Probing electronic correlations of quantum matter at high magnetic fields

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Strong electronic correlations are intimately related to the emergence of a plethora of exotic metallic quantum states such as unconventional superconductivity, electronic-nematic states, charge stripe- and loop order, hidden order and most recently topological states of matter such as skyrmion lattices, topological Kondo insulators and semimetals and chiral superconductors. Here neutron spectroscopy has been tremendously successful probe for understanding the underlying spin correlations, which are thought to mediate many of these ground states.

More recently, we and others have demonstrated that in strongly correlated metals the measurements spin dynamics can be also used to determine the so-called Lindhard susceptibility, which is directly related to the underlying electronic band structure. This provides unique opportunities to study the electronic structure of metallic quantum states at the extremes of high magnetic fields. This is notably so, because angle-resolved photoemission spectroscopy (ARPES) cannot be carried out in magnetic fields, and quantum oscillations measurements do not reveal full electronic structure information. Here I will discuss a few quantum materials that are candidates for such measurements at high-magnetic fields.