Stripe order in the 2D Hubbard model

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The discovery of high-temperature superconductivity in the cuprates has stimulated intense study of the Hubbard and t-J models on a square lattice. However, the accurate simulation of these models is one of the major challenges in computational physics. In this talk I report on recent progress in simulating the Hubbard model at a particularly challenging point in the phase diagram, $U/t = 8$, and doping $\delta = 1/8$, at which an extremely close competition between a uniform d-wave superconducting state and different types of stripe states is found [1]. Here I mostly focus on results obtained with infinite projected-entangled pair states (iPEPS) - a variational tensor network approach where the accuracy can be systematically controlled by the so-called bond-dimension D. Systematic extrapolations to the exact, infinite D limit show that the fully-filled stripe ordered state is the lowest energy state. Consistent results are obtained with density matrix embedding theory, the density matrix renormalization group, and constrained-path auxiliary field quantum Monte Carlo [1], demonstrating the power of current state-of-the-art numerical methods to solve challenging open problems.

[1] B.-X. Zheng, C.-M. Chung, P. Corboz, G. Ehlers, M.-P. Qin, R. M. Noack, H. Shi, S. R. White, S. Zhang, and G. K.-L. Chan, arXiv:1701.00054.