Title: Low temperature specific heat characterization of the geometrically frustrated magnetic compound Yb2Ti2O7

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Abstract: Yb2Ti2O7 is a geometrically frustrated magnet that proposed as a quantum spin liquid (QSL) candidate. This would have an emergent U(1) gauge structure, support emergent quasiparticles and a continuum of gapless spin excitations. A cubic power law dependence is expected in the specific heat down to zero temperature. [1,2] Identifying a power law is hindered by the presence of a sharp transition at 0.26K and a Schottky anomaly due to nuclear hyperfine interactions below 0.1K. [3] By preparing an isotopically enriched sample with 174-Yb and 48-Ti, we suppress the Schottky anomaly. This allows us to extend the specific heat to lower temperatures, revealing a polynomial behavior to at least 0.05 K that is suggestive of a quantum spin liquid.

Low temperature specific heat characterization of the geometrically frustrated magnetic compound $\rm Yb_2Ti_2O_7$

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Overview

Anomalous transition ~0.27K has first-order, ferromagnetic nature [L'hotel *et al.* 2014]



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Lack of ordering is still observed below this transition [Gardner et al. 2004, Ross et al. 2009, Bonville et al. 2004]



Project Goals To measure specific heat below 100 mK Check for QSL phase -Expect T³ behavior [Benton, Sikora, Shannon 2012, Savary, Balents 2012]



Specific Heat Setup

Homebuilt setup on dilution rerigerator Samples pressed with silver powder



Specific Heat Setup

Homebuilt setup on dilution rerigerator

Samples pressed with silver powder

Suspended from nylon thread

RuO₂ thermometer and metal film heater

6 um diameter NbTi leads (~10⁻¹⁵ W/K @10mK)

Low noise electronics and filtering

Specific heat measured with quasiadiabatic heat pulse method, also checked with relaxation method for equilibration issues



Low Temperature Thermometry

CMN paramagnetic salt measured with homebuilt SQUID magnetometer (CMN orders below 2 mK)

Raw AC susceptibility (SQUID output voltage on y-axis) is compared to a calibrated Germanium Resistance Thermometer (GRT) from 400mK to 150mK



RuO₂ Calibration

RuO2 thermometer is calibrated to CMN paramagnet using the calibrated SQUID output













