MAR08-2007-002313

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

**Fermi surface of underdoped cuprate revealed by quantum oscillations and Hall effect**

CYRIL PROUST, Laboratoire National des Champs Magnétiques Pulsés (CNRS)

Despite twenty years of research, the phase diagram of high temperature superconductors remains enigmatic. A central issue is the origin of the differences in the physical properties of these copper oxides doped to opposite sides of the superconducting region. In the overdoped regime, the material behaves as a reasonably conventional metal, with a large Fermi surface [1]. The underdoped regime, however, is highly anomalous and appears to have no coherent Fermi surface, but only disconnected 'Fermi arcs' [2]. We have reported the observation of quantum oscillations in the electrical resistance of the oxygen-ordered copper oxides $YBa_2Cu_3O_{6.5}$ [3] and $YBa_2Cu_4O_8$ [4], establishing the existence of a coherent closed Fermi surface at low temperature in the underdoped side of the phase diagram of cuprates, once superconductivity is suppressed by a large magnetic field. The low oscillation frequency reveals a Fermi surface made of small pockets, in contrast to the large cylinder characteristic of the overdoped regime. Moreover, the negative sign of the Hall effect at low temperature reveals that these pockets are electron-like rather than hole-like. We propose that the Fermi surface of these Y-based cuprates consists of both electron and hole pockets, probably arising from a reconstruction of the FS [5]. Work in collaboration with N Doiron-Leyraud, D. LeBoeuf and L. Taillefer from the University of Sherbrooke, J. Levallois and B. Vignolle from the LNCMP, A. Bangura and N. Hussey from the University of Bristol and R. Liang, D. Bonn, W. Hardy from the University of British Columbia.

[1] N Hussey et al, *Nature* **425**, 814 (2003)
[2] M. Norman et al, *Nature* **392**, 157 (1998)
[3] N. Doiron-Leyraud et al, *Nature* **447**, 565 (2007)
[4] A. Bangura et al, submitted to *Phys. Rev. Lett* (arXiv: 0707.4461)
[5] D. LeBoeuf et al, *Nature* **450**, 533 (2007)