Antiferromagnetic and superconducting orders in quasi-one-dimensional organic conductors

Claude Bourbonnais[1], Abdelouahab Sedeki[1]

[1]*Regroupement Québécois des Matériaux de Pointe (RQMP), Département de physique Université de Sherbrooke, QC, Canada J1K-2R1*

The Bechgaard salts series $(TMTSF)_2X$ (X=PF_6, ClO_4, ...) of organic conductors stands out as among the first superconductors showing a proximity between antiferromagnetism and superconductivity in their phase diagram under pressure **[1]**. The amplitude of spin correlations in the metallic state, as probed by the enhancement of NMR spin relaxation rate $1/T_1$ and linear-T resistivity, shows a remarkable correlation with the size of the superconducting T_c. Both features are captured from the renormalization group theory for the repulsive quasi-one-dimensional electron gas model **[2]**. In this work, we show how this approach can describe the interplay between the two interfering orders, and how this contributes to both the emergence of a Curie-Weiss type of enhancement for $1/T_1$ and an electron-electron scattering rate and electrical resistivity linear in temperature. The results are found to be in excellent agreement with a recent detailed experimental investigation of electrical transport of these materials **[1]**, which have established that the anomalous $1/T_1$ enhancement and linear-T resistivity are intimately linked to magnetism and the onset of superconductivity under pressure.

[1] N. Doiron-Leyraud et al., Phys. Rev. **80**, 214531 (2009)

[2] C. Bourbonnais and A. Sedeki, Phys. Rev. **80**, 85105 (2009); A. Sedeki, D. Bergeron and C. Bourbonnais, to be published (2010).