Decrease of pairing strength with underdoping in cuprate superconductors

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The transition temperature $T_c$ of cuprate superconductors decreases at low hole doping $p$, but it is still unclear whether the pairing strength decreases or increases. Different interpretations of the pseudogap lead to opposite conclusions. Different estimates of the upper critical field $H_{c2}$ are in sharp contradiction. In this talk, we resolve the latter contradiction by showing that superconducting fluctuations in the underdoped cuprate Eu-LSCO, measured via the Nernst effect, obey the theory of Gaussian fluctuations, as in conventional superconductors [1, 2]. The extracted critical field $H_{c2}$ is small, and it dips at $p = 0.11$, showing that pairing strength is weak where stripe order is strong. In the archetypal cuprate superconductor YBCO, $H_{c2}$ extracted from other measurements [3] has the same doping dependence, also with a minimum at $p = 0.11$, again where stripe order is present [4, 5]. We conclude that competing states such as stripe order weaken the pairing strength and this, rather than phase fluctuations, is the predominant cause for the low $T_c$ of underdoped cuprates. Work done in collaboration with N. Doiron-Leyraud, E. Hassinger, J.-Ph. Reid, O. Cyr-Choinière, F. Laliberté, R. Daou, S. Pyon, T. Takayama, H. Takagi, and Louis Taillefer.