USC Viterbi
School of Engineering
Ming Hsieh Department of Electrical Engineering