

Low-Noise Current Controller for Ultracold Sodium Atoms

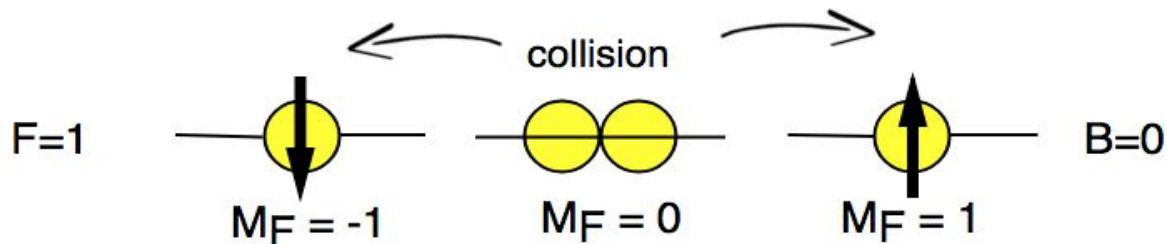
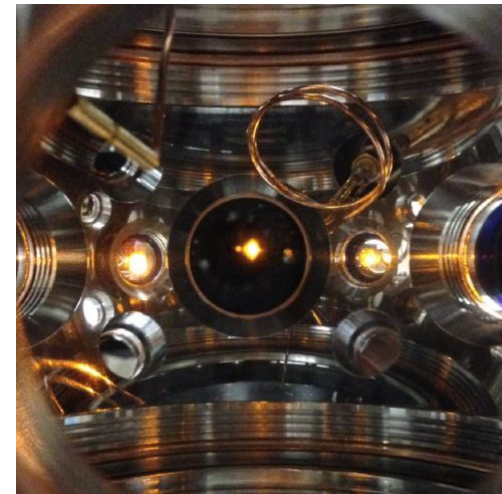
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Controlling Collisions in Bose-Einstein Condensate

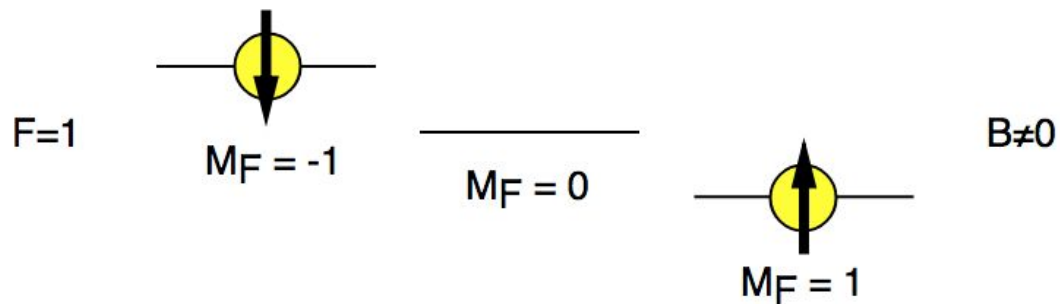
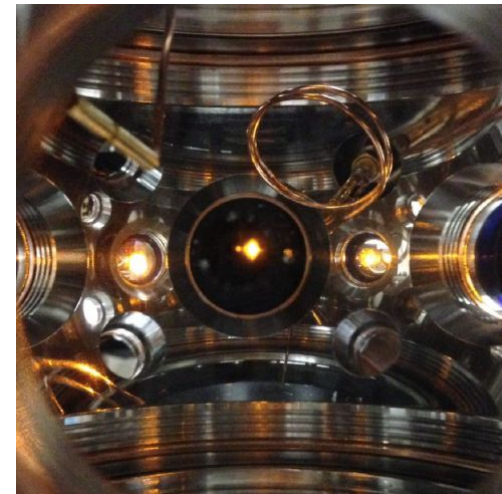
- Study ultracold gases of sodium
- All atoms are in electric ground state
- Spin changing collisions depend sensitively on magnetic field
- Magnetic field shifts energy level (Zeeman effect)
- Collisions happen more slowly
- **Goal: Create low noise current controller**





Controlling Collisions in Bose-Einstein Condensate

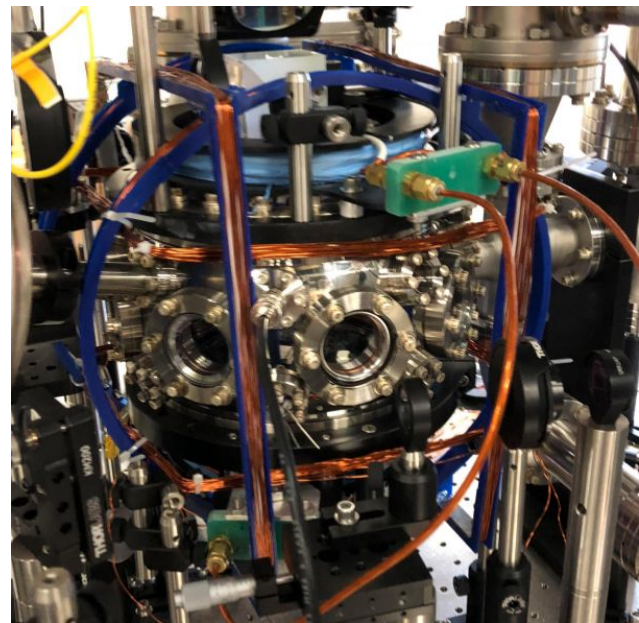
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Controlling Magnetic Field

