# The correlated metal on the border of Mott localisation in high-pressure $NiS_2$

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The origin of metallic and insulating behaviour in clean, crystalline solids represents arguably the most fundamental challenge in solid state physics, and its explanation in terms of electronic energy bands is one of the most important results of the 20th century quantum revolution. In many materials, for which single-electron band theory would predict metallic behaviour, the electrostatic repulsion between electrons causes them to lock into an insulating ground state, called Mott insulator. Near the threshold of the Mott insulating state, or interaction induced localisation, metals exhibit a wide range of correlated phenomena, which include various forms of magnetic, orbital and charge order as well as superconductivity at elevated temperatures.

Despite decades of study a central aspect of the phenomenon of Mott localisation, namely the evolution of the electronic Fermi surface and the associated charge carrier mass, has not been resolved experimentally. Whereas photoemission spectroscopy offers superior access to the single electron spectral function over a wide energy range, it cannot distinguish between the incoherent parts of the spectrum and the coherent low energy excitations which contribute to long-lived Landau quasiparticles. These, conversely, can be detected by observing quantum oscillatory phenomena in high magnetic fields, which probe the quasiparticle spectrum directly, making it possible to follow the evolution of the correlated metallic state as Mott localisation is approached.

Detecting quantum oscillations while tuning a clean correlated metal towards and ultimately across the metal-insulator transition by varying applied pressure, without doping or disorder, affords a direct view on evolution of quasiparticle properties within the correlated metallic state. We have observed the electronic Fermi surface and carrier mass on the metallic side of a Mott insulating transition by quantum oscillation measurements in pressure-metallised $NiS_2$ [1]. Our measurements extend to pressures of up to ~120 kbar, demonstrating that high precision probes of transport and magnetic properties can productively complement x-ray and optical experiments at such high pressures. We find that the Fermi surface remains large and that the carrier mass is increasingly renormalised on approaching Mott localisation.

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