

DEPARTMENT OF PHYSICS & ASTRONOMY

Physics & Astronomy Colloquium

Dr. Andrei Piryatinski
(Los Alamos National Lab)
(Host: Prof. Mahdi Sanati)



3:30 - 4:30 p.m. | Tuesday, Nov. 18
ESB I Building 120

Title: Engineering Coherent and Quantum Photons with Metal-Semiconductor Nanostructures

Abstract: This presentation will begin with a brief overview of the rapidly evolving field of quantum plasmonics and nanophotonics, setting the stage to discuss our recent contributions. Specifically, we examine how the surface plasmon resonances of metal nanoparticles facilitate enhanced local electromagnetic fields, enabling their application as photonic or plasmonic nano-antennas and optical cavities. By coupling semiconductor nanoparticles with these plasmonic resonances, we discuss the formation of hybrid light-matter quasiparticles known as exciton-polaritons. The talk will explore our theory and modeling efforts covering the nonlinear optical properties of polaritonic states in metal-semiconductor nanostructure arrays, highlighting mechanisms for generating coherent photon states in the up-conversion regime. We will also address down-conversion processes, including difference-frequency generation and terahertz (THz) pulse production, both driven by the nonlinear response of plasmonic arrays. Finally, the presentation will cover our recent work on modeling generation of entangled photon pairs via spontaneous parametric down-conversion (SPDC) within the nanostructured plasmonic arrays.



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Bio:

Andrei Piryatinski is a physicist and senior technical staff member in the Theoretical Division at the Los Alamos National Laboratory (LANL), where he also holds an adjunct faculty position in the Physics Department at the University of New Mexico. UNM Department of Physics and Astronomy.

Dr. Piryatinski obtained his M.S. in Physics from Kyiv University in 1992 and earned his Ph.D. in Physics from the University of Toledo in 1997. His postdoctoral work spanned the University of Rochester (1997–2000) and the University of Wisconsin–Madison (2000–2002). He joined LANL's Theoretical Division in 2002 and subsequently advanced to his current staff scientist role. Dr. Piryatinski's research focuses on the electronic and optical properties of nanostructured semiconductor materials, including hybrid photonic/plasmonic systems, quantum photon emitters, and coherent light sources. In his roles, he contributes to interdisciplinary efforts at the nexus of condensed matter physics, nanophotonics, and quantum materials, helping to bridge fundamental theory with emerging technologies.