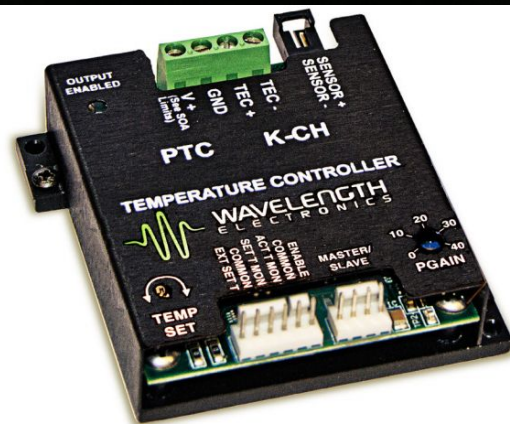
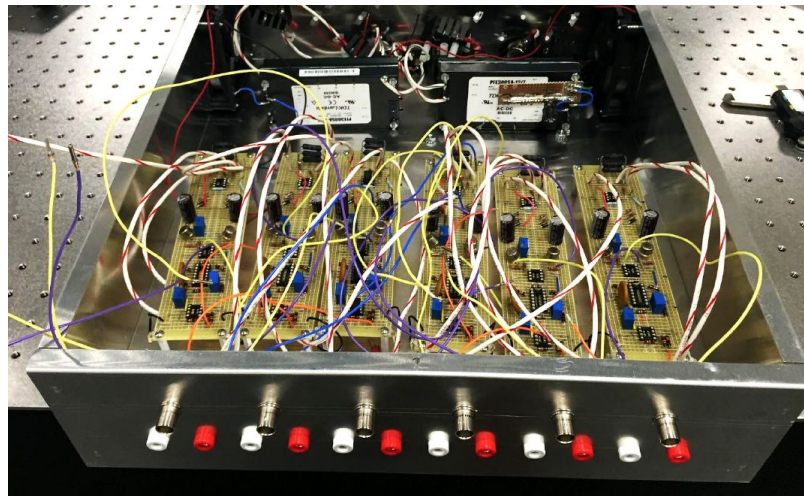
- Control magnetic field by changing current through Helmholtz coils
- Helmholtz coils are pairs of short coils that create uniform magnetic field in the center
- Coils were 3-D printed by former REU student
- Cancel out other fields (earth, nearby magnets)
- Control collisions by applying arbitrary magnetic fields





The Idea - Use a Temperature Controller (TC)

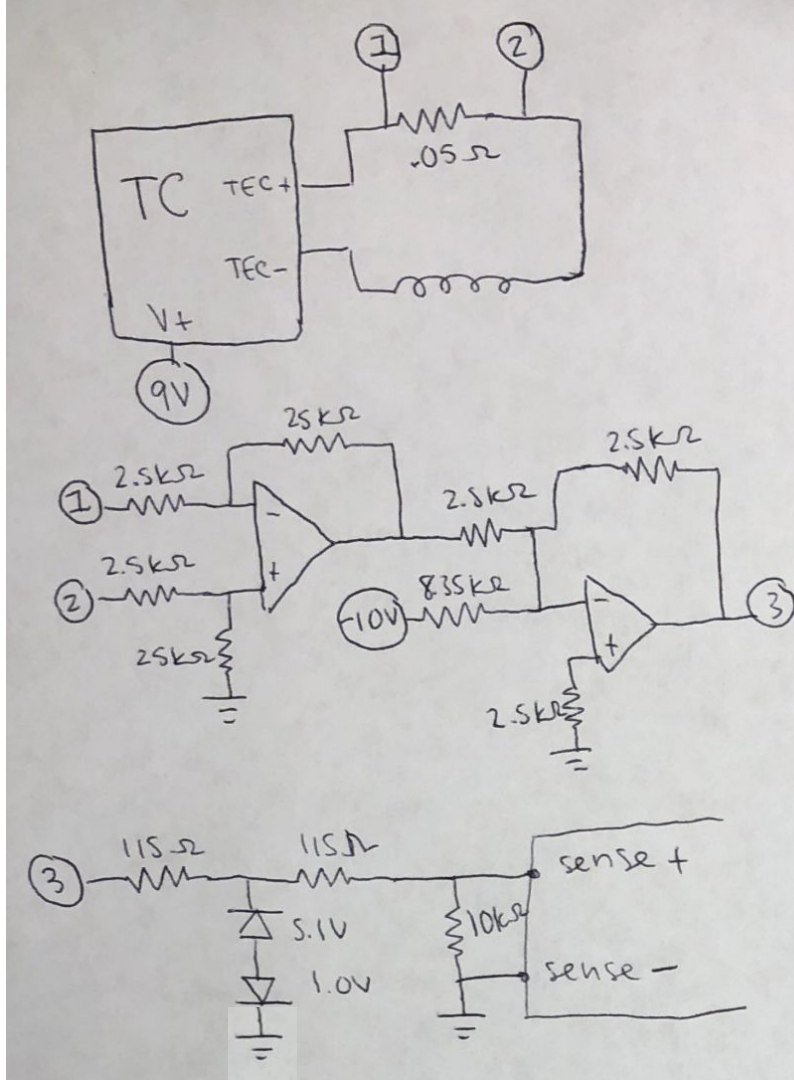
- Currently using homebuilt supply -- fast but noisy
- Difficult to find commercial solution
 - Bipolar, active stabilization, remote current programming, fast
- TC meets these requirements
- TC expects to sense a temp and adjust a current
- Challenge: convert current data into fake temperature data





