Abstract Submitted
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**Beyond the Hubbard model: best effective single dressed band description of interacting atoms in optical lattices**[1] ULF BISSBORT, FRANK DEURETZBACHER, WALTER HOFSTETTER, Goethe Universität Frankfurt a.M. — We construct the effective lowest-band Bose-Hubbard model incorporating interaction-induced on-site correlations. The model is based on ladder operators for local correlated states, which deviate from the usual Wannier creation and annihilation operators, allowing for a systematic construction of the most appropriate single-band low-energy description in form of the extended Bose-Hubbard model. A formulation of this model in terms of ladder operators not only naturally contains the previously found effective multi-body interactions, but also contains multi-body induced single particle tunneling, pair tunneling and nearest-neighbor interaction processes of higher orders. An alternative description of the same model can be formulated in terms of occupation-dependent Bose-Hubbard parameters. These multi-particle effects can be enhanced using Feshbach resonances, leading to corrections which are well within experimental reach and of significance to the phase diagram of ultracold bosonic atoms in an optical lattice. We analyze the energy reduction mechanism of interacting atoms on a local lattice site and show that this cannot be explained only by a spatial broadening of Wannier orbitals on a single particle level, which neglects correlations.

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