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Optical resonators based on photonic crystal membranes integrated with hollow-core fibers[1] JEREMY FLANNERY, MICHAL BAJCSY, University of Waterloo — Fabry-Pérot resonators integrated in hollow-core photonic-crystal fibers (HCPCFs) would offer a platform for enhanced light-matter interactions through which optical nonlinearities arising in the presence of just a few photons can be achieved. We propose to implement such optical cavities by attaching photonic-crystal (PC) membranes acting as dielectric metasurface mirrors to the ends of a HCPCF piece. The holes of the PC membrane would allow laser-cooled or room-temperature atomic gases to be loaded into this fiber-integrated cavity and act as an optically dense medium in which optical nonlinearities can be engineered. We report our progress on fabrication of these cavities with high-reflectivity dielectric metasurface mirrors. We present the results of our numerical simulations optimizing the reflectivity of a PC membrane for the HCPCF mode, the design of PC membranes with polarization-selective reflectivity, reflectivity measurements of fabricated membranes, and a first experimental demonstration of an assembled cavity. We also discuss potential applications of this platform with a focus on optical transistors controlled by single photons.

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