Investigation of pressure tuned quantum criticality utilizing thermodynamic probes

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New quantum states of condensed matter are a fascinating research area, which is at the basis of modern solid-state physics. Unconventional phases, such as unconventional superconductivity and non-Fermi liquid phases, are typically observed at low temperatures in regions of competing energy scales, e.g. near a spin-density wave instability. In these regions, only small changes of an appropriate external control parameter, such as hydrostatic or uniaxial pressure pressure, can change the properties of a material fundamentally and lead to the discovery of novel unconventional groundstates.

Here, I will discuss how external pressure can be used as a tool to deliberately tune the groundstate properties of correlated materials to investigate the nature of novel unconventional phases by electrical-transport, magnetic, and thermodynamic probes without introducing additional disorder as in the case of substitution studies.[1]

In Ce-based heavy-fermion materials compression of the unit cell leads generally to a decrease in the magnetic ordering temperature, making hydrostatic pressure an ideal tool to tune the material in a clean way to a quantum critical point.[2,3] At moderate hydrostatic pressures, we are able to deploy complementary experimental probes in order to obtain a comprehensive knowledge of the physical properties of the material. In particular, we can measure absolute values of the specific heat, which provide important insights in thermodynamic properties, which are not available otherwise.

[1] M. Nicklas, *Pressure Probes*, in *Strongly Correlated Systems*, eds. A. Avella and F. Mancini, Springer Series in Solid-State Sciences 180, Springer (2015).

[2] E. Lengyel, M. Nicklas, H. S. Jeevan, C. Geibel, and F. Steglich, *Pressure Tuning of the Interplay of Magnetism and Superconductivity in* $CeCu_2Si_2$, Phys. Rev. Lett. 107, 057001 (2011).

[3] E. Lengyel, M. E. Macovei, A. Jesche, C. Krellner, C. Geibel, and M. Nicklas, *Avoided ferromagnetic quantum critical point in CeRuPO*, Phys. Rev. B **91**, 035130 (2015).