

Phase-sensitive Optical-wave Transfer in Waveguide-Resonator Systems

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There has recently been great interest in coupled systems involving compact, high quality resonators, such as microdisks. Applications of such systems not only facilitates novel photonic system operation, but also enhances fundamental studies based on coherent wave interactions, such as electromagnetically induced transparency [1] and strong photon coupling [2]. In this paper, we present a dispersive phase response of optical waveguide-resonator systems, where two Whispering-Gallery-Modes (WGMs) of microcavity couple to the single mode of a tapered, accessing optical fiber. The observed phase responses are shown to stem from the coherent interference between light waves coupled to each doublet WGMs. The resulting group delay becomes positive (+10 ps) and negative (-55 ps) near the high-Q ($\sim 10^5$) WGMs. These phenomena arise in the all-optical and linear regime, and therefore will be useful for controlling single photon transfer [3] and studying the phase-sensitive dynamics of quantum-dot-cavity coupled systems.

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