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**Quantum Phase Transitions of Ultra Cold Gases in the Fermi-Bose Hubbard Hamiltonian**[1] D. G. SCHIRMER, L.D. CARR, Colorado School of Mines, I. DANSHITA, J.E. WILLIAMS, CHARLES CLARK, National Institute for Standards and Technology, NATIONAL ELECTRON AND OPTICAL PHYSICS DIVISION, INSTITUTE FOR STANDARDS AND TECHNOLOGY COLLABORATION, L.D CARR THEORETICAL PHYSICS GROUP, PHYSICS DEPARTMENT, COLORADO SCHOOL OF MINES COLLABORATION — The experimental realization of ultracold fermions has stimulated work on theoretical models of zero-temperature quantum phase transitions and the BCS-BEC crossover. Ultracold gases confined in optical lattices can demonstrate a wide range of different phases by varying controllable system parameters, such as optical lattice intensity, particle number, spin composition and atomic interactions. We perform numerical studies of a Fermi-Bose-Hubbard Hamiltonian with the Vidal algorithm (Time Evolving Block Decimation). Our Hamiltonian treats a one dimensional system of fermions coupled to a bosonic molecular state, as occurs in Feshbach resonances, and encompasses a very large parameter space. We present the quantum phase diagram, focusing on small systems and the most experimentally relevant parameters.

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