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SenSIP Seminar Series

Collective Dynamics of Quantum Emitters Coupled to Waveguides

Presenter: Kanu Sinha, Assistant Professor, ECEE

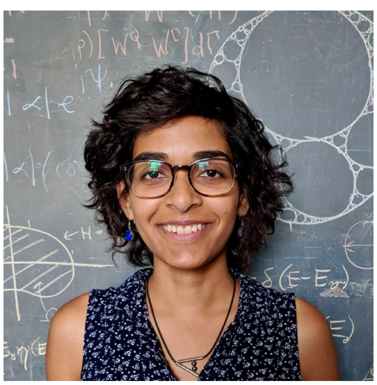
April 13, 2022, 3:00 PM

Zoom: https://asu.zoom.us/j/88562891694

Abstract

Collections of atoms and solid-state quantum emitters coupled to waveguides and nanophotonic structures offer a promising platform for scalable quantum information processing. The applications of such systems range from building long-ranged quantum networks, quantum memory devices, to facilitating new experimental regimes with exotic light-matter interactions. However memory effects of the electromagnetic environments often become pronounced in such configurations, necessitating a non-Markovian treatment of the system.

In this talk I will discuss non-Markovian dynamics in collective atom-field interactions resulting from retardation. Considering a model system of two correlated emitters coupled to a waveguide, we demonstrate that such a system can exhibit surprisingly rich non-Markovian dynamics, with collective spontaneous emission rates exceeding those of Dicke superradiance (`superduperradiance') [1], formation of highly delocalized atom-photon bound states [2] and frequency-comb features in the output field spectrum [3]. We also show that the cooperativity of the system, an important figure of merit in quantum information applications, can decrease exponentially with distance, necessitating a careful consideration of retardation effects in quantum network protocols based on long-distance emitters.



Biography:

Kanu Sinha is an Associate Research Scholar at the Department of Electrical and Computer Engineering at Princeton University and will be joining the School of Electrical, Energy and Computer Engineering as an Assistant Professor at ASU. She earned her Bachelors of Technology in Engineering Physics at the Indian Institute of Technology, New Delhi, followed by her Ph.D. in Physics at University of Maryland, College Park. Her research involves engineering quantum phenomena in nanoscale quantum optical systems, pertinent to near-term quantum technology applications. While primarily a theorist, she collaborates closely with ongoing experiments in superconducting circuits, optical nanofibers, and optomechanics platforms.

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