Abstract Submitted for the MAR12 Meeting of The American Physical Society

Cavity-Free Photon Blockade Induced by Many-Body Bound States¹ HUAIXIU ZHENG, DANIEL GAUTHIER, HAROLD BARANGER, Duke University — We show theoretically that a variety of strong quantum nonlinear phenomena occur in a completely open one-dimensional waveguide coupled to an N-type four-level system. This system could be realized, for example, in experiments using superconducting circuits. We focus on photon blockade, photon-induced tunneling, bunching or anti-bunching, and the creation of single-photon states, all in the absence of a cavity. Many-body bound states appear due to the strong photon-photon correlation mediated by the four-level system. These bound states cause photon blockade, generating a sub-Poissonian single-photon source [1]. Such a source is crucial for quantum cryptography and distributed quantum networking; our work thus supports the notion that open quantum systems can play a critical role in the manipulation of individual, mobile quanta, a key goal of quantum communication. [1] H. Zheng, D. J. Gauthier, and H. U. Baranger, Phys. Rev. Lett. in press (2011), arXiv:1107.0309.

¹Supported by the U.S. Office of Naval Research, the U.S. NSF (TAMOP program), and the Fitzpatrick Inst. for Photonics.

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Date submitted: 11 Nov 2011

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