

Abstract Submitted
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Highly nonlocal optical nonlinearities in atoms trapped near a waveguide EPHRAIM SHAHMOON, Department of Chemical Physics, Weizmann Institute of Science, Israel; Department of Physics, Harvard University, PJOTRS GRISINS, Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, 1020 Vienna, Austria, HANS PETER STIMMING, Fakultat für Mathematik, Universität Wien, 1090 Vienna, Austria, IGOR MAZETS, Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, 1020 Vienna, Austria, GERSHON KURIZKI, Department of Chemical Physics, Weizmann Institute of Science, Rehovot, 7610001, Israel — Nonlinear optical phenomena are typically local. Here we predict the possibility of highly nonlocal optical nonlinearities for light propagating in atomic media trapped near a nano-waveguide, where long-range interactions between the atoms can be tailored. When the atoms are in an electromagnetically-induced transparency configuration, the atomic interactions are translated to long-range interactions between photons and thus to highly nonlocal optical nonlinearities. We derive and analyze the governing nonlinear propagation equation, finding a roton-like excitation spectrum for light and the emergence of long-range order in its output intensity. These predictions open the door to studies of unexplored wave dynamics and many-body physics with highly-nonlocal interactions of optical fields in one dimension.

Ephraim Shahmoon
Weizmann Institute of Science, Israel; Department of Physics, Harvard University

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