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Exact Diagonalization Study of Superconductivity in the 2D Hubbard Model CHUNJING JIA, CHENG-CHIEN CHEN, BRIAN MORITZ, THOMAS DEVEREAUX, Stanford University and SLAC, SRIRAM SHASTRY, University of California, Santa Cruz — The two dimensional (2D) Hubbard model in the intermediate coupling limit is believed to capture the essential physics of high-Tc cuprates in the low energy sector. Extensive numerical studies, using small clusters, have demonstrated that the 2D Hubbard model contains much of the key physics in these materials including a Mott insulating, antiferromagnetic ground state at half-filling and d-wave superconductivity with subsequent hole-doping. To investigate the conjecture that the Hubbard Model has a superconducting groundstate, we study an extension of the Hubbard Model including an infinite-range pair-field term which precipitates superconducitivity in the d-wave channel. We study the states of the model as a function of the strength of this pairing term. We calculate observables such as the d-wave condensate occupation, fidelity and the ratio between the two lowest natural orbitals of the pair-field density matrix. We also consider the effect longer range hopping on the model. Calculations show that the Hubbard model favors a superconducting groundstate for some parameters, longer range hopping plays an important role. The numerical results have been obtained using a combination of LAPACK, (P)ARPACK, and Lanczos exact diagonalization techniques.

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