SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

Nonlinear Effects in Whispering Gallery Mode Optical Microresonators and Their Applications

PhD Preliminary Exam

Yihang Li
PhD Candidate

Abstract: In a nonlinear optical system, the output optical fields are not linearly related to the power of input optical fields. On the contrary, the input fields could modify the optical properties of the system comprehensively, inducing the change in the transmission/reflection spectrum or the generation of lights at different wavelengths. However, such nonlinear phenomena often require enormous optical pump power to be observed. In whispering gallery mode (WGM) microresoantors with high quality (Q) factors and small mode volumes (V), an intense intra-cavity optical power could be achieved by the spatial confinement and the temporal accumulation of the input light. Thus, enhanced nonlinear effects could be realized with moderate input power in a small-footprint device, which has shown promise in areas including communication, all-optical controlling, sensing, measuring, and special light generation.

In the talk, I will introduce several designs and demonstrations of WGM-based systems for enhanced nonlinear effects. The first project is about the thermo-optical nonlinear dynamics of a cascade resonator pair. With a proper resonance detuning, the thermal dynamics of the secondary resonator could be switched by the primary one. The overall thermo-optical dynamics could be divided into different regimes, where mutual resonance locking and optical non-reciprocity could be realized. The second project is on enhanced Raman spectroscopy in a hybrid structure of WGM microresonators and natural nanoplasmonic hotspots. Evidence of the Raman spectroscopy pumped by the WGM-nanoplasmonic hybrid mode will be introduced. As a follow-up of the second project, I will discuss a new method of sample preparation of Raman spectroscopy, where the liquid analyte of interest is directly made into a WGM resonator for enhanced Raman signal generation.

Date: Tuesday, February 25, 2020
Time: 1:30 p.m.
Location: Green Hall, Room 0120

Dissertation advisor:
Dr. Lan Yang

Washington University in St. Louis
James McKelvey School of Engineering