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Trapped Atoms in One-Dimensional Photonic Crystals[1]

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I describe one-dimensional photonic crystals that support a guided mode suitable for atom trapping within a unit cell, as well as a second probe mode with strong atom-photon interactions [1]. A new hybrid trap is analyzed that combines optical and Casimir-Polder forces to form stable traps for neutral atoms in dielectric nanostructures. By suitable design of the band structure, the atomic spontaneous emission rate into the probe mode can exceed the rate into all other modes by more than tenfold. The unprecedented single-atom reflectivity $r_0 \simeq 0.9$ for the guided probe field could create new scientific opportunities, including quantum many-body physics for $1D$ atom chains with photon-mediated interactions [2,3] and high-precision studies of vacuum forces. Towards these goals, my colleagues and I are pursuing numerical simulation, device fabrication, and cold-atom experiments with nanoscopic structures [4].

[1] C.-L. Hung, S. M. Meenehan, D. J. Chang, and H. J. Kimble, arXiv (2013).
[2] D. E. Chang, L. Jiang, A. V. Gorshkov, and H. J. Kimble, *New J. Phys.* **14**, 063003 (2012).
[3] D. E. Chang, J. I. Cirac, and H. J. Kimble, arXiv:1211.5660.
[4] A. Goban *et al.*, *Phys. Rev. Lett.* **109**, 033603 (2012).

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