SDSU College of Engineering Mechanical Engineering

Mechanical Engineering Seminar Series
February 24, 2026, 11:00AM

Dean's Conference Room, E-203E

# Title: Army Research Office (ARO) Solid State Physics Program Overview

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**US Army Research Office**

**Abstract:** Solid-state physics (SSP) is broad branch of condensed matter physics that studies the physical properties of rigid matter, or solids. It employs principles from quantum mechanics, crystallography, and electromagnetism to understand how the arrangement of atoms in a solid gives rise to its macroscopic properties, such as electrical conductivity, heat capacity, and magnetic behavior. SSP and quantum materials are deeply interconnected fields, with the former providing the foundational knowledge and tools to explore the frontiers of the latter. In essence, the study of quantum materials is a natural evolution of solid-state physics, delving into more complex and exotic quantum phenomena that hold the promise for future technologies. The SSP program at ARO supports basic, foundational research in quantum materials and relevant quantum phenomena. The goal of his program is to drive research that looks beyond the current understanding of natural and designed condensed matter, to lay a foundation for revolutionary electronic device concepts for future generations of warfighters. Understanding, predicting, and experimentally demonstrating novel phases of matter in strongly correlated solid state materials will lay a foundation for new technology paradigms for applications ranging from information processing to sensing to novel functional materials. Interest primarily involves strong correlations of electrons, but those of other particles or excitations are not excluded His program is currently emphasizing endeavors to determine if material properties can be significantly altered by dressing bosonic states within materials with engineered fluctuations of the vacuum. In this talk, Dr. Neupane will provide an overview of the program highlighting various research areas of interest and recent accomplishments and describe how this research findings may one day impact Army applications. He will also provide insights into funding mechanisms, and the proposal application process.

**Brief Bio:** Dr. Mahesh R. Neupane is currently the Program Manager (PM) for Solid State Physics Program in the Army Research Office (ARO). In his current role as PM, he supports basic, foundational research in solid-state physics in support of Warfighter. Prior to serving as PM. Dr. Neupane was a research scientist in the RF and Electronics Branch in the EMSS Competency in Army Research Laboratory (ARL). Dr. Neupane earned his MS and PhD degrees in Electrical Engineering from University of California, Riverside (UCR) in 2012, and 2015, respectively. Dr. Neupane led the materials and device modeling team within the Diamond Electronics Group in Army Research Directorate (ARD) and was responsible for the design and development of multiscale modeling paradigms. His research endeavors at ARL involved atomistic study of materials and interfaces for RF and emerging electronics and have resulted in a patent and 80 publications in high-impact journals like Nature Communications, Advanced Materials, ACS Nano, Nano Letters, Physical Rev. B, and Applied Physics Letter, etc. As an ARL research scientist, he recently received PECASE 2025 Award, and Army's Simulations and Modeling Award. In addition, he is also recipient of multiple ARL wide awards and accolades such as OSD-LUCI Fellow 2022, ARL Early Career Award 2022, SEDD Directorate Diversity Award 2020, ARL Customer Service Award 2017, and ARL Science Award 2016 for his research and mentorship accomplishments. He also currently holds a research faculty position with the Department of Electrical and Computer Engineering (ECE) and Materials Science (MS) Program at UCR.