The pseudogap critical point of cuprate superconductors

Louis Taillefer[1,2,3]

[1] *Institut Quantique, Sherbrooke, Canada*
[2] *Université de Sherbrooke, Sherbrooke, QC, Canada*
[3] *Canadian Institute for Advanced Research*

Email: louis.taillefer@usherbrooke.ca

By suppressing superconductivity with a large magnetic field, we have investigated the metallic ground state of several cuprate superconductors in the $T = 0$ limit (YBCO, Bi2212, LSCO, Nd-LSCO, Eu-LSCO), via measurements of resistivity, Hall and Seebeck coefficients, thermal conductivity and specific heat. We observe a sharp transition at a critical doping p^*, into the enigmatic pseudogap phase (red dot in Figure below). The key signature is a drop in carrier density n from $n = 1 + p$ above p^* to $n = p$ below p^* [1,2], signalling a major transformation of the Fermi surface. At p^*, we observe the classic signatures of quantum criticality : the electrical resistivity is linear in T at low T, the electronic specific heat C_{el} shows a sharp peak at p^*, where it varies in temperature as $C_{el} \sim -T \log T$.

Understanding the mechanisms responsible for these various signatures will help elucidate the nature of the pseudogap phase.

Work done in collaboration with: S.A.A. Afshar, P. Auban-Senzier, S. Badoux, J. Béard, S. Benhabib, D.A. Bonn, P. Bourgeois-Hope, C. Collignon, O. Cyr-Choinière, H. A. Dabkowska, D. Destraz, M. Dion, N. Doiron-Leyraud, M. Dragomir, P. Fournier, B.D. Gaulin, C. Girod, G. Grissonnanche, W.N. Hardy, J. Kačmarčík, T. Klein, T. Kurosawa, F. Laliberté, A. Legros, S.Y. Li, Z.Z. Li, R. Liang, S. Licciardello, Q. Ma, C. Marcenat, B. Michon, N. Momono, C. Proust, S. Pyon, H. Raffy, W. Tabis, H. Takagi, T. Takayama, S. Verret, B. Vignolle, D. Vignolles, S. Wiedmann, K. Yamada, and J.-S. Zhou.

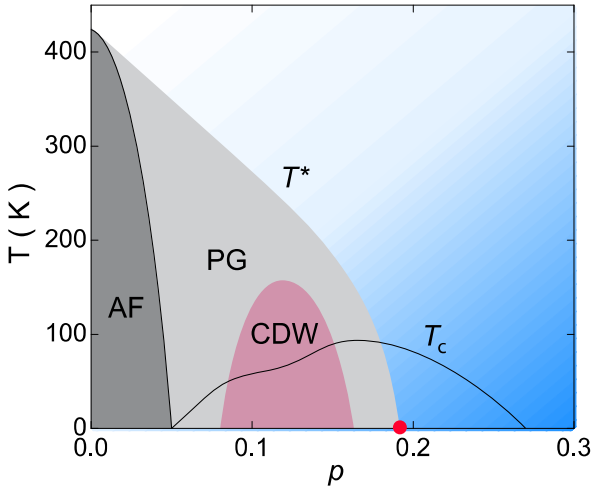

Figure. Schematic temperature-doping phase diagram of a hole-doped cuprate superconductor, once superconductivity has been removed by application of a large magnetic field. The zero-field critical temperature T_c is shown as a dotted line. The focus of this talk is the pseudogap (PG) phase (in grey), which ends at a critical doping p^* (red dot). The phase of charge-density-wave (CDW) order (in burgundy) is peaked at $p \sim 0.12$ and it ends before p^*.

References

[1] Badoux S et al 2016 *Nature* 531, 210
[2] Collignon C et al 2017 *Physical Review B* 95, 224517