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Coherent Control of Thermal Atoms with Photonic Crystal Cavities HADISEH ALAEIAN, RALF RITTER, ARTUR SKLJAROW, HARALD KUBLER, TILMAN PFAU, ROBERT LOW, University of Stuttgart — Unless proper modifications are employed, the atom-photon interaction is an inefficient process in free space. Historically, optical and superconducting cavities have been used successfully to increase the atom-photon interaction probability for the optical and microwave photons, respectively. With recent advancements in nanofabrication, integrated Nano-photonic devices have been employed successfully to enhance the quantum optical phenomena in several solid-state based platforms like quantum dots and vacancy centers. In this work, we present our recent theoretical and experimental efforts on the integration of high-Q cavities with thermal atoms beyond the perturbative limit. In particular, we discuss about an optimized cavity in a Si_3N_4 photonic crystal supporting a high-Q mode with small volume at 780nm, i.e. 5S $\rightarrow$ 5P of rubidium. Through detailed Monte-Carlo calculations and incorporating all the device effects, including the Purcell enhancement and Casimir-Polder potential, we demonstrate the feasibility of reaching a strong atom-light coupling down to a single photon.

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