Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

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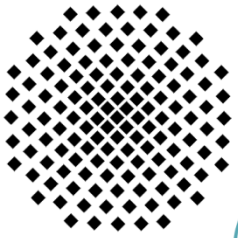

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High temperature conventional superconductivity

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Abstract

Superconductivity is a fascinating phenomenon. In 1957, the Bardeen-Cooper-Schrieffer (BCS) theory revealed its nature. The key ideas are the pairing of electrons and their Bose condensation. The theory allows in principle room temperature superconductivity, however, BCS superconductivity remained to be low temperature phenomenon. Only in 2015, this major prediction of BCS theory was confirmed with the discovery of superconductivity at 203 K in hydrogen sulfide H3S under high pressures of about 150 GPa. Then superconductivity at nearly room temperatures of 250-260 K in LaH_{10} and of 243 K in YH_9 was found, also at high pressures. These materials with a high content of hydrogen — “superhydrides” can be considered as a close realization of superconducting metallic hydrogen. The conventional BCS superconductivity in superhydrides is well established by proving zero resistance, screening of magnetic field, trapped flux, its persistence with time, isotope effect, IR reflection, X-ray diffraction studies of the structure, and an excellent agreement with theory. In the present talk, I will emphasize our recent studies of the magnetic properties of the superhydrides. We developed SQUID magnetometry that allowed us to determine a London penetration depth and other parameters in H3S and LaH10. We established that these compounds belong to the group of “moderate” type II superconductors. The trapped magnetic flux gave us further insight into the nature of these superconductors.

I will discuss in detail the further possible increase of superconductivity to room temperature and above at high pressures, and progress in high temperature superconductivity at ambient pressure.