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Single-photon bound states for propagating photons interacting with many atoms YIDAN WANG, Joint Quantum Institute, NIST/University of Maryland, College Park, MD 20742, USA, MICHAEL GULLANS, Department of Physics, Princeton University, Princeton, NJ 08540, USA, DARRICK CHANG, ICFO-Institut de Ciencies Fotoniques, Mediterranean Technology Park, 08860 Castelldefels (Barcelona), Spain, ALEXEY GORSHKOV, Joint Quantum Institute, NIST/University of Maryland, College Park, MD 20742, USA — We illustrate the existence of single-excitation bound states for propagating photons interacting with N two-level atoms. These bound states can be calculated from a spin Hamiltonian and their existence relies on the dissipation in the system. We find that the appearance of these bound states is in a one-to-one correspondence with zeros in the single-photon transmission and infinite bunching in the second-order photon-photon correlation functions. We also formulate a dissipative version of Levinson's theorem for this system by looking at the relation between the number of bound states and the winding number of the transmission phases.

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