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Many-body quantum dynamics, induced correlations and bound states of Bose polarons SIMEON MISTAKIDIS, GEORGIOS KOUTENTAKIS, GARYFALLIA KATSIMIGA, University of Hamburg, THOMAS BUSCH, OIST Graduate University, PETER SCHMELCHER, University of Hamburg, THEORY GROUP OF FUNDAMENTAL PROCESSES IN QUANTUM PHYSICS TEAM —
We unravel the ground state properties and the nonequilibrium dynamics of spinor impurities immersed in a bosonic gas following an interspecies interaction quench. For the ground state of non-interacting impurities we reveal signatures of attractive induced interactions and the formation of bipolaron states, whilst a direct impurity-impurity repulsion forces the impurities to stay apart. Turning to the quench dynamics we inspect the time-evolution of the contrast unveiling the existence, dynamical deformation and the orthogonality catastrophe of Bose polarons. It is shown that for an increasing postquench repulsion the impurities reside in a superposition of two distinct two-body configurations while at strong repulsions their corresponding two-body correlation patterns show a spatially delocalized behavior evincing the involvement of higher excited states. For attractive interspecies couplings, the impurities exhibit a tendency to localize and remarkably for strong attractions they experience a mutual attraction on the two-body level which signals the formation of a bipolaron state. To analyze and quantify induced impurity-impurity correlations, we construct an effective two-body Hamiltonian identifying the mean-field attraction and the corresponding correlations effects.

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