

Invited: QMBS-I-03

Phase diagram of one-dimensional $t - J$ model with long-range dipolar interactions

Chen Cheng^{1,2}, Bin-Bin Mao¹, Fu-Zhou Chen¹, Hong-Gang Luo^{1,2}

1.Center of Interdisciplinary Studies & Key Laboratory for Magnetism and Magnetic Materials of the Ministry of Education, Lanzhou University, Lanzhou 730000, China

2. Beijing Computational Science Research Center, Beijing 100084, China

We study systematically the effect of long-range dipolar interactions on the ground-state phase diagram of one-dimensional $t - J$ model [1] by means of density matrix renormalization group[2]. While the basic phases described by the Luttinger parameter K_ρ , namely, the repulsive Luttinger liquid (metallic phase, $K_\rho < 1$), attractive Luttinger liquid (superconducting phase, $K_\rho > 1$), and the phase separation ($K_\rho \rightarrow \infty$) are similar to those of the conventional $t - J$ model[3], the presence of the long-range dipolar interactions leads to significant differences. (i) At high density regime, the phase boundaries of these three phases are pushed to even large- J region; At low density regime, (ii) these phase boundaries shift toward small- J region and most importantly (iii) the spin-gap region spreads across the boundary of $K_\rho = 1$, suggesting an exotic metallic phase with spin gap, which is absent in the conventional $t - J$ model[3]. The result indicates that the long-range dipolar interactions have a significant influence on the ground-state properties of the one-dimensional $t - J$ model. Its implication on the pseudogap phenomenon of the hole-doped cuprates is briefly discussed.

References:

1. C. Cheng, B.-B. Mao, F.-Z. Chen, and H.-G. Luo, EPL 110 37002 (2015).
2. S. R. White, Phys. Rev. Lett. **69**, 2863 (1992).
3. A. Moreno, A. Muramatsu, and S. R. Manmana, Phys. Rev. B 83, 205113 (2011).