

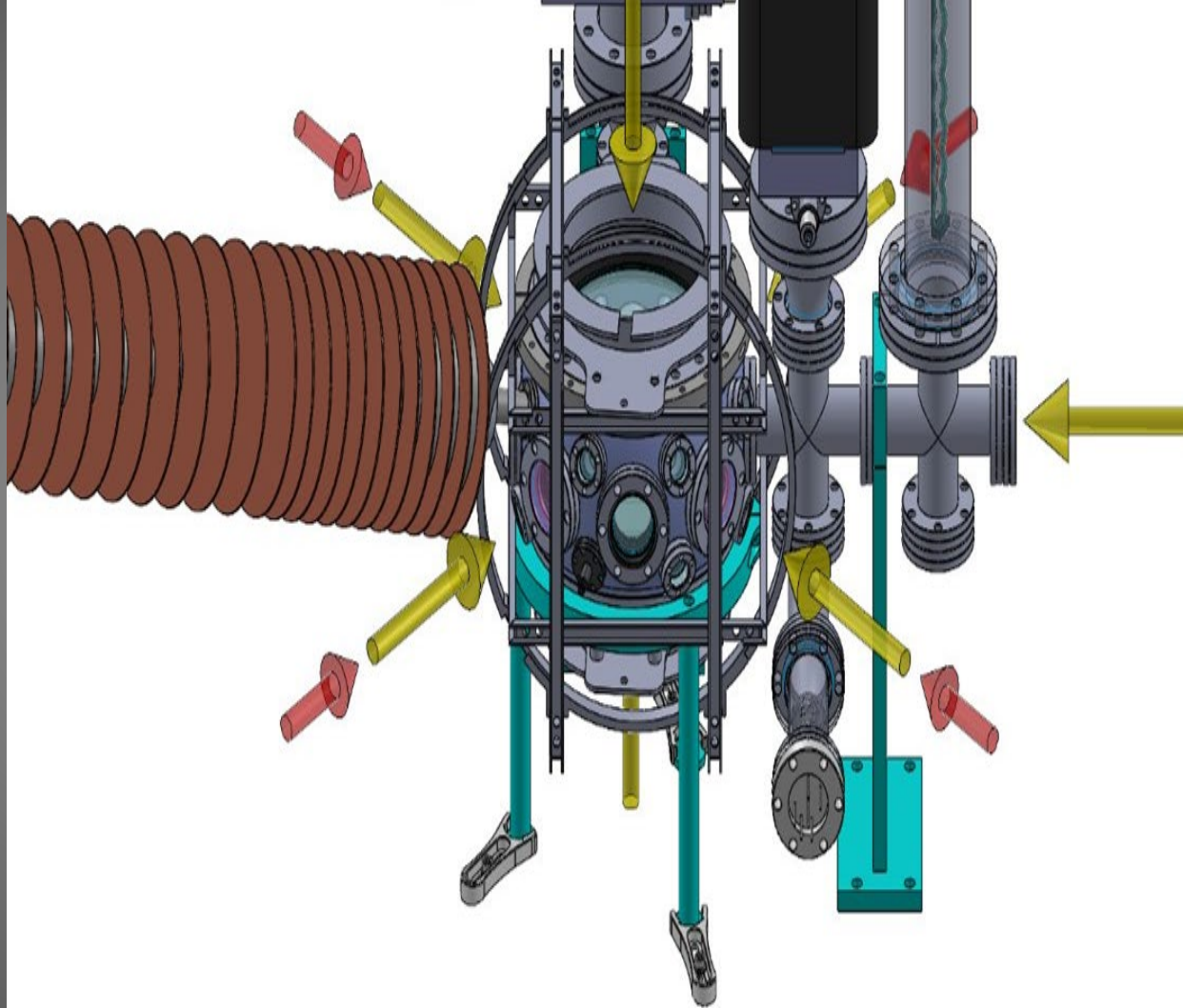


Laser Cooling & Optical Dipole Trap

Carlos Alvarado

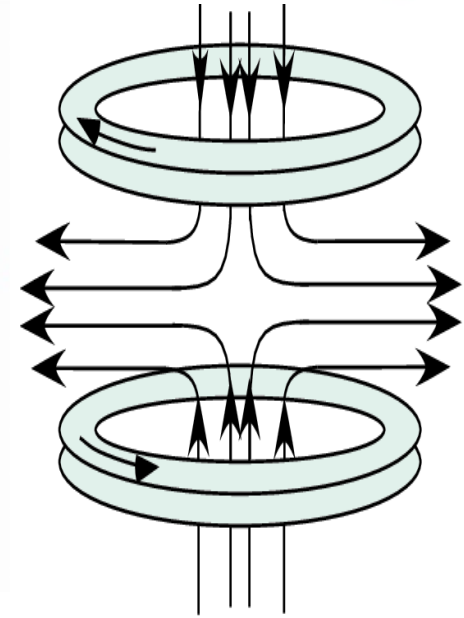
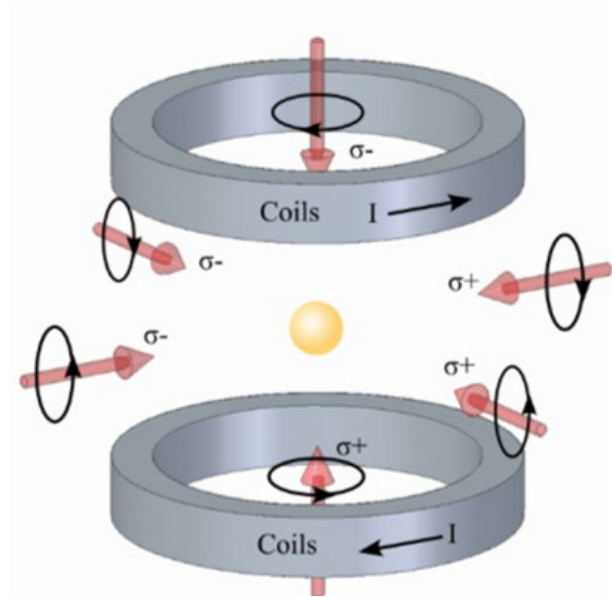
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Group:
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Graduate Students



