MECHANICAL ENGINEERING SEMINAR

# Engineering photons through nonlinear dynamics in nanostructures

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Propelled by advances in nanofabrication, we can now examine the control of photons in engineered nanostructures. First, we demonstrate the strong control of dispersion and localization in photonic crystal structures, leading to the observations of negative refraction, zero-index superlattice band gaps, and ultrahigh-Q subwavelength nanocavities. Coherent interactions in such nanostructures lead to recent observations of an optical analogue to electromagnetically-induced-transparency. Second, we report our studies in nonlinear optics through the tight field confinement and long photon lifetimes in our photonic crystal structures. Examples include slow-light Raman scattering, and femtojoule Fano-type optical bistability. Third, we describe our efforts in nonclassical optics through these nanostructures. Examples include controlling spontaneous emission through cavity quantum electrodynamics for efficient on-demand single photon sources, and realizing scalable quantum phase gates for quantum information sciences.

Professor Wong joined the Columbia faculty in 2004, after receiving the Doctorate of Science in Mechanical Engineering (Optical Nanotechnology) from the Massachusetts Institute of Technology in 2003. In 2001, he received his Masters of Science degree from MIT. From 1996 to 1999, he completed his double degree (B. Sc. in Mech. Eng. with highest honors and B. A. in Econs. with highest honors) at the University of California at Berkeley. He was a post-doctoral research associate with the MIT Microphotonics Center in 2003.

Professor Wong received the 3M Faculty award in 2009, the NSF CAREER award in 2008, and the DARPA Young Faculty Award in 2007. He enjoys working on nonlinear and quantum optics in nanophotonics, silicon electronic-photonic circuits and photonic crystals, quantum dot interactions in nanocavities, nanoelectromechanical systems, and nanofabrication. Since 2003, he has published 30+ journal articles, 40+ conference papers, 2 book chapters, given ~ 30 invited talks, and has 6 awarded patents and 10 pending patents. He is a member of APS, ASME, IEEE, OSA and Sigma Xi.

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