Spontaneous emission of matter-waves into structured reservoirs

V. Klüsener,[1, 2] S. Pucher,[1, 2] F. Spriestersbach,[1, 2] J. Geiger,[1, 2] I. Bloch,[1, 3, 2] and S. Blatt[1, 3, 2]

[1]*Max-Planck-Institut für Quantenoptik, 85748 Garching, Germany*

[2]*Munich Center for Quantum Science and Technology, 80799 München, Germany*

[3]*Fakultät für Physik, Ludwig-Maximilians-Universität, 80799 München, Germany*

The emission characteristics of a quantum emitter can be strongly modified by its local environment. Here, we investigate spontaneous emission in an artificial system of ultracold atoms that emits matter-waves rather than optical radiation [1,2]. Our system is realized by trapping atoms in state-dependent optical lattices [3] and introducing a tunable bath coupling using high-resolution spectroscopy [4]. Upon coupling the emitters to one- and two-dimensional structured reservoirs we observe a pronounced modification of the emission rate. We observe the momentum distribution of the emitted matter-waves using matter-wave lensing techniques. In addition, we search for directional emission of matter-waves by performing single-atom resolved quantum gas microscopy.

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