PHYSICS COLLOQUIUM:
Playing with Photons in Flatland: Controlling Light and Matter in Two-Dimensional Materials

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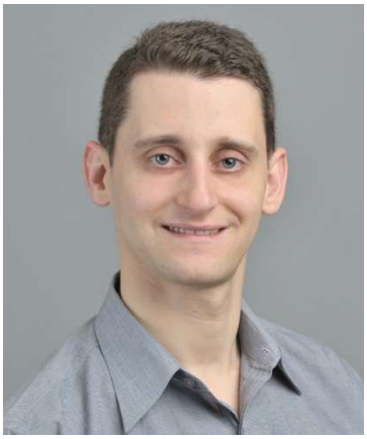
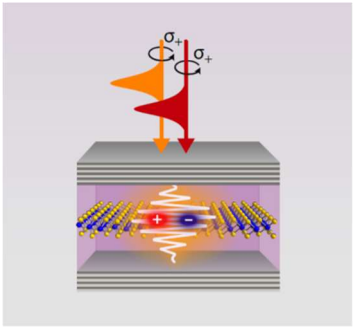
Date:
10/9/2020

Time:
10:30 AM-11:50 AM

Link:
Please email snsgradstaff@ucmerced.edu for Zoom link and passcode.





About The Speaker:

Nathaniel is an Associate Professor and Director of Undergraduate Studies in the Department of Physics and Astronomy at Northwestern University. His research is focused on the fundamental quantum interactions of photons with atoms, nano-scale materials, and magnetism. His group's current work emphasizes nanofabrication, photonics, and low-dimensional materials, with significant transdisciplinary interactions across chemistry, materials science, and astronomy. Nathaniel's past research expertise is broad, spanning semiconductor spintronics, atomic physics, novel materials, and quantum optics. At Northwestern, he has received the Early Career Research Award from the U.S. Department of Energy and the Young Investigator Award from the Office of Naval Research, and he is a Fellow of the Alfred P. Sloan Foundation. Prior to moving to Northwestern University, Nathaniel was a lifelong resident of Southern California. He was a Tolman Prize Postdoctoral Fellow at the California Institute of Technology, and he received his Ph.D. at the University of California, Santa Barbara as a Fellow of the Fannie and John Hertz Foundation. His work as an undergraduate at Harvey Mudd College, also in California, was honored with the LeRoy Apker Prize of the American Physical Society.

Abstract:

Light is a powerful tool of science. The quantum conception of light consisting of particles of discrete energy, or photons, underlies its interaction with matter. For solid materials, this understanding has led to transformational applications both as conventional as sensor and display technologies and as extraordinary as lasers. Despite this ubiquity, advances in materials science continue to reveal nuances in the interaction of light with matter. The emergence of layered materials of atomic-scale thickness presents a new two-dimensional landscape in which to play with the interaction between light and matter. These atomically-thin nanomaterials at the extreme limit of surface-to-volume ratio exhibit rich optical phenomenology that can be exploited to achieve new regimes of light-matter interactions. In this presentation, I will discuss photonic dressed states in monolayer semiconductors in which excitations of matter become entwined with the photon field. I will describe the emergence of spin-polarized half-light, half matter quasiparticles, or exciton-polaritons, in transition metal dichalcogenides embedded in photonic microcavities. I will trace these novel photonic dressed states across strong and weak regimes, adding to the toolbox for engineering quantum applications harnessing the unique properties of low-dimensional nanomaterials.

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