Why trap atoms?
Room temperature atoms are fast (~500 m/s)
Hard to interact with for long periods of time
Many phenomena require long-term light-matter interactions
Cold atoms (~100 µK) have an average velocity of 10 cm/s
Cold atoms are nearly standing still

How does an atom trap work?

Doppler cooling
A photon is absorbed by an atom
Photon momentum is transferred to the atom
Random photon emission gives atoms a net force
Red-detuned beams: velocity-dependent force

Zeeman Effect
In an external magnetic field, the atomic levels shift
Circular polarization selects between two different transitions

Magneto-Optical Trap
Trapping and cooling neutral atoms
The MOT is a combination of Doppler cooling and zeeman trapping.
A spherical MOT is formed by a set of six beams.
Each beam applies a force along one axis (x, y, and z).
Trap located at B = 0

Rubidium Resonance Structure

Stage 1: spherical MOT

Stage 2: spherical mirror-MOT

Stage 3: anisotropic mirror-MOT

Making our own mirrors
Tollens reaction
Back surface coating
Prevent oxidization
Microscope slides and coverslips

Future Work
Optimize anisotropic trap
Characterize atomic number density
Beam propagation in anisotropic cold atom cloud
Pattern formation, nonlinear optics, photonics applications

References

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