www.physik.uni-stuttgart.de/aktuelles/kolloquium

Stuttgarter Physikalisches Kolloquium

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

Ansprechpartner: Andreas Schnyder
E-Mail: A.Schnyder@fkf.mpg.de
Telefon: 0711 689-1553

Dienstag, 1. Februar 2022 | **16.15 Uhr** | **Hörsaal 2D5**

Stuttgarter Max-Planck-Institute, Heisenbergstraße 1, 70569 Stuttgart-Büsnau

High temperature conventional superconductivity. Seven-year journey.

Mikhail I. Eremets
Max Planck Institute for Chemistry, Mainz

Abstract

There is dramatic progress in conventional superconductivity since hydrogen sulfide with the critical temperature T_c =203 K was discovered under high pressures of about 150 GPa [1]. Many other superconductors were found some of them even at higher temperatures and high pressures: with T_c =243 K in YH_9 [2], 250-260 K in LaH_{10} [3,4], and 287 K in carbonaceous hydrogen sulfide [5]. Two main structures of the superconducting hydrides were discovered. Most of the high temperature hydrides have a cage-like structure. In particular, in lanthanum hydride LaH_{10}, La atom is located at the center of the cage of hydrogen atoms. The lanthanum atom acts as an electron donor contributing to electron pairing, while the hydrogen atoms form weak covalent bonds with each other within the cage. This and other superhydrides (YH_9, CaH_6) can be considered as a close realization of superconducting metallic hydrogen [6]. The second structure realized in H_3S^1 is different: here each hydrogen atom is connected by a strong covalent bond to the two nearby sulfur atoms. The strong bonding provides large electron-phonon coupling and enhanced superconductivity. The covalent metals are perspective ambient pressure superconductors. We will discuss different ways for further increase of T_c at high and ambient pressures.

[1] Drozdov, A. P., Eremets, M. I., Troyan, I. A., Ksenofontov, V. & Shylin, S. I. Conventional superconductivity at 203 K at high pressures. *Nature* **525**, 73 (2015).
[2] Kong, P. P. *et al.* Superconductivity up to 243 K in yttrium hydrides under high pressure. *Nature Comm.* (2021).
[3] Drozdov, A. P. *et al.* Superconductivity at 250 K in lanthanum hydride under high pressures *Nature* **569** 528 (2019).
[4] Somayazulu, M. *et al.* Evidence for Superconductivity above 260 K in Lanthanum Superhydride at Megabar Pressures. *Phys. Rev. Lett.* **122** 027001 (2019).
[5] Snider, E. *et al.* Room-temperature superconductivity in a carbonaceous sulfur hydride. *Nature* (2020).
[6] Ashcroft, N. W. Metallic hydrogen: A high-temperature superconductor? *Phys. Rev. Lett.* **21**, 1748-1750 (1968).