Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Atom-atom interactions in an 'Alligator' photonic crystal waveguide ANA ASENJO-GARCIA, Caltech, JONATHAN D. HOOD, Harvard, AKIHISA GOBAN, JILA, MINGWU LU, JQI, SU-PENG YU, Caltech, DARRICK E. CHANG, ICFO, H. JEFF KIMBLE, Caltech — New opportunities for optical physics emerge from the integration of cold atoms with nanophotonic devices. Due to their small optical loss and tight field confinement, these nanoscale dielectric devices are capable of mediating strong atom-light interactions and open new avenues for quantum transport and quantum many-body phenomena. In particular, coupling atoms to the band edge of a photonic crystal waveguide (PCW) provides a unique platform for generating tunable range coherent atom-atom interactions which are mediated by the guided mode photons. Due to the evanescent nature of the field in the band gap, dissipation into the structure is suppressed exponentially. We have experimentally observed the transition into the bandgap for the first time by shifting the band edge frequency of the PCW relative to the D1 line of atomic cesium with an average of 3 atoms trapped along the PCW [1]. In addition, we have developed a formalism that provides a clear mapping between the transmission spectra and the local Greens function, which allows us to identify signatures of dispersive and dissipative interactions between the atoms [2]. [1] J. D. Hood et al., PNAS 113, 1050710512 (2016). [2] A. Asenjo-Garcia, J. D. Hood, D. E. Chang, H. J. Kimble, arXiv:1606.04977 (2016).

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Date submitted: 27 Jan 2017 Electronic form version 1.4