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Seminar Room IV, CFEL (Bldg. 99, 01.111)

CFEL SCIENCE

Max Planck Research Department for Structural Dynamics

SEMINAR

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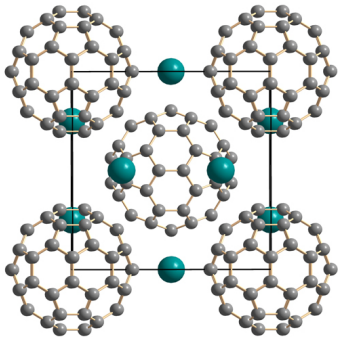
When Sir Mott meets Bardeen-Cooper-Schrieffer. Correlated Superconductivity mediated by phonons in alkali fullerides.

High-temperature superconductivity in Cs-doped fullerides challenges the distinction between conventional electron-phonon superconductors and strongly correlated materials. Despite the "conventional" phononic origin of pairing, the phase diagram of these compounds as a function of pressure indeed reflects that of the cuprates as a function of doping, with a superconducting "bell" flanked by an antiferromagnetic state [1].

The similarity is not accidental and descends from a key-role of electron-electron correlations in fullerene-based materials. We have shown that the properties of this compound, and of the whole family of trivalent fullerides, can be understood in a unifying framework by solving a model including strong Hubbard interactions and Jahn-Teller electron-phonon coupling [2]. This shows that phononic pairing can actually be favored by correlations leading to a phase diagram which has been experimentally confirmed [3].

We propose several methods to further verify the role of electronic correlations, from a peculiar behavior of the optical spectra and of the kinetic energy to a pseudogap in the normal state. Since phonon pairing in this compound involves spin degrees of freedom, a central role of spin entropy is expected, in analogy with unconventional magnetic driven superconductors [2]. The behavior of the superconductor-insulator line as a function of temperature represents a test of this observation.

The analogies and difference with aromatic molecular superconductors such as doped picene are briefly discussed [4].



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[1] Y. Takabayashi, et al., Science 2009, 323, 1585
[2] M. Capone et al., Rev. Mod. Phys. 81, 943 (2009)
[3] M. Capone et al. Science 296, 2364 (2002)
[4] G. Giovannetti and M. Capone, Phys. Rev. B 83, 134508 (2011)

Host: Andrea Cavalleri, MPSD-CFEL