



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

学术报告

Title: Ground state phase diagram of the doped Hubbard and t-J model on the 4-leg cylinder

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Abstract

The Hubbard and closely related t-J model are widely believed to contain the essential ingredients that underlie the phenomenon of high temperature superconductivity, whose ground state properties, however, remain still unclear till now. In this work, we report a large-scale density-matrix renormalization group study of the lightly doped Hubbard model on 4-leg cylinders in the presence of next-nearest hopping $t'\prime$. By keeping a large number of states for long system sizes, we are able to reveal a rich phase diagram consisting of a variety of distinct phases, including an insulating phase with "filled" charge stripe and long-range charge-density-wave (CDW) order but no superconductivity (SC), and two Luther-Emery liquid phases characterized by quasi-long-range SC and CDW order, but with distinct spin properties. In particular, we found that the insulating phase only occupies a small fraction in the phase diagram around $t'\prime=0$, and a tiny $t'\prime\sim -0.02t$ is enough to drive the system to the Luther-Emery liquid phase. Aside from $t'\prime$, the effect of Coulomb repulsion and doping concentration has also been explored. Our results indicate that a route to robust long-range superconductivity involves destabilizing insulating charge stripes in the doped Hubbard model.