NEW SOLITON-WALL PHASE NEAR ANTIFERROMAGNETIC QUANTUM CRITICAL POINT IN THE BECHGAAD SALTS

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Introduction

Phase diagram of the Q1D organic salt $(TMTSF)_2PF_6$ revealed coexistence of a spin density wave (SDW) and superconductivity (SC) near the critical pressure, p_{cr}, that destroys SDW-phase. The standard renormalization group analysis is not applicable here because for an antiferromagnetism with nesting features no expansion in a form of the Landau free energy functional is possible at T=0[1]. Recently the question regarding the specific features for such a critical point (QCP) has been resolved experimentally [2]. Namely, the transition between SC and SDW states turned out to be of the 1st order, i.e., quantum fluctuations seem not to play a decisive role near p_{cr}.

Results and Discussion

The most unexpected finding in [2] was the discovery of a pressure interval below p_{cr} where SDW and the metal phases (or SDW and SC phases, at lower temperatures) coexist in a form of parallel domains running perpendicular to the chain direction. We proposed [3] that such domain superstructure can be interpreted as formation of a new phase of the soliton walls suggested by one of us in [4]. We constructed the phase diagram in the (T,p)-plane that is in the qualitative agreement wit the experiments[2].

Conclusions

It is shown that in the vicinity of QCP in Q1D materials, such as the Bechgaard Salts, one meets with a new soliton wall phase. If pressure would gradually increased from p=0, one first crosses at some p_1 the line of the second order transition and enters into the periodic soliton structure, until, at p_{cr} ,the system goes over into the metallic state through the 1st order transition. Details of the phase diagram and the soliton-wall phase strongly depend on details of the anisotropy of the electron spectra, i.e., on the transverse tunneling integrals between the chains.

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References

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