Magnetic Fields for Ultracold Atoms Experiments

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Ultralow temperature quantum gasses interact through low-energy collisions referred to as s-waves collisions. The strength and nature of these interactions (attractive or repulsive) depends on the magnitude and sign of the scattering length, obtained from the differences between the incident and scattered waves. Following the proposals of Fano and Feshbach, it is possible to change the value of this scattering length by applying an external magnetic field, a technique known as Feshbach resonances. This technique is possible due to the sensitivity of the atom energy levels to the application of magnetic fields. In this sense, another cooling and trapping technique for atoms that is common to this type of experiment, also using the influence of magnetic fields on the energy levels of atomic states, is the magneto-optical trap (MOT), combining pairs of counter propagating lasers and a magnetic field gradient. In this project, we aimed to design, manufacture and characterize two coil systems, responsibles for generating the magnetic fields for synchronizing the Feshbach resonances and for cooling and trapping atoms in a 2D bose gas of potassium-39.