凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: **Room 413**, School of Science Bldg. 5 (理学 5 号館 413 号室)

Date: **13:30-15:00**, Wednesday, 5 December 2018

“Quantum oscillations in topological Kondo insulator”

Speaker:

Robert Peters (Condensed Matter Theory Group)

Abstract:

One of the most puzzling recent experimental discoveries in condensed matter physics has been the observation of quantum oscillations in insulating materials SmB6 and YbB12 [1,2]. Our understanding of quantum oscillations is rooted in the existence of a Fermi surface; electron bands, which form the Fermi surface, form Landau levels in a magnetic field. When the magnetic field strength is changed, the energy of these Landau levels changes which lead to an oscillatory behavior in almost all of the observable properties. However, SmB6 and YbB12 are strongly correlated f electron systems for which a gap develops due to a hybridization between conduction electrons and strongly correlated f electrons, and thus a large resistivity at low temperatures can be measured. Thus, we can expect that SmB6 and YbB12 do not possess a Fermi surface, thus there are no electrons, which can form Landau levels close to the Fermi energy. On the other hand, SmB6 and YbB12 are both good candidates for topological Kondo insulator. Naturally, the question arises, if these quantum oscillations can be due to the interplay between non-trivial topology and strong correlations.

We here answer this question by showing results of dynamical mean field theory in a magnetic field for a two dimensional topological Kondo insulator. We demonstrate that the gap closing, described for a noninteracting continuum model with momentum dependent hybridization[3], persists for a topological Kondo insulator on a two dimensional (2D) lattice. Furthermore, we demonstrate that the amplitude of quantum oscillations is strongly enhanced due to correlations, which makes them easily observable in quantities like magnetization and resistivity over a wide range of magnetic fields before the magnetic breakdown occurs.

References:

[1] Tan et al. Science 349, 287 (2015).

[2] Z. Xiang et al. in Science (2018).

[3] Long Zhang et al. Phys. Rev. Lett. 116, 046404 (2016).