Superconductivity in Organic Conductors at Low and High Magnetic Fields

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Several criteria must be met in order that singlet superconductors survive to fields greater than the Pauli paramagnetic limit H_P where inhomogeneous (Fulde-Ferrell-Larkin Ovchinnikov, FFLO) superconducting phases might be observed. Among these, the system must be in the clean limit and magnetic field-induced orbital suppression of superconductivity has to be avoided. These conditions apply to a number of organic superconductors, including the quasi-one dimensional $(TMTSF)_2X$, and the quasi-2D κ-$(BEDT\text{-}TTF)_2Cu(NCS)_2$. In both cases, the interlayer coherence length is sufficiently small that orbital coupling is diminished for in-plane fields, and superconductivity is observed to survive to fields significantly exceeding H_P. In the case of (TMTSF)2X, triplet spin pairing, at least at high fields, is a possible explanation. Nevertheless, both systems are candidates for the observation of the FFLO state. The local spin susceptibility is probed with ^{77}Se NMR measurements for $(TMTSF)_2ClO_4$ and ^{13}C for κ-$(BEDT\text{-}TTF)_2Cu(NCS)_2$. The inferred distribution of hyperfine fields, as well as the field dependence of the relaxation rate, are discussed in this context. For the quasi-1D system, there is evidence for a rapid change from small spin susceptibility χ_s to that expected for the normal state at $H \sim H_P$. Experiments for the quasi-2D material are ongoing.

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