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Particle-hole pair excitations in Mott insulator quench dynamics KHAN MAHMUD, LEI JIANG, Joint Quantum Institute, NIST and University of Maryland, PHILIP JOHNSON, American University, EITE TIESINGA, Joint Quantum Institute, NIST and University of Maryland — We investigate the dynamics of strongly interacting bosons in an optical lattice in a quantum quench scenario where we start from a Mott insulator state and suddenly raise the lattice depth. Despite the nature of short-range coherence in the Mott state, we find that the coherence visibility exhibits collapse and revival oscillations which could be observed in experiments. The quasi-momentum distribution oscillates between a maximum occupation at $k = 0$ (during revivals) and $k = \pi$ (during collapse). We show that the $k = \pi$ revivals are caused by the presence of particle-hole pair excitations on top of a constant Mott background. We further show that similar effects are found in other lattice models such as with fermions and Bose-Fermi mixtures. We provide a general framework and point to a new avenue to probe strongly correlated many-body states going beyond the superfluid paradigm of collapse and revivals.

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