

Physics Colloquium

Prof. David J. Singh

“Thermoelectrics: Contraindication and its Resolution”

Thermoelectric materials are important for spacecraft power, waste heat recovery, thermal management, and cooling applications. Here I discuss the basic physics of thermoelectric effects and approaches for discovering new thermoelectric materials. A key issue is the contraindication of high thermoelectric performance, which places thermoelectrics into an interesting group of materials that includes transparent conductors, magnetic semiconductors, and multiferroics. The efficiency of thermoelectric systems is limited by the material's performance. This is measured by the figure of merit $ZT = \frac{S^2}{\sigma T}$, where S is the thermopower and the other symbols have their usual meaning. ZT is therefore a composite property involving electronic and thermal transport, with high ZT favored by high conductivity, high thermopower, and low thermal conductivity. However, these properties are inter-related, often to the detriment of high ZT . This talk discusses these correlations and points out ways to overcome them.

David J. Singh is a Curators' Professor in the Department of Physics and Astronomy at the University of Missouri, which he joined in 2015. Previously he was a Corporate Fellow and Group Leader at Oak Ridge National Laboratory and Section Head for Theory of Functional Materials at the Naval Research Laboratory. He has a Ph.D. in Physics from the University of Ottawa, is a fellow of the American Physical Society and, is a recipient of Gordon Battelle, E.O. Hulburt, and Sigma Xi prizes. He is the author of more than 600 scientific papers, with over 48,000 citations and an h-index of 80. He is a Fellow of the American Physical Society and has served in leadership roles in its Division of Computational Physics and on its Publications Oversight Committee. His scientific work centers on the development and use of first-principles methods for understanding the properties of materials. He has worked extensively on various classes of functional materials, including Ferroelectrics, Thermoelectrics, Superconductors, Magnets, and Optoelectronic Materials.

Thursday April 29th at 4:25 via Zoom

**If you are outside the Lehigh Physics Department, please email
Professor Bitan Roy (bir218@lehigh.edu)**