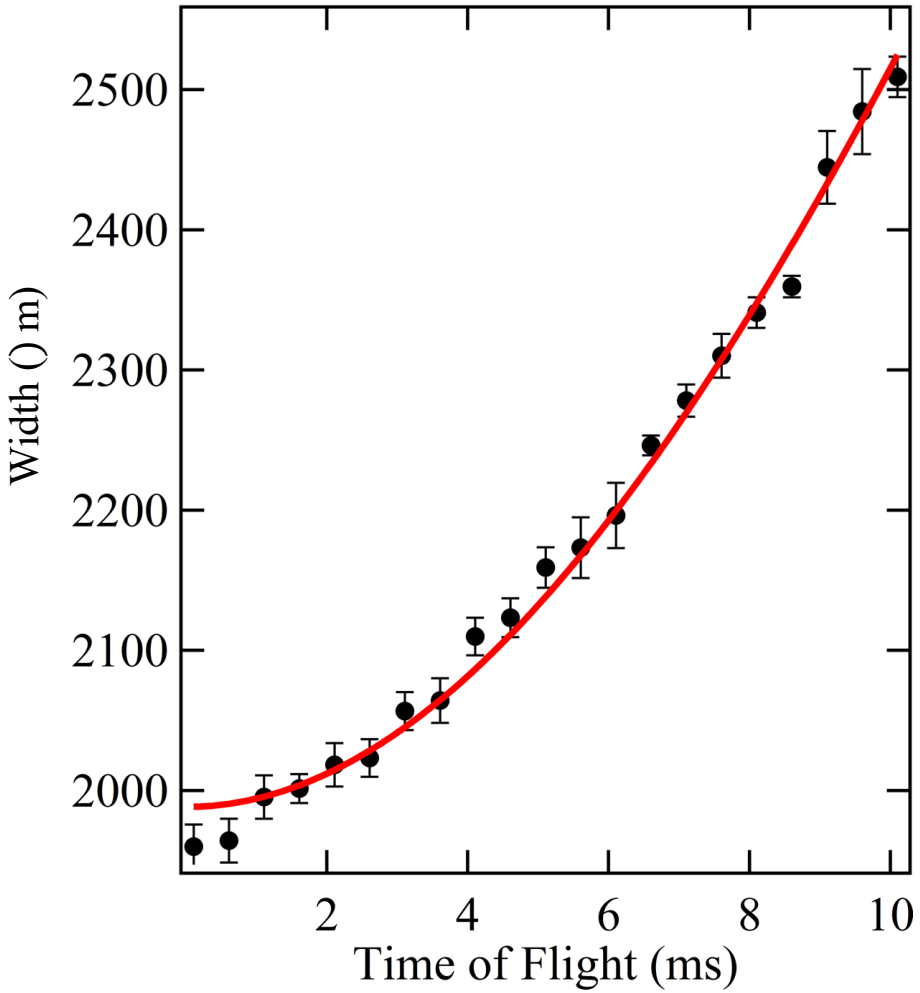
Next Steps:

- Test sodium oven
- Optimize Zeeman Slower
- Test Anti-Helmholtz coils
  - Current
  - New water cooling
  - Computer control
- Check polarization and alignment for MOT
- Diagnostic measurements (next slide)

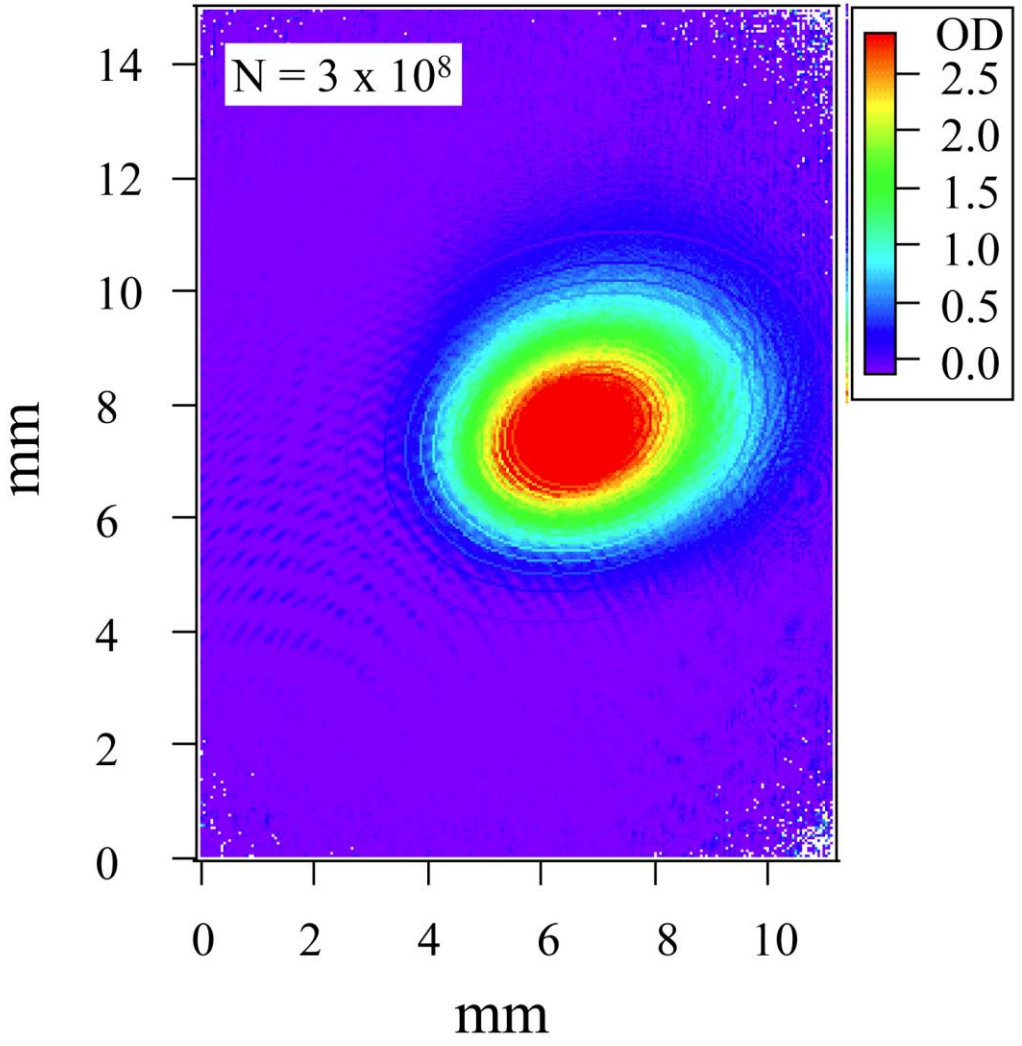


Experimental apparatus

Diagnostic Measurements



Temperature measurement using time of flight method



False color absorption image

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References

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Questions?