Study on Unconventional Superconductors via Angle-resolved Specific Heat

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Recommended with a Commentary by Al Migliori, Los alamos National Labs.

The usual approaches to the measurement of heat capacity in magnetic field are tied to many experimental details, including the field dependence of thermometers and addenda. For useful heat capacity studies of electronic systems, life is further complicated by the presence of a large, energetic phonon bath at higher (striking distance of the Debye) temperatures. However, the prizes can be considerable, especially for superconducting systems (but not limited to them). In this work, the authors make a wonderfully simple and straightforward run at the variation of electronic density of states via variations in the heat capacity with magnetic field direction relative to crystallographic, AT CONSTANT FIELD. Because temperature and field are held constant while the sample is rotated, only a few nasty effects intrude, such as radiation heating variations with angle, that the authors deal with. The observation of field-direction-modulated specific heat is quite nice, and clearly this paper outlines an approach that should be applied to many systems. Although cyclic variations in specific heat are observed, several caveats apply. For one, at 90K, YBCO data are essentially obscured by noise because of the phonon contributions that dominate (the variations are of order 1%). At 15K things are much nicer in the borocarbides where signal-to-noise is good. It is also clear that this technique cannot, as yet, distinguish between directional dependence and full nodes in the gap. This is not such a big deal, but it is no smoking-gun-test either.

Very much worth reading, and very important for us to corroborate the borocarbide and YBCO data with another test.