MAR06-2006-040279

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Angle-Resolved High Field Low Temperature Calorimetric Measurements of Low Dimensional Materials

NATHANAEL FORTUNE, Smith College

Quasi-two-dimensional materials exhibit a rich variety of magnetic-field-induced superconducting and magnetic states. These states are highly anisotropic with respect to magnetic field orientation; in some cases, the very existence of the state is field angle dependent. To establish the phase boundaries of these high-field, low temperature, angle-dependent states, we have fabricated miniature rotatable calorimeters for measurements of specific heat and the magnetocaloric effect at temperatures ranging from 0.1K to 20K in magnetic fields up to 20, 35 or 45 tesla. The sample orientation relative to the applied field can be continuously varied at low temperature along a single axis (with a resolution of 0.02 degrees) and at room temperature along a second axis (with a resolution of 2 degrees). The sample temperature can be programatically set and regulated to better than 0.1 percent over the entire field and temperature range, allowing field sweeps at constant temperature in addition to temperature sweeps at fixed fields. In this talk, I will discuss the design, performance, and evolution of our calorimeter and recently obtained results, including the calorimetric observation of an angle-dependent magnetically enhanced FFLO superconducting state in a heavy fermion superconductor and an angle-dependent quantum fluctuation induced "plateau state" at 1/3 of the saturation magnetization in a quasi 2D S = 1/2 Heisenberg antiferromagnet.