Seminar of Dr. Siddhartha Ghosh

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Acoustic wave microsystems for chip-scale RF and optical signal processing

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Abstract: Acoustic waves are well-suited for a variety of signal processing applications including RF filtering and optical modulation. Advances in material and fabrication capabilities have enabled the demonstration of chip-scale subsystems in which phonons can exhibit strong interactions with a variety of other physical domains. This talk will discuss progress in the areas of acousto-electric (AE) amplification and acousto-optic (AO) modulation as well as present the development of a phononic integrated circuit platform.

In recent years, non-reciprocal and switchable delay lines have generated great interest for applications in full duplex radio networks. As a result, AE-based approaches to mitigating signal interference in the RF front end have been sought. Here we will consider the use of bonding processes for integrating thin film silicon and InGaAs on lithium niobate to produce strong non-reciprocity. These results are developed with regard to implementation in analog correlators and non-magnetic circulators.

Next, we will discuss the development of piezoelectrically-actuated AO modulators in polycrystalline and doped aluminum nitride (AlN) materials. Optical coupling to AlN thin films is demonstrated in the telecommunications bands, enabling monolithic integration of photonic and bulk acoustic resonators. Overlap of these fields enables efficient conversion from RF to optical frequencies, with applications in integrated microwave photonics and quantum information transfer.

Finally, we will present the development of phononic integrated circuits (PnICs) in scandium-doped aluminum nitride thin films on sapphire substrates. Here we demonstrate wavelength-scale confinement of guided surface acoustic waves to generate a library of components including bent waveguides, splitters and directional couplers. The integration of PnICs with AE and AO effects will thus pave the way for a new class of robust hybrid acoustic microsystems for communications and information processing.

Biography : Siddhartha Ghosh is an Assistant Professor in the Department of Electrical and Computer Engineering at Northeastern University. He received the B.S. degree in from Cornell University in 2007, the M.S.E. degree from the University of Pennsylvania in 2011 and the Ph.D. degree from Carnegie Mellon University in 2015, all in electrical engineering. From 2015-2020 he was a member of the Technical Staff at MIT Lincoln Laboratory. He has served in the Technical Program Committees for the IEEE MEMS Conference, the International Frequency Control Symposium (IFCS) and the CLEO Subcommittee on Micro- and Nano-Photonic Devices. He received the DARPA Young Faculty Award in 2023 and the NSF CAREER Award in 2024. His research interests include piezoelectric MEMS, optomechanical resonators, oscillator-based computing and acousto-electronic devices.

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