**Quantum criticality, nodal hybridization and non-trivial topology in β-$YbAlB_4$**

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Emergent phenomena in quantum materials are subject of intense experimental and theoretical research at present. A wonderful example thereof is the heavy fermion material β-$YbAlB_4$ [1]. The experiments have uncovered the quantum critical $T/B$-scaling in β-$YbAlB_4$, proving that it is a quantum critical "strange" metal that occurs at zero magnetic field, without any external tuning [2]. This exotic metallic state further gives rise to an unconventional superconductivity, albeit with a tiny transition temperature $T_c \sim 80$ mK. Here, I will present a theoretical perspective on the quantum critical scaling in β-$YbAlB_4$ and will show that the observed critical exponents can be derived from the nodal structure of the hybridization matrix between Yb $f$-band and the conduction electrons. I will further show that the hybridization possesses a topological structure in $\mathbf{k}$-space – a vortex line – governed by the dispersion $V(\mathbf{k}) \sim (k_x \pm \mathrm{i}k_y)^2$. I will discuss the ramifications of this observation for the possibility of topologically protected surface states in this material. I will also discuss the analogy with the (nodal) topological superconductor $UPt_3$ whose B-phase has a superconducting gap with a similar dispersion $\Delta(\mathbf{k}) \sim k_z (k_x \pm \mathrm{i}k_y)^2$, which we showed leads to the existence of topologically protected Majorana surface states [3].

[1] S. Nakatsuji *et al*., Nature Physics 4, 603 (2008).
[2] Y. Matsumoto *et al.*, Science 331, 316 (2011).
[3] P. Goswami and A. H. Nevidomskyy, arXiv:1403.0924.