Excitations and Dynamics in Inversion Symmetry-Broken Phases

Emergent phenomena in solids, whether they involve lattice, charge, spin, orbital, or other degrees of freedom, are attractive for creating, stabilizing and/or controlling novel states in matter. New paradigms based on these phenomena are attractive candidates for capturing, converting, and carrying energy more efficiently. I will discuss two intriguing electromagnetic wave-matter interaction phenomena that can emerge in non-centrosymmetric solids. The first involves visible-light generation of two types of photovoltaic currents, one of which transforms, remarkably, a band insulator into a high-mobility conductor. In the second, we reimagine the energy landscape associated with a two-dimensional crystal defect that has traditionally been viewed as an impediment to the flow of radio-frequency microwave energy. Under special conditions a resonant behavior emerges, enabling the material to exhibit dielectric properties that can exceed intrinsic limits.

Jonathan E Spanier is Professor of Materials Science & Engineering, of Physics and of Electrical Engineering at Drexel University. He served as an associate dean of the College of Engineering, director of the university's Centralized Research Facilities, and currently as Interim Department Head of Mechanical Engineering & Mechanics. He received the PhD in applied physics from Columbia University in 2001 and completed a postdoctoral fellowship in physical chemistry at Harvard University prior to joining the Drexel faculty in 2003. He investigates the structure, physical, electronic and dielectric properties of solid-state electronic materials. He probes interactions of light with matter, including Raman scattering, the effects of symmetry and nanoscale effects on photovoltaic energy conversion, and electronic excitations and resonant phenomena. He also studies the solid phase epitaxy enabling formation of high-quality oxide perovskite films via atomic layer deposition. He received the Presidential Early Career Award for Scientists and Engineers, the Army Research Office Young Investigator Program Award, and the Distinguished Service Award from the Louis R Stokes Alliance for Minority Participation, and he was named a Louis and Bessie Stein Family Fellow. He was awarded a Japan Trust International Research Cooperation Fellowship from the National Institute of Information and Communications Technology to work as a visiting scientist at Fujitsu Labs. He participated by invitation in the National Academy of Engineering Frontiers of Engineering at UC Irvine in 2014. In 2016 he was elected Fellow of the American Physical Society, Division of Materials Physics.

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Theoretical and Applied Physics

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4:00 PM

Innovation Hall

Room E430

Refreshments will be available at

3:30 PM.

In E217

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