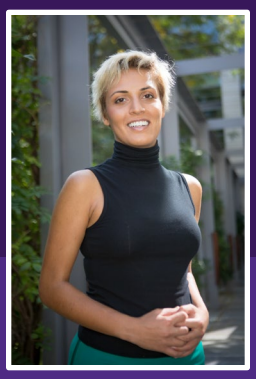
THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT SPRING COLLOQUIUM SERIES PRESENTS:

Prineha Narang

Professor, Harvard University



Correlated Light-Matter Interactions and Excited-State Dynamics in Quantum Materials

The physics of quantum materials is rich with spectacular excited-state and non-equilibrium effects, but many of these phenomena remain poorly understood and consequently technologically unexplored. Therefore, this talk will focus on how quantum-engineered materials behave, particularly away from equilibrium, and how we can harness these effects in quantum technologies and quantum information science. Electron-photon, electron-electron as well as electron-phonon dynamics and far-from-equilibrium transport are critical to describe ultrafast and excited-state interactions in materials. Ab initio descriptions of phonons are essential to capture both excitation and loss (decoherence) mechanisms, and are challenging to incorporate directly in calculations due to a large mismatch in energy scales between electrons and phonons. I will show results using a new theoretical method we have developed to calculate arbitrary electron-phonon and electron-optical interactions in a diagrammatic many-body framework integrated with a nonequilibrium carrier transport method. Further, I will discuss a new formalism at the intersection of cavity quantum-electrodynamics and electronic structure methods, quantum-electrodynamical density functional theory, to treat electrons and photons on the same quantized footing. I will demonstrate how these ab initio techniques guide the search for relevant quantum properties in 2D and 3D materials, including new quantum emitters. Finally, I will show recent results using newly developed theoretical methods to evaluate the linear and nonlinear optical properties of low dimensional and heterostructured quantum materials and pathways to leverage these properties in quantum devices.

Prineha Narang is a Professor at the John A. Paulson School of Engineering and Applied Sciences at Harvard University. Prineha's work has been recognized by many awards and special designations, including being named a Moore Inventor Fellow by the Gordon and Betty Moore Foundation for innovations in quantum science and technology, CIFAR Azrieli Global Scholar by the Canadian Institute for Advanced Research, a Top Innovator by MIT Tech Review (MIT TR35), and a Young Scientist by the World Economic Forum in 2018. In 2017, she was named by Forbes Magazine on their "30under30" list for her work in atom-by-atom quantum engineering. Prineha designs materials at the smallest scale, using single atoms, to enable the leap to quantum technologies. She has pioneered work in classical and quantum computing to approach problems in physics and chemistry with a new toolkit. At SEAS she designed and teaches ES 170, a popular undergraduate class on quantum engineering. Outside of science, she is an avid triathlete and runner.

Tuesday, April 16 • 4 pm | Tech L361

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