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Self-adaptive Behavior of a Quasi-one-dimensional Organic Superconductor $(TMTSF)_2PF_6$

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The Quasi-one-dimensional organic salts $(TMTSF)_2PF_6$ is a strongly correlated system, renowned for its remarkably rich physical properties. These properties range from an insulating to a superconducting phase, depending on applied pressure, magnetic field, and temperature. Among the related phenomena are: the quantum Hall effect associated with field induced spin density wave transition, a non-Fermi liquid behavior, an angular-dependent electronic ground state which is coupled to a magic angle effect and a possible spin triplet superconductivity. We have studied simultaneous nuclear magnetic resonance and electrical transport in the pressure range near the border of the antiferromagnetic spin density wave (SDW) and the metallic/superconducting phases. Measurements indicate that there exist macroscopic domains of SDW and metallic/superconducting regions with little influence on each other, thereby eliciting strong hysteretic effects in temperature and magnetic field as the volume fraction of the antiferromagnetic insulating phase changes. As pressure is reduced toward a critical pressure, there also present a strong enhancement in the upper critical field (H_{c2}) and a strong upward curvature in H_{c2} vs temperature. The picture which is emerging for the macroscopic coexisting (domain) regime is the near-degeneracy of SDW and superconductor and ability to rearrange the interface between the two phases under applied magnetic fields. A simple model based on self-consistently dividing the superconductor into thin layers will be discussed.

keywords : quasi-one-dimensional organic superconductor, coexisting phase, unusual superconductivity