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EINLADUNG zum IFP-SEMINAR

Exotic s-wave superconductivity in fullerides induced by unusual cooperation between electron correlation and phonons

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Host:	Karsten Held, Jan Tomczak
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Ort:	Institut für Festkörperphysik, TU Wien Wiedner Hauptstraße 8-10, 1040 Wien Seminarraum FH gelb 09 (gelber Bereich, 9. OG)
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The alkali-doped fullerides (A3C60, A = K, Rb, Cs) show the highest superconducting transition temperature Tc (around 40 K) among molecular solids. In the phase diagram, s-wave superconductivity (SC) lies next to Mott insulating phase. This adjacency is similar to the cuprates (d-wave SC) but is more surprising because s-wave SC is believed to be severely suppressed by strong correlations.

In the first part of the talk, I will talk about first principles study on the equilibrium phase diagram [1,2]. A fully ab initio calculation shows that the fullerides are unique multi-orbital systems with an effectively negative exchange interaction (negative J) and a strongly repulsive Hubbard U. We show that this unusual form of intramolecular interaction leads to a surprising cooperation between the strong correlations and phonons in the s-wave pairing, in stark contrast to the conventional phonon mechanism.

In the second part of the talk, I will present recent results which study the effect of several perturbations on SC in three-orbital negative-J Hubbard model. The study is motivated by a recent remarkable report on the SC-like nonequilibrium optical property in K3C60 at a temperature much higher than the equilibrium transition temperature [3]. I will show that an asymmetric form of Coulomb interaction can enhance superconductivity and that this asymmetric interaction can be realized by the pumping of T1u phonons [4].

Finally, I will show that effective negative exchange interaction (J<0) can induce orbital freezing phenomenon [5], in contrast with the spin freezing induced by positive J. The top of the Tc dome in doped two-orbital model is found to coincide with the maximum of orbital fluctuation associated with the crossover from normal metal to orbital-frozen bad metal, confirming the importance of orbital fluctuation in superconductivity.

[1] Y. Nomura et al., Science Advances 1, e1500568 (2015)
[2] Y. Nomura et al., J. Phys.: Condens. Matter 28, 153001 (2016)
[3] M. Mitrano et al., Nature 530, 461 (2016)
[4] M. Kim et al., arXiv:1606.05796
[5] K. Steiner et al., Phys. Rev. B 92, 115123 (2015)