Exploring nonreciprocity and high-throughput nanoparticle sensing with opto-mechanical interactions

Abstract: Time-reversal symmetry is a property shared by all wave phenomena in linear stationary media. However, broken time-reversal symmetry is required for synthesizing nonreciprocal devices like isolators, circulators, gyraators, and for topological systems supporting chiral states. In this talk, I will present our unique approach to achieving nonreciprocity using microresonators that support co-localized interacting modes of light and sound. I will describe our efforts to exploit the momentum conservation rules intrinsic to this light-sound coupling to generate chiral systems for both photons and phonons — enabling complete optical isolation with ultra-low loss, and even optically inducing disorder tolerance to phonon transport. Most recently, intuitions drawn from these optical experiments in microresonators are being used to design practical microwave and acoustic systems in our lab with strong nonreciprocal responses.

In a parallel effort, our group has been exploring new opto-mechano-fluidic systems for quantifying mechanical properties (e.g. compressibility, density) of free-flowing nanoparticles without labeling or binding. In this second portion of my talk, I will describe our optomechanofluidic resonator (OMFR) platform, and our latest results that demonstrate single particle detection at speeds exceeding 10,000 particles/second with sub-micron noise floors. The new informational degrees-of-freedom provided by such opto-acoustic measurements could lead to surprising new sensor applications in the near future.

Biography: Dr. Gaurav Bahl is an Assistant Professor of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign, and is an Affiliate in the Department of Electrical and Computer Engineering. He received his PhD and MS degrees in Electrical Engineering from Stanford University in 2010 and 2008, and the BEng degree from McMaster University in 2005. Dr. Bahl has authored the first experimental papers on lasing and cooling of traveling acoustic waves using Brillouin interactions in ultra-high-Q resonators, and developed the first opto-mechanical systems capable of fluid-phase sensing. His work on Brillouin cooling and opto-mechano-fluidic sensing has been featured twice in the December special issues of OSA Optics & Photonics News (2012 and 2013). He is a recipient of the AFOSR Young Investigator Award in 2015, the ONR Director of Research Early Career Grant in 2016, and was elevated to Senior Member of the IEEE in 2016.

Date: February 24, 2017 (Friday)
Time: Lunch at 12:00 pm
Talk begins at 12:15 pm
Place: Phillips 233

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