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Numerical studies of a Matter-Wave Open Quantum System[1]
MICHAEL STEWART, LUDWIG KRINNER, ARTURO PAZMINO, JOONHYUK KWON, DOMINIK SCHNEBLE, Stony Brook University — In a recent experiment [2], we implement a model for an open quantum system consisting of an array of Weisskopf-Wigner type emitters ("artificial atoms") realized with ultracold atoms in an optical lattice geometry [3]. Each emitter can spontaneously emit matter waves, with fully tunable decay strength and excited state energy. In a recent theoretical analysis [4], we studied a single site coupled to a one-dimensional waveguide and analyzed the transition from Markovian to non-Markovian dynamics including the formation of a bound state. In the experiment, we found strong qualitative deviations of the data compared to the single site analytical treatment. We present numerical studies on the effect of neighboring ground-state emitters, which suggest that the observed differences can be explained in terms of resonant re-absorption of emitted matter waves, such as tunneling and diffusion. We also propose schemes for direct characterization of transport properties in the lattice.

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[2]L. Krinner, arxiv 1712.07791
[3]I. de Vega et. al, Phys. Rev. Lett. **101**, 260404, 2008
[4]M. Stewart et. al, Phys. Rev. A **95**, 013626, 2017

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