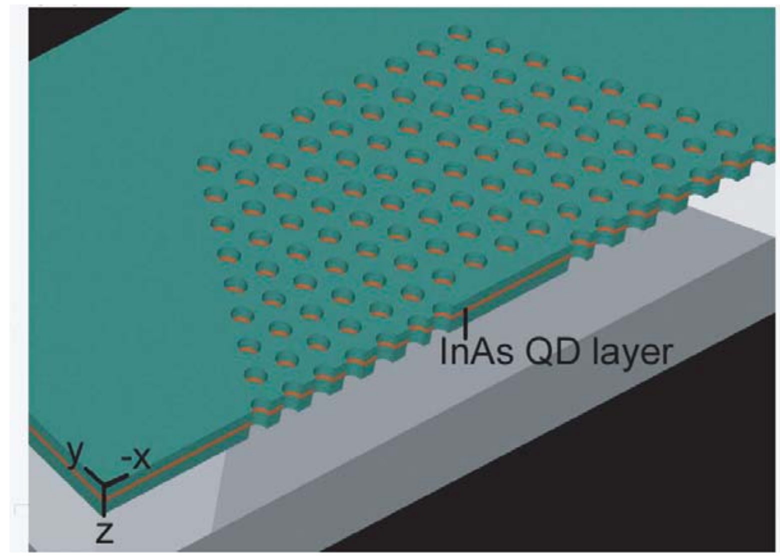
Colloquium

The Institute of OPTICS — University of Rochester

Semiconductor Cavity QED



Hyatt Gibbs
College of Optics
University of Arizona

PhD Berkeley
Bell Labs 13 years
Arizona, 1980 -

Recent progress is described in the effort to make semiconductor quantum dots the system of choice for cavity QED and other experiments of quantum optics and quantum information.

3:00 pm, Monday, March 17, 2008
Sloan Auditorium, Goergen Building
Refreshments following lecture

Semiconductor Cavity QED

Hyatt Gibbs, University of Arizona

Abstract

There is growing excitement amongst semiconductor quantum optikers as quantum dots begin to prove themselves as artificial atoms with characteristics that may soon make them the oscillators of choice for cavity QED experiments.[1] Nonlinear light-matter interactions are enhanced by placing the nonlinear optical materials in the antinode of the intracavity field. Optical bistability and nonlinear optical switches utilize this fact.[2] And so does vacuum Rabi splitting (VRS), first seen in semiconductors by Weisbuch et al. in a VCSEL-like planar microcavity containing several quantum wells.[3] VRS splitting becomes even more interesting for quantum optics and information science when the cavity is made three-dimensional and shrunk to a mode volume of a cubic wavelength *and* the quantum wells are replaced by a single quantum dot.[3-5] This changes the VRS from many-atom-like to single-atom-like, i.e. the regime of true strong coupling where the state of the quantum dot is entangled with the presence or absence of a photon in the cavity field. This quantum system shows the characteristic strong coupling anticrossing[4] of the quantum-dot and cavity-mode energies, and it emits quantum (nonclassical) light, exhibiting antibunching and sub-poissonian photon statistics. It should eventually be used for quantum state transfer and for demonstrating higher rungs of the Jaynes-Cummings ladder.

Biography

Ph. D. Physics from University of California, Berkeley; 13 years at Bell Telephone Labs; Professor of Optical Sciences, University of Arizona, since 1980; Fellow of American Physical Society, Optical Society of America, and Franklin Institute; 1984 Michelson Medal of Franklin Institute; Humboldt Research Award, 1998. Research areas: optical pumping, self-induced transparency, optical bistability, nonlinear etalons, optical instabilities and chaos, optical nonlinearities, radiative coupling between periodically positioned quantum wells, normal mode coupling between a quantum well and planar microcavity, and strong coupling between a single quantum dot and a 3D photonic crystal slab nanocavity.