Magneto-Optical Trap (MOT)

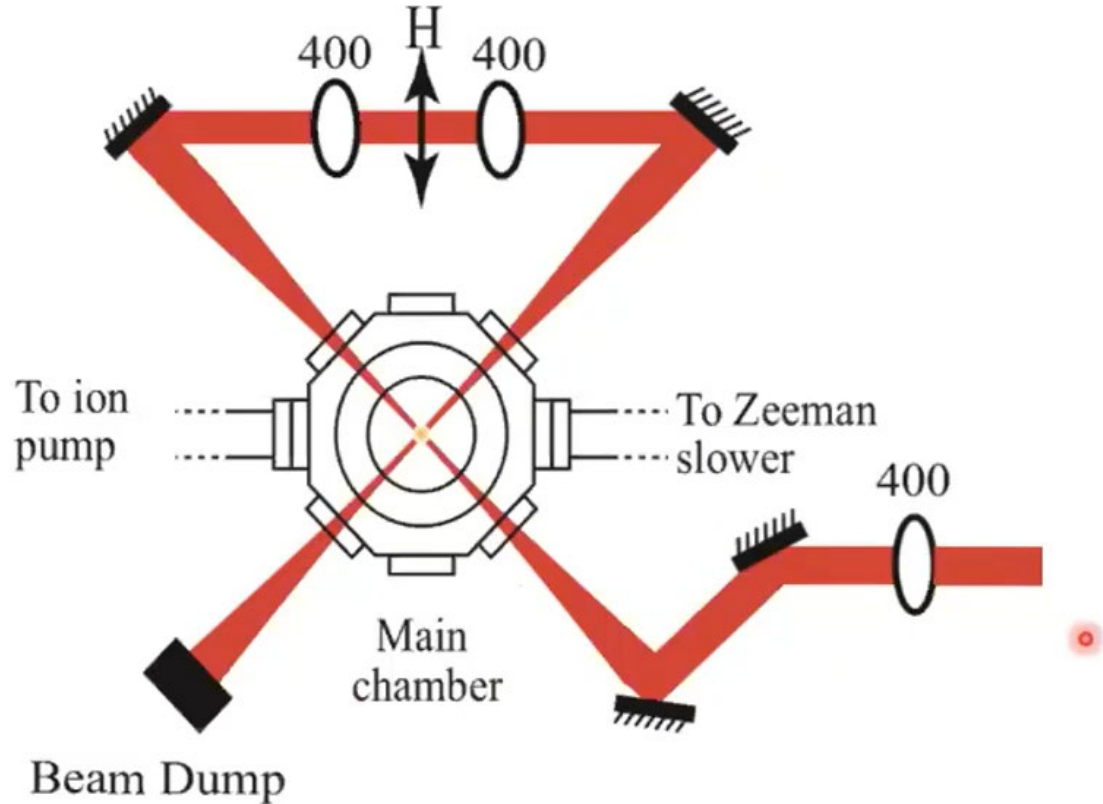
- Need for localization
- Inhomogeneous Magnetic Field: Magnet Coils in anti-Helmholtz configuration
- Zeeman Effect
- Velocity- Dependent force \rightarrow Position-dependent restoring force
- Spinor BEC vs. BEC: Spin states at $(x, y, z) = 0$



Optical Dipole Trap

- AC Stark Effect
- Gradient of the light
- Red-Detuned Beam (Negative Detuning)
- Non-Dissipative Nature
- Large Detuning with High Intensity

$$\Gamma_{scatt}(\vec{r}) = \frac{3\pi c^2}{2\hbar\omega_0^3} \left(\frac{\omega_L}{\omega_0}\right)^3 \left(\frac{\Gamma}{\Delta}\right)^2 I(\vec{r}).$$



Evaporative Cooling

- Sodium's Recoil temperature (MOT limit cooling) $\sim 2.39 \mu\text{K}$
- Evaporative Cooling
- Increased Density
- In the nano-Kelvin Regime
- Leads to macroscopic population of the ground state which is Bose-Einstein condensation (BEC)

