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EINLADUNG zum IFP-SEMINAR

Discovery of Superconductivity and Electron-Phonon Drag in the Non-centrosymmetric Semimetal $LaRhGe_3$

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Host: Andrej Pustogow

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Ort: Institut für Festkörperphysik, TU Wien
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Seminarraum DC rot 07 (roter Bereich, 7. OG)

Abstract:

Non-centrosymmetric (NCS) superconductors are theoretically proposed to have a mixture of singlet and triplet pairing in the superconducting state [1]. A novel spin-triplet state in a superconductor can host Majorana fermions, and can open up applications for quantum computing. A NCS superconductor with a strong triplet component can exhibit spontaneous time-reversal symmetry breaking (TRSB) as it enters the superconducting state in zero-field. A key ingredient to realizing triplet superconductivity is strong antisymmetric spin-orbit coupling (ASOC), which is generated by the lack of inversion symmetry and elements with strong spin-orbit interactions. This ASOC splits the degeneracy of spin-up and spin-down bands, which can be directly probed via studies of the de Haas van Alphen (dHvA) effect. One family of materials where this has been demonstrated to occur is the intermetallic germanides La*T*Ge3 (*T*: Co, Rh, Ir) [2], which crystalize in the non-centrosymmetric space group *I*4*mm* and are therefore a promising platform to search for spin-triplet superconductivity.
We have grown large single crystals of $LaRhGe_3$ using a self-flux method for the first time. I present our discovery of Type-I superconductivity in $LaRhGe_3$ with evidence from heat capacity and μSR experiments, with a critical temperature Tc of 0.385 K and critical field H_c of 2.1 mT [3]. Despite the strong ASOC in $LaRhGe_3$, we do not detect any evidence for TRSB across T_c in $LaRhGe_3$ in our zero-field μSR experiment. Our results are consistent with $LaRhGe_3$ being a weak-coupling s-wave superconductor with a dominant singlet pairing. We also characterize the normal state of LaRhGe3 with temperature and field dependent electrical transport. We find a non-saturating magnetroresistance of 3000% at 2 K and 14 T, which is related to electron-hole compensation in $LaRhGe_3$. We comment on semimetallicity and topology from band structure calculations on $LaRhGe_3$, and highlight the Weyl nodal lines protected by the I4mm space group. Finally, we find that above the onset of superconductivity, LaRhGe3 exhibits an unusual temperature dependence in its resistivity, $\rho \sim T^3$, suggestive of possible non-Fermi liquid behavior. We utilize Raman spectroscopy to study the phonons in $LaRhGe_3$ at low temperature.

[1] E. Bauer & M. Sigrist Non-Centrosymmetric Superconductors: Introduction and Overview (Springer, 2012).
[2] T. Kawai et al., JPSJ 77, 064717 (2008).
[3] M. Oudah, et al., in preparation.