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Linear- T scattering and pairing from spin fluctuations in organic superconductors

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The (TMTSF)₂X series of organic superconductors, with X=PF₆ or ClO₄, are clean single-band metals that exhibit unconventional superconductivity in the vicinity of a pressure-induced spin-density wave (SDW) quantum critical point. As such, they epitomize the interplay between magnetism and superconductivity observed in heavy fermion, cuprate, and iron-pnictide superconductors. We have recently examined the electrical resistivity $\rho(T)$ of (TMTSF)₂X materials as a function of temperature and pressure. At the SDW quantum critical point, we observed a strictly linear temperature dependence of the resistivity over two decades in temperature [1,2]. Moving away from SDW order with increasing pressure, this linear resistivity was found to decrease in parallel with the weakening superconductivity, such that A , the coefficient of the linear contribution to $\rho(T)$, directly correlates with the superconducting T_c [1,2]. This shows that linear- T scattering and superconducting pairing share a common origin. A similar correlation was also found between A and the spin fluctuations seen by NMR experiments [2]. Owing to the quasi-1D nature of the (TMTSF)₂X system, this connection between spin fluctuations, scattering, and superconductivity is well described theoretically by a model that considers the hitherto overlooked mutual reinforcement of SDW and pairing correlations [3]. In particular, the feedback of pairing correlations on SDW fluctuations appears to be decisive for the strength of the linear resistivity and its extent in temperature and pressure. The fact that the same empirical correlation between linear- T resistivity and T_c is observed in the hole-doped [4,5] and electron-doped [6] cuprates, as well as in iron-pnictides [1,4], shows that the same mechanism is at play in these materials. This points to a common, magnetic origin to the superconducting pairing. Work done in collaboration with S. René de Cotret, P. Auban-Senzier, D. Jérôme, C. Bourbonnais, K. Bechgaard, and L. Taillefer.

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