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Density matrix embedding theory studies of the two-dimensional Hubbard model[1]

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Density matrix embedding theory (DMET) provides a quantum embedding framework to compute the electronic structure in strongly correlated lattice systems. It has been applied to various model Hamiltonians and *ab initio* systems. In this talk, I will review the results obtained in the two-dimensional one-band Hubbard model using DMET. Over the last years, we mapped a calibrated ground-state phase diagram of the two-dimensional Hubbard model, concerning magnetic, superconducting and various inhomogeneous phases. Based on the results from this work, as well as the consistent data from other numerical methods, we are able to conclude that many parts of the Hubbard phase diagram is already settled up to an accurate energy scale of 0.001t. Recently, by using large-scale auxiliary-field quantum Monte Carlo (AFQMC) in the impurity problem, we are able to treat much larger embedded clusters at half-filling (and with the constrained path approximation at non-half-filling), which provides a deeper understanding on the finite-size effects of energy and observables in both quantum embedding and finite cluster numerical methods. Finally, we systematically investigated the putative inhomogeneous phases in the underdoped, strong coupling Hubbard model, proposing new inhomogeneous patterns as strong candidates for the ground state. Reference: [1] Bo-Xiao Zheng, Garnet K.-L. Chan, arXiv:1504.01784 [2] J.P.F. Leblanc, Andrey E. Antipov, et al., arXiv:1505.02290

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