# Neutral Fermions Revealed by High-Field Heat Capacity in a Kondo Insulator

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**Quantum oscillations**—regular variations in material properties with magnetic field—are typically found only in metals, where they serve as a direct fingerprint of the Fermi surface. Their unexpected appearance in electrical **insulators** raises fundamental questions about the nature of the charge carriers in these systems. The **Kondo insulator $YbB_{12}$** has emerged as a key platform for exploring these exotic, potentially charge-neutral quasiparticles.

Using **high-field heat-capacity measurements** in continuous fields up to **41.5 tesla** at the **MagLab's DC-Field Facility**, researchers directly detected large-amplitude quantum oscillations from bulk, charge-neutral excitations. These measurements are complemented by **magnetization, torque, and resistivity studies at the Pulsed-Field Facility (PFF)**, which track how these excitations evolve to even higher fields. Together, the DC and PFF results show that neutral-fermion quantum oscillations persist through the insulator–metal transition near 45–47 T and give way to a different high-field magnetic state above ~65 T, providing a consistent picture across independent techniques.

This combined approach offers strong evidence for a **neutral Fermi surface** in an insulating state and reveals how it transforms under **extreme magnetic fields**. The work highlights the power of complementary thermodynamic and magnetic-response measurements across MagLab facilities to uncover unexpected forms of quantum matter.

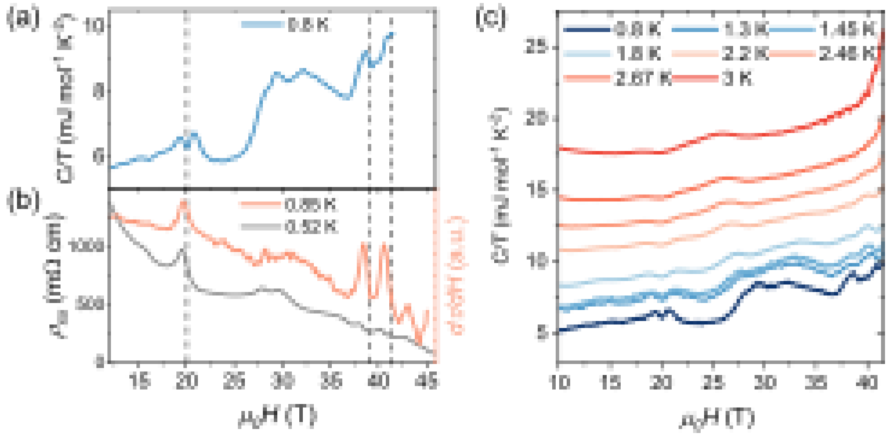


**Figure 1.** High-field heat capacity of $YbB_{12}$ shows a clear double-peak feature near 20 T and well-defined quantum oscillations above 35 T. The left panels display heat capacity versus magnetic field, while the right panel shows the raw C/T data as a function of temperature used to identify these features.

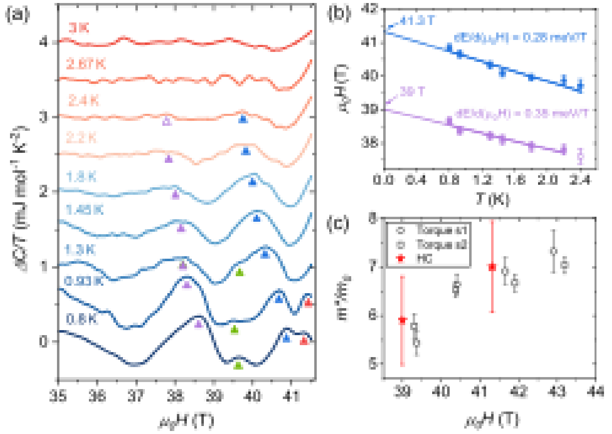


**Figure 2.** Oscillatory component of the heat capacity at several temperatures, obtained after subtracting a smooth background. The field positions of the peaks shift systematically with temperature, enabling determination of the quantum-oscillation frequency and effective masses. These thermodynamic oscillations are consistent with high-field transport and torque measurements.

**Facilities and instrumentation used:** DCFF Cell 12 (35 T) and Cell 6 (41.5 T) - high-resolution nanocalorimetry. Magnetization measurements performed at PFF.

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