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Distinct Ranges of Superconducting Fluctuations and Pseudogap in $YBa_2Cu_3O_{6+x}$

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The contribution of superconducting fluctuations (SCF) to the ab-plane conductivity has been determined accurately in a series of $YBa_2Cu_3O_{6+x}$ single crystals using high magnetic fields to restore the normal state behavior [1]. This allows us to determine within the same set of transport measurements both the field $H'_c(T)$ and the temperature T'_c above which the SCFs are fully suppressed, and the pseudogap temperature $T^\star$. A careful investigation near optimal doping shows that $T^\star$ becomes smaller than T'_c, which unambiguously evidences that the pseudogap cannot be assigned to preformed pairs [2]. In the nearly optimally doped samples, the SCF contribution to conductivity can be accounted for by Gaussian Aslamazov-Larkin fluctuations in the Ginzburg-Landau approach [3]. A phase fluctuation contribution might be invoked in the most underdoped sample in a T range which increases when controlled disorder is introduced by electron irradiation. The analysis of the fluctuation magnetoconductance allows us to determine the critical fields $H_{c2}(0)$ which are found to be very similar to $H'_c(0)$ and to increase with hole doping. These two depairing fields which are directly connected to the magnitude of the superconducting gap therefore follow the evolution of T_c, which is at odds with the sharp decrease of the pseudogap with increasing hole doping.

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