Present Status

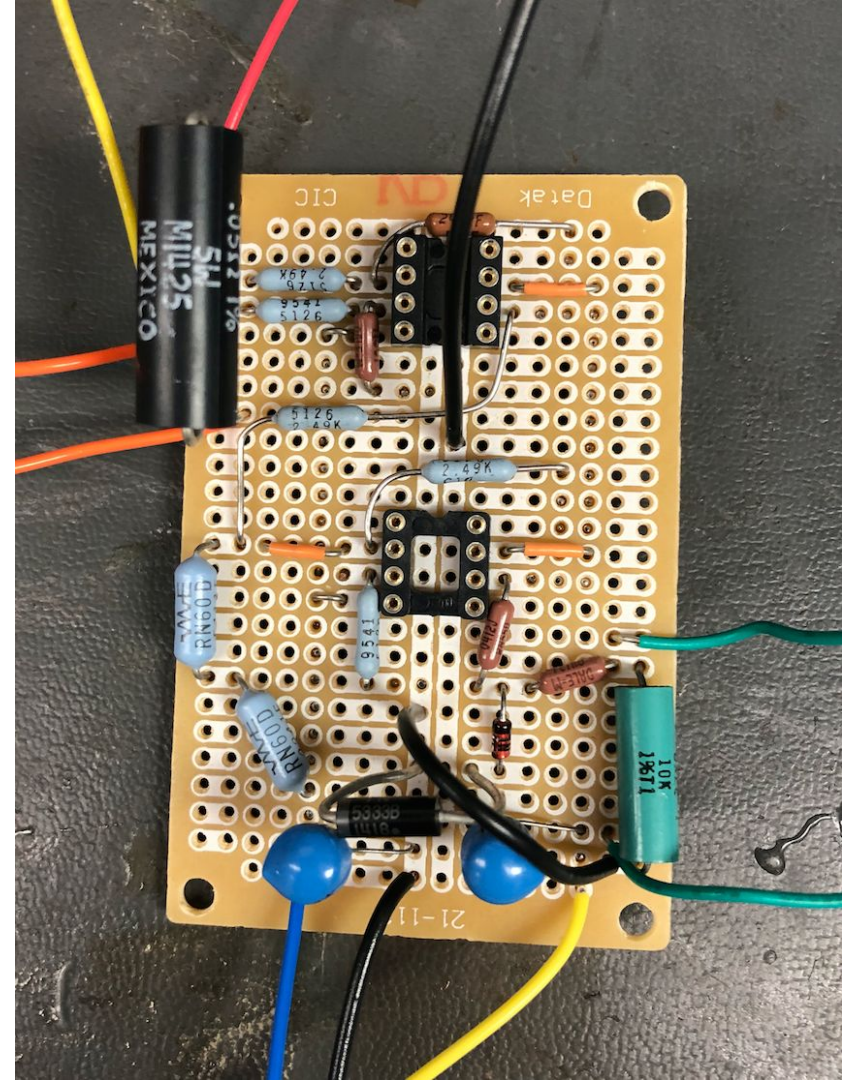
- Designed and built a prototype circuit that senses current and presents fake temp to TC
- The sensing circuit appears as a $10\text{k}\Omega$ thermistor
- Use $.05\Omega$ sense resistor to sense current





Outlook

- Finish real circuit
- Test circuit under realistic conditions
- Test the speed of controller's reaction to set point voltages
- Implement into experiment



Questions?

