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Strong Atom-Light Interactions in Photonic Crystals

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New paradigms for optical physics emerge with lattices of atoms trapped in one and two-dimensional photonic crystals [1-4]. Exemplary experimental platforms include photonic crystal waveguides [5-7] and cavities [8, 9]. Owing to their small optical loss and tight field confinement, these nanoscale dielectric devices are capable of mediating long-range atom-atom interactions using photons propagating in their guided modes. In a complimentary fashion, long-range interactions between photons can be mediated by an underlying lattice of atoms. Such systems have the potential to provide new tools for scalable quantum networks, quantum phases of light and matter, and quantum metrology. However, bringing this future of *atom nanophotonics* to fruition requires the creation of an interdisciplinary toolkit for the control, manipulation, and interaction of atoms and photons with a complexity and scalability not currently possible. I will give an overview of the theoretical prospects for new physics and review experimental progress in this nascent field at the interfaces of nano-photonics, atomic physics, and quantum optics.

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