

New high-magnetic-field thermometers for sub-millikelvin temperatures

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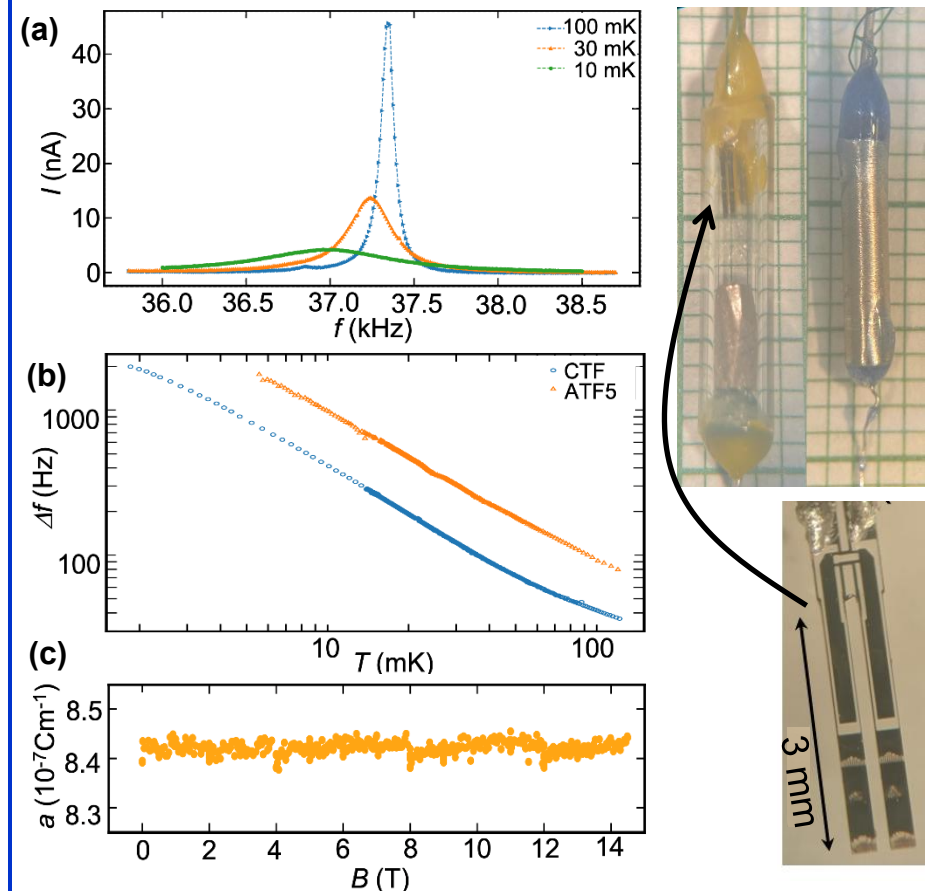


Funding Grants: G.S. Boebinger (NSF DMR-1644779); L. Steinke (MagLab User Collaboration Grant, 2021-2022)

The MagLab's High B/T facility at the University of Florida combines high magnetic fields with the extreme environment of ultra-low temperatures of order 1 mK. Most measurement techniques require adaptations to be successfully performed under these conditions, but specific heat and thermal transport are particularly challenging due to a lack of suitable thermometry. Here, MagLab scientists report progress on developing new thermometers, based on quartz tuning forks in liquid ^3He , that will help realize these heavily-demanded user experiments.

The measurement principle relies on the temperature-dependent viscosity of liquid ^3He , which leads to a temperature-dependent broadening of the Lorentzian vibration resonance curves. Despite being a measurement in liquid, tuning fork thermometers are one of the most promising candidates to realize miniature thermal probes for small solid crystals, since they are scalable to microscopic dimensions and compatible with both high magnetic fields and ultralow temperatures.

The newly developed thermometers will make the high B/T regime accessible to calorimetric and thermal transport measurements, enabling users to study superconductors, quantum critical behavior, quantum spin liquid states, and topological materials under these extreme conditions.



Facilities and instrumentation used: MagLab High B/T facility, Bay 3, University of Florida, Gainesville, FL.

Citation: Andrew J. Woods, Alexander M. Donald, Lucia Steinke, “Developing compact tuning fork thermometers for sub-mK temperatures and high magnetic fields”, arXiv:2107.02387 (2020)