GABRIEL KOTLIAR
Professor of Physics
Rutgers University

“Towards a Predictive Theory of Strongly Correlated Electron Materials”

The standard model of solids, grounded on Fermi Liquid theory and powerful computational techniques, provides an accurate description of many materials of great technological significance. Correlated electron systems are materials which fall outside the standard model of solid state physics. They display remarkable emergent phenomena as for example metal to insulator transitions and unconventional high temperature superconductivity. The most recent example provided by the iron based high temperature superconductors. From a theoretical perspective correlated electrons pose a most challenging non-perturbative problem in physics.

In this colloquium I will give an elementary introduction to the field of strongly correlated electron systems and Dynamical Mean Field Theory (DMFT) a non perturbative method which provided a zeroth order picture of the strong correlation phenomena in close analogy with the Weiss mean field theory in statistical mechanics. Applications to materials containing f and d electrons will be presented to show how the anomalous properties of correlated materials emerge from their atomic constituents. Different roads for the formation of strongly correlated states, will be traced to Mott Hubbard and Hund’s physics. I will conclude with an outlook of the challenges ahead and the perspectives for rational material design using strongly correlated materials.

Gabriel Kotliar known for his contributions to the theory of strongly correlated and disordered electron systems. He is one of the pioneers of dynamical mean field theory and approach which revolutionized the ability to calculate the physical properties of these complex systems. His current research interests include the theory of the Mott transition, superconductivity in strongly correlated electron systems, the electronic structure of transition metal oxides, lanthanides and actinides, and the development of first principles approaches for predicting physical properties of materials. He received his Ph.D in Princeton in 1983, did a postdoc at the Institute for Theoretical Physics in Santa Barbara, was an assistant professor at MIT till 1987 and has been at Rutgers University since, where he is a Board of Governors Professor of Physics.

He was an Alfred P. Sloan Research Fellow in 1986 to 1988, received a Presidential Young Investigator Award in 1987, a Lady Davies Fellowship in 1994 and 2011, a Guggenheim fellowship in 2003, the Blaise Pascal Chair in 2005 and one of the recipients of the Agilent Technologies Europhysics Prize in 2006 of a Simons fellowship in 2017 and Humboldt fellowship in 2019. He has been a general board member of the Aspen Center for Physics (2006-2016) and is currently a member of the Canadian Institute for Advanced Research. He has been a visiting professor at the Ecole Normale and the Ecole Polytechnique in Paris and Hebrew University in Jerusalem. He has been a fellow of the American Physical Society since 2001 and has coauthored more than 350 publications in refereed Journals. In 2019 he was elected to the American National Academy of Sciences.