Ground-state phase diagram of the Hubbard model with hopping modulation in the y-direction

Md Zahid Ansari[1], and Chia-Min Chung [1,2]

[1]*Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan*
[2]*Physics Division, National Center for Theoretical Sciences, Taipei 10617, Taiwan*

The Hubbard model serves as a testbed for exploring the essential physics of strongly correlated electron systems and has proven valuable in elucidating key aspects of unconventional superconductivity. Previously, the model with uniform and nearest-neighbor hopping has revealed the subtle competition between the charge density wave (CDW), spin density wave (SDW), and the superconducting order [1]. Notably, the ground state of the pure (with only uniform nearest-neighbor hopping) Hubbard model is found to be non-superconducting near optimal hole doping (i.e., 12.5%) [1]. However, the inclusion of next-nearest-neighbor hopping has been shown to induce superconductivity in the system [2, 3].

Recently, it has been shown that periodic modulation of the hopping amplitude along the y-direction can enhance superconducting correlations [4]. In this work, we employ the state-of-the-art density matrix renormalization group (DMRG) method to investigate the ground-state phase diagram of the modulated Hubbard model on a four-leg cylinder. We compute superconducting correlations and the pairing order parameter across a range of hole dopings and model parameters to probe different phases.

References

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