# Mass renormalisation and superconductivity in quantum materials

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Correlated electron systems often display enhanced effective masses of the charge carriers as well as a tendency towards long-range order. Where a continuous phase transition into a magnetically ordered state is suppressed to zero, near a magnetic quantum critical point, anomalous low temperature transport or thermodynamic properties are frequently observed, sometimes accompanied by unconventional superconductivity. This talk will discuss the combination of base-line mass enhancement caused by local interactions and the emergence of long-range interactions near a quantum critical point, with the help of recent examples:

(i) Applied pressure turns the Mott insulator NiS2 into a good metal. We have used high pressure quantum oscillation measurements [1] to track the electronic Fermi surface and carrier mass in the correlated metallic state of pressure-metallized NiS2 up to ~120 kbar.

(ii) The new iron-based superconductor YFe2Ge2 has an unusually high heat capacity Sommerfeld ratio , suggesting strong electronic mass renormalisation. We have resolved the electronic Fermi surface and carrier mass in quantum oscillation measurements. Our findings indicate that the mass enhancement is uniform over the Fermi surface rather than limited to hot spots, suggesting a key role for local (on-site) correlations [2].

(iii) The Kondo lattice system CeSb2 undergoes a pressure-induced structural transition. A heavy fermion state forms within the high-pressure structure. Mapping out its low-temperature phase diagram, we find that CeSb2 superconducts over a narrow pressure range near a magnetic quantum critical point and superconductivity is resilient to magnetic fields that exceed the Pauli limit by nearly an order of magnitude [3].

**References**

[1] Semeniuk, K. *et al,* PNAS e2301456120 (2023)

[2] Baglo, J. *et al,* Phys. Rev. Lett. **129,** 046402 (2022)

[4] Squire, O.P. *et al,* Phys. Rev. Lett. **131,** 026001 (2023)