Anomalous thermodynamic power-laws at the topologial transition state in nodal superconductors

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The theory of nodal quasiparticles has a wide range of applications, from unconventional superconductors to topological materials and graphene. At low temperatures, their linear dispersion away from a nodal point or line on the Fermi surface (a Dirac point or a Dirac line), leads to a characteristic power-law dependence of the specific heat:

$$\boxed{C_v \sim T^n}$$

In superconductors, such behaviour can be used to detect experimentally whether the order parameter has line nodes (n = 2) or point nodes (n = 3) and therefore to identify the Cooper pairing symmetry.

I will begin this talk by pointing out that other, non-integer exponents are possible when the dispersion of quasi-particles away from the nodes becomes non-linear. I will show that they occur when line nodes cross or near topological transitions where point nodes, line nodes, or line node crossings either appear, disappear or re-configure themselves in a non-trival way on the Fermi surface (e.g., at a nodal-line reconnection transition). Such anomalous exponents thus provide *bulk* thermodynamic signatures of the topological transitions in question – with important experimental implications. I will describe in detail their relevance to the Li2Pt3Pd3-xB series of noncentrosymmetric superconductors.

To conclude, I will show that a material need not be exactly at the topological transition in order for the anomalous exponent to be observed. Indeed the topological transition state holds sway over a large part of the phase diagram, similarly to a quantum critical endpoint (QCEP). I will speculate that this state may be stabilised by an order-by-disorder mechanism. I will propose a novel technological application of the “soft” quasiparticles found in this state.