Negative charge compressibility induced by fluctuations near a charge-ordering transition

Kazuyoshi Yoshimi[1], Takeo Kato[2], and Hideaki Maebashi[2]
[1] *College of Liberal Arts and Sciences, Tokyo Medical and Dental University, Japan*
[2] *Institute for Solid State Physics, University of Tokyo, Japan*
Email: yoshimi@issp.u-tokyo.ac.jp

Among a variety of phase transitions appearing in organic conductors, charge-ordering (CO) phenomena have recently attracted much attention in strongly correlated electron systems. As a typical example, the quasi-two-dimensional organic conductor θ-(BEDT-TTF)$_2$ RbZn(SCN)$_4$ shows a metal-insulator transition with charge disproportion at T = 195K[1]. Recently, inhomogeneous charge disproportion above T_{MI} have been reported by infrared and Raman spectrum and dielectric measurement[1]. This strange state is often called as simply "short-range charge-ordering" without its exact definition.

In this talk, we study the uniform charge susceptibility in the single-band extended Hubbard model with the nearest-neighbor Coulomb interaction V on the 2D square lattice by using the shielded interaction approximation within the Baym-Kadanoff conserving approximation. The merit of this approximation is that all the vertex corrections can be fully treated by direct differential calculation of the response of the system with respect to the external potential. This calculation allows us to study the feedback effect of strong charge fluctuations onto the response function through the vertex corrections. We find that the strong charge fluctuations lead to a remarkable enhancement of the charge compressibility and even make it negative indicating the instability of uniform metallic state near the CO transition. This may provide a trigger of the inhomogeneous charge disproportion called as "short-range charge-ordering" observed in the experiments.

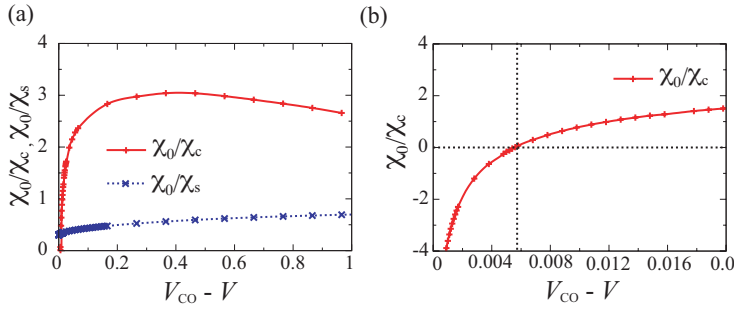

Fig. 1 V-dependence of the inverse of the uniform charge (spin) susceptibility χ_c (χ_s) at U = 4 for T = 0.1. The solid and dashed lines represent χ_c and χ_s, respectively. V_{CO} is the CO transition point determined by renormalized random phase approximation.

[1] T. Takahashi, Y. Nogami and K. Yakushi: J. Phys. Soc. Jpn. 75 (2006) 051008, and references there in.