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Effective theory and emergent $SU(2)$ symmetry in the flat bands of attractive Hubbard models MURAD TOVMASYAN, Institute for Theoretical Physics, ETH Zurich, 8093 Zürich, Switzerland, SEBASTIANO PEOTTA, PÄIVI TÖRMÄ, COMP Centre of Excellence, Department of Applied Physics, Aalto University School of Science, FI-00076 Aalto, Finland, SEBASTIAN HUBER, Institute for Theoretical Physics, ETH Zurich, 8093 Zürich, Switzerland — We study fermions interacting via attractive Hubbard interaction on a lattice with a flat Bloch band separated from the other bands by a finite energy gap. First, we project the Hamiltonian into the flat band Wannier functions. Then, we do a further approximation which leads to an effective ferromagnetic spin chain with an emergent $SU(2)$ symmetry. As a specific example, we consider a one-dimensional ladder with two perfectly flat Bloch bands. We show that as a manifestation of the emergent $SU(2)$ symmetry the Bardeen-Cooper-Schrieffer (BCS) wavefunction is the exact ground state of the projected Hamiltonian, and that the compressibility is diverging. We extend the projected model by using the Schrieffer-Wolf transformation and show that the $SU(2)$ symmetry is broken by second order interband transitions also resulting in a finite compressibility, which we calculate analytically and compare to the result obtained via quasi-exact DMRG simulations. Our predictions can be tested via transport measurements in cold atom experiments.

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