# Pressure-tuned structural and electronic instabilities in quantum materials

## *F. Malte Grosche*

### Cavendish Laboratory, J J Thomson Avenue, Cambridge CB3 0HE, UK

Many complex materials display an interesting interplay between structural and electronic properties, which can be studied effectively under applied pressure. This talk will discuss recent examples such as:

(i) if a continuous structural phase transition is suppressed to low temperatures (e.g. [1]), low-energy vibrational excitations can arise that boost superconductivity and cause a linearly temperature dependent electrical resistivity.

(ii) In aperiodic high-pressure host-guest structures, such as that found in high-pressure bismuth [2], a low-energy sliding phonon mode is built in. Related findings in high pressure antimony and in Nowotny chimney-ladder phases suggest that strongly damped low-frequency vibrations are essential for thermodynamic and transport properties.

(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] Goh, S. K. et al., Phys. Rev. Lett. **114,** 097002 (2015)

[2] Brown, P. et al., Science Advances **4,** eaao4793 (2018)

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