SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

PHOTONIC MOLECULES FORMED BY ULTRA HIGH QUALITY FACTOR MICRORESONATOR FOR LIGHT CONTROL

DISSERTATION DEFENSE

By

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Abstract: Whispering-gallery-mode (WGM) optical microresonators with micro-scale mode volumes and high quality factors have been widely used in different areas ranging from sensing, quantum electrodynamics (QED), to lasing and optomechanics. Due to the ultra-high Q and the tight spatial confinement, the cavity provides high intra-cavity field intensity and long interaction time, which enhances the interaction between light and materials. This feature makes WGM microresonator a great candidate for low-threshold nonlinear processes, cavity optomechanics, signal processing, and sensor with ultrahigh sensitivity. Also, modification of the modes in these resonators has been of considerable interest for their potential applications and underlying physics. Two or more coupled resonators form a compound structure—photonic molecule (PM)—in which interactions of optical modes create supermodes. This molecular analogy stems from the observation that confined optical modes of a resonator and the electron states of atoms behave similarly. Thus, a single resonator is considered as a "photonic atom," and a pair of coupled resonators as the photonic analog of a molecule. Studying the interactions in PMs is critical to understand their resonance properties and the field and energy transfers to engineer new devices such as phonon lasers and enhanced sensors. Further modification of the compound structure with gain mechanism such as rare-earth dopants makes the coupled cavity system a novel Parity-Time symmetric optical device. More surprisingly, the implementation of non-Hermitian on-chip WGM photonic molecule with exceptional points even enables the control and modification of laser emission with just loss tuning.

In this talk, we present the study and new implementation of applications with ultra-high Q WGM microresonator based photonic molecules. We discuss the on-chip Parity-Time symmetric microresonator and non-Hermitian photonic molecule design for light manipulation and optical isolation, lasing and dissipation control, directional switching and PM-based optical analog of electromagnetically induced transparency, as well as highly sensitive tuning of WGM Raman microlaser with PM loss manipulation.

DATE: Thursday January 29, 2015
TIME: 2:00 pm
PLACE: Green Hall, Room 0120

Dissertation advisor:
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