Pressure-driven Antiferromagnetic Quantum Phase Transition

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Abstract:

My project focuses on the pressure-driven antiferromagnetic quantum phase transition in pure Cr metal. This is a model system for studying the effects of quantum fluctuations on an itinerant antiferromagnet.

Our group has selected chromium for the experiment because it is the simplest metal close to a quantum critical point. Chromium alloy has some of the same peculiarities as the more exotic materials, including a quantum critical point, a strongly temperature-dependent Hall resistance and evidence for a ‘pseudogap’.

This quantum phase transition has been studied using the Hall effect before, using vanadium (V) doping to drive the transition. My project is to use pressure rather than doping to drive the phase transition. Elemental chromium orders antiferromagnetically near room temperature, but the ordering temperature can be driven to zero by applying large pressures. My group has combined diamond anvil cell and synchrotron x-ray diffraction techniques to measure directly the spin and charge order in the pure metal at the approach to its quantum critical point. Now we want to study the magnetism by Hall effect.

To achieve my goal, first step is to bring the old eletro-magnet into life, including making adjustment to the magnet, adding a water-cooling system, and building a stage for sample. The whole apparatus will be finished by the end of this quarter. From next quarter, I will use the equipment to do some measurements and study pressure-driven antiferromagnetic quantum phase transition.