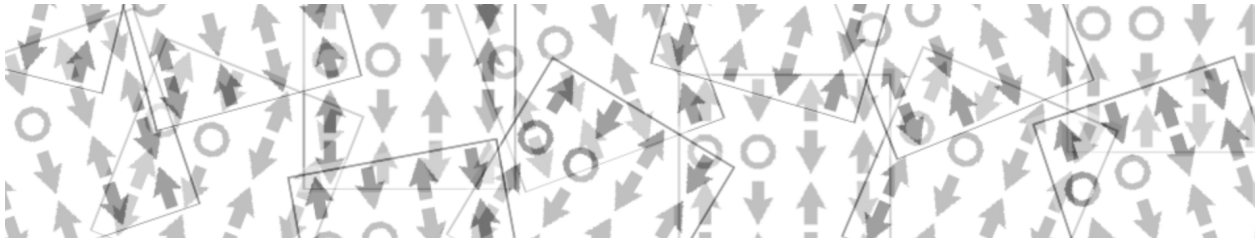
Department of Theoretical Physics F-1 and Department of Complex Matter F-7,
Jožef Stefan Institute



Seminar: November 19 (2019) at 11:15, Seminar room for physics

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High-Tc cuprates — story of two electronic subsystems

The high-Tc cuprates are amongst the most intensively studied correlated materials. Nevertheless, pivotal questions regarding their principal phases and regimes, as well as the transitions between them, remain unanswered. This is, largely, due to the complexity of these materials that renders the extraction of intrinsic properties difficult. We have performed a thorough experimental study of $HgBa_2CuO_{4+\delta}$, which, in many respects, is a model cuprate compound. From the comparison of our measurements with data for other cuprates, we are able to separate universal behavior from compound-specific features. This exercise leads to a series of remarkable findings, the most important of which are that the effective mass and the scattering rate remain essentially unchanged across the phase diagram [1,2], and that the scattering rate is dominated by an umklapp process [3]. These novel insights enabled an accurate count of charges across the phase diagram. The electronic system is thus found to consist of 1+p charges, where p corresponds to doping. At low dopings, within the pseudogap regime, exactly one hole is localized per planar copper-oxygen unit. Upon increasing doping and temperature, the hole is gradually delocalized and becomes itinerant [4]. The overall behaviors are consistent with a gradual extension of Fermi arcs to a full Fermi surface, without an essential change of the underlying Fermi surface that encloses 1+p states. Finally, we have established that the itinerant Fermi-liquid holes become superconducting while the localized hole provides the glue.

[1] N. Barišić *et al*, New J. Phys. 21, 113007 (2019)
[2] Li *et al*, Phys. Rev. Lett. 117, 197001 (2016)
[3] N. Barišić *et al*, Proc. Natl. Acad. Sci. 110, 12235 (2013); S. I. Mirzaei *et al*, Proc. Natl. Acad. Sci. 110, 5774 (2013); M. Chan *et al*, Phys. Rev. Lett. 113, 177005 (2014); P. Popčević *et al*, Quantum Mater. 3, 42 (2018)
[4] D. Pelc *et al*, Sci. Adv. 5, eaau4538 (2019)