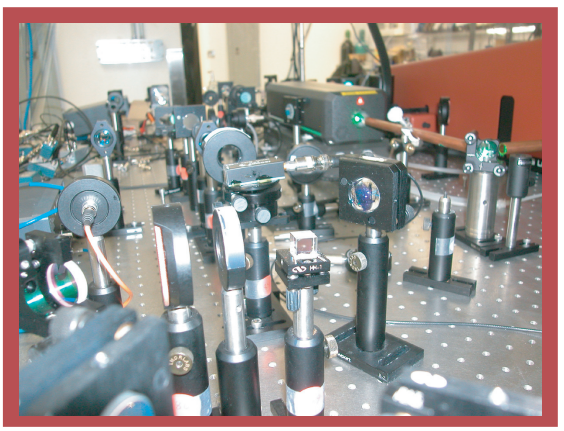
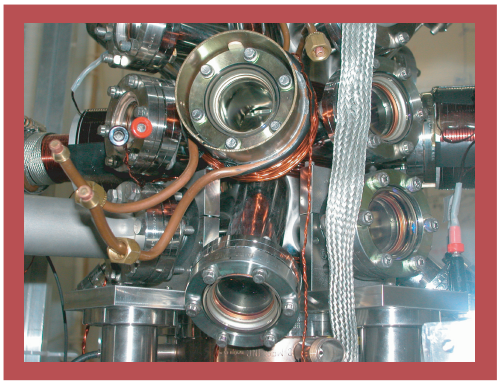
Ultracold Atoms and Plasmas

Plasma is the most common state of matter in the universe, ranging in temperature from 10^{16} K in a pulsar to 300 K in the Earth's ionosphere. We use **ultracold** atoms created with **laser-cooling techniques** and pulsed lasers to create the **coldest** neutral plasmas ever made, with temperatures as low as 1 K. They tend to last for less than one millisecond, blown apart by the pressure of the electrons and the recombination of electrons and ions into highly excited atoms. We hope to further our understanding of the physics of plasmas by continuing to push the limits.



Optical lattices are crystals made of light – periodic potentials that confine **ultracold** atoms (less than 1 millionth of a degree above absolute zero). These atoms in optical lattices are almost perfect analogies of electrons trapped in crystals, but our optical lattices are defect and impurity free, unlike real world solid-state materials. We will use **coherent** atoms from a **Bose-Einstein condensate** to study the wave-like properties of atoms trapped in these potentials. We can study exotic states of matter such as a **"Bose glass"**, phase transitions that rely on the graininess of quantum mechanics rather than thermal fluctuations, and the question of just why the world seems so classical when we believe quantum mechanics is the correct microscopic description.

GROUP MEMBERS



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