$CeRh_2As_2$: locally noncentrosymmetric superconductor

Andrzej Ptok[1]

[1]Institute of Nuclear Physics, Polish Academy of Sciences, W. E. Radzikowskiego 152, PL-31342 Kraków, Poland

The recently discovered heavy fermion $CeRh_2As_2$ compound crystallizes in nonsymmorphic $P4/nmm$ symmetry, which enables the occurrence of topological protection [1]. Experimental results show that this material exhibits unusual behavior, which is manifested by the appearance of two superconducting phases.

During this lecture, we will discuss the role of Rh_2As_2 layers and their impact on the electronic and dynamical properties of the system. The location of Ce atoms between two nonequivalent layers allows for the realization of orbital order. We point out that the electronic band structure around the Fermi level is associated mostly with Ce $4f$ and Rh $4d$ orbitals and suggest the occurrence of the Lifshitz transition induced by an external magnetic field. We discuss also the role played by the f-d orbital hybridization in the electronic band structure.

Additionally, the existing electronic band structure in this material is still under debate. Energy scale occurring in the system can be important for adequate theoretical description of its supercomputing properties. We analyze electronic surface states which can be compared with recently obtained angle-resolved photoemission spectroscopy measurement (ARPES). Additionally, we present the analyses of the hopping parameters obtained from the electronic band structure. The As-Rh layers are characterized by much more significant hopping parameters between atoms than these obtained for the Ce-Ce atoms. This suggests need of a revision of the tight binding model necessary for adequate description of the physical properties of $CeRh_2As_2$.

References

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