TT 16: Symposium “50 Years BCS Theory”

Time: Tuesday 18:00–20:00 Location: H20

TT 16.1 Tue 18:00 H20

BCS theory of a neutral Fermi liquid: the superfluid phases of Helium 3 — •Peter Woelfle — Institut f. Theorie der Kondensierten Materie, Universitaet Karlsruhe, 76128 Karlsruhe

The superfluid phases of Helium 3 are described in the framework of BCS theory with Cooper pairs of angular momentum L=1 and spin S=1. The necessary attractive interaction is mediated by intrinsic fluctuations of spin and mass current. The internal structure of the Cooper pairs allows for the existence of several different phases featuring a broad spectrum of excitations (nuclear spin resonance, zero sound, pair vibrations, vortices). Of particular interest is the existence of textures of the order parameter preferred directions, providing a background for unusual fermionic excitations. Analogies in the behavior of the superfluid A-phase with problems of current interest in elementary particle physics (chiral anomaly) and cosmology (Kibble-Zurek mechanism) may offer new insights to be gained from Helium laboratory experiments.

TT 16.2 Tue 18:30 H20

Unconventional BCS States in Heavy-Fermion Superconductors — •Frank Steglich — Max Planck Institute for Chemical Physics of Solids, Dresden, Germany

Heavy-fermion (HF) superconductivity (SC) discovered in 1979 often occurs in the vicinity of an antiferromagnetic (AF) quantum critical point (QCP). Here, we concentrate on the prototypical HF compound $CeCu_2Si_2$, whose phase diagram also contains ‘phase A’, an ordinary spin density wave (SDW) with very small ordered moment. Application of low pressure was found to smoothly suppress ‘phase A’ and to establish an antiferromagnetic (AF) QCP of (3D) SDW type. A narrow superconducting dome centered around this QCP exists in the T-p phase diagram of $CeCu_2Si_{1.8}Ge_{0.2}$ - similar to what was discovered earlier for $CePd_2Si_2$ [Mathur et al. (1998)]. Different from its Pd homologue, however, $CeCu_2Si_{1.8}Ge_{0.2}$ exhibits a second superconducting dome, coinciding with a weak valence transition near $p = 5$ GPa. Because of the low-lying critical end point of the first-order valence transition line, SC under this high-p dome is likely to be mediated by charge-density fluctuations [Miyake et al. (1999)]. Here, we discuss experimental evidence for HFSC in $CeCu_2Si_2$ under the low-p dome to be due to AF quantum critical paramagnons, as first proposed in the case of $CePd_2Si_2$. The lack of SC in the isostructural quantum critical material $YbRh_2Si_2$ will also be addressed.
Work done in collaboration with: P. Gegenwart, C. Geibel, F.M. Grosche, S. Jeevan, M. Loewenhaupt, O. Stockert, S. Wirth and H. Q. Yuan.

TT 16.3 Tue 19:00 H20

Hochtemperatur-Supraleitung: Ein Beispiel für die BCS-Idee? — •Werner Hanke — Institut für Theoretische Physik & Astrophysik, Universität Würzburg

Der Vortrag gibt einen Überblick über den aktuellen Stand der mikroskopischen Theorie der Paarbildung und Supraleitung in den Hoch-Tc Materialien(HTSL). Ausgehend von grundlegenden Experimenten wird die Frage diskutiert, inwieweit die BCS-Idee in diese Theorie eingeht, bzw. diese Idee, auf Grund zum Beispiel der starken Korrelationen der Ladungsträger und der damit verbundenen eventuellen Aufhebung des Quasiteilchen-Bildes, entscheidende Korrekturen erfährt.

TT 16.4 Tue 19:30 H20

Strolling through and beyond the Fields of BCS — •Jochen Mannhart — Universität Augsburg, EKM, Institut für Physik

The BCS-model has proved to be a powerful approach for describing key aspects of low- and high-temperature superconductivity as well as of superfluidity. The theory is brilliant in its success and has been understood in fantastic detail.

Emphasizing the power of BCS, we shall show that the BCS-theory predicts the electron systems of the high-temperature superconductors to display extraordinary and surprising collective phenomena which are as yet unknown in superconductivity.

We will also discuss current and possibly future trends in superconductivity which push the physics far beyond the BCS-limits and open vast, new ranges.

The work to be presented was performed together with Y.S. Barash, G. Hammerl, F. Loder, A. Kampf, T. Kopp, and C.W. Schneider.