From quantum oscillations to charge order in high-Tc copper oxides

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Résumé

25 years after the discovery of high temperature cuprate superconductors, the observation of quantum oscillations [1] has deeply changed the theoretical landscape relevant to these materials. The measurements of quantum oscillations on both sides of the phase diagram of cuprates confirm the existence of a Fermi surface with sharply defined excitations on the overdoped side but also show that the Fermi surface has suffered a drastic modification on the underdoped side. The small Fermi pocket inferred from quantum oscillations in the underdoped regime combined with the negative Hall and Seebeck coefficients pointing to an electron pocket greatly strengthens the case that the Fermi surface of YBa_2Cu_3O_y undergoes a reconstruction because the translational symmetry of its lattice is broken at low temperature.
Many studies such as NMR measurements [2], x-ray scattering [3] point to a reconstruction of the Fermi surface due to charge order. In this talk, I will briefly provide the context for charge order in underdoped cuprates and I will present sound velocity measurements, a thermodynamic probe, in magnetic fields large enough to suppress superconductivity at low temperature. We provide the first thermodynamic signature of the competing charge order phase transition in YBa_2Cu_3O_y allowing construction of a field-temperature phase diagram. The comparison of different acoustic modes indicates that the charge modulation is bi-axial [4]. Tentative theories linking the charge order to the pseudogap phase in cuprates will be discussed.

N. Doiron-Leyraud *et al*, *Nature* **447**, 565 (2007)

T. Wu *et al*, *Nature* **477**, 191 (2011)

G. Ghiringhelli *et al* , *Science* **337**, 821 (2012) / J. Chang *et al*, *Nature Physics* **8**, 871 (2012)

D. LeBoeuf *et al*, *Nature Physics* **9**, 79 (2013)

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