Condensed Matter Seminar

Exploring Non-Transfer Photon Interactions at the Nanoscale

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Thursday, December 5 ◆ 4:00 P.M.
Room 184 Nieuwland Science Hall

The frontiers of quantum physics lie not only in the manipulation of single particles, but in the deliberate design of complex systems piece-by-piece from basic constituents. Systematic control of large-scale quantum systems promises transformative advances such as new collective phenomena, novel realizations of condensed matter systems, efficient quantum simulation, and quantum computation and communication. The persistent challenge in this endeavor is to connect different entities over large scales while at the same time preserving each component's capability for quantum superposition, or coherence. Exemplifying this trajectory is the several-decade quest to couple a single atom with a single photon within the setting of cavity quantum electrodynamics (cQED), which is hoped could form the basis for quantum information networks. Offering an extension to the robust cavity QED framework that has been developed in a plethora of physical systems, I will discuss efforts to explore new interfaces between light and matter that exploit non-transverse near-field photons for control of helicity-sensitive nanoscale material systems. In particular, I will focus on exploiting non-transverse photons to realize non-reciprocity in solid-state quantum photonics. Extensions of this approach to recently-discovered two-dimensional semiconductor nanomaterials will be discussed, exhibiting the potential for exploring new physical regimes of light-matter coupling based on engineering quantum interactions with nanoscale materials.

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