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Boson Hubbard model with weakly coupled fermions: Effects of higher bands and shrinking of the superfluid phase[1] SANKAR DAS SARMA, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park, MD, ROMAN LUTCHYN, Condensed Matter Theory Center (CMTC) and Joint Quantum Institute (JQI), University of Maryland, College Park, MD, SUMANTA TEWARI, Department of Physics, Clemson University, Clemson, SC — We study Boson Hubbard model with weakly coupled fermions and take into account the effects of the higher boson Bloch bands. For attractive couplings between the bosons and the fermions, mixing of the higer bands results in an effective enhancement of the boson on-site repulsion. The overall shift of the boson Hubbard phase diagram due to the presence of the fermions is thus determined by two competing effects: an effective fermion- mediated interaction between the constituent bosons (which favors the superfluid phase), and the renormalization of the boson-boson interaction due to the virtual boson transitions to the higher Bloch bands (which favors the Mott insulating phase). We find that the latter is typically dominant for the cold-atom experiments, which is consistent with the observed loss of the superfluid coherence in recent experiments.

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