Controlling interactions between coupled photonic crystal cavities using photochromic tuning

TAO CAI, RANOJOY BOSE, Department of Electrical Engineering, University of Maryland, College Park, GLENN SOLOMON, Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology; National Institute of Standards and Technology, EDO WAKS, Department of Electrical Engineering, University of Maryland, College Park — Strongly coupled photonic crystal (PhC) resonator systems provide a promising platform for studying cavity quantum electrodynamics (QED) using semiconductor quantum dots (QDs). These device structures enable important applications such as photon blockade, quantum simulation, quantum-optical Josephson interferometer, and quantum phase transition of light. Many of these applications require the ability to accurately tune the resonant frequencies of individual cavities in the array, which provides a method to control their coupling interactions. This tuning method must be sufficiently local to address individual cavities spaced by less than 1 micron spatial separation. Here, we present a method for controlling the coupling interaction of photonic crystal cavity arrays by using a local and reversible photochromic tuning technique. By locally altering the refractive index of the photochromic material all-optically, the coupling interaction between two cavity modes could be modified over a tuning range as large as 700 GHz. By using this technique, we demonstrate the ability to couple photonic crystal cavities with a normal mode splitting of only 31.50 GHz. We further demonstrate that this tuning method can be extended to control the coupling interaction in larger cavity arrays.

Tao Cai
Dept of Electrical Engineering, University of Maryland, College Park

Date submitted: 27 Nov 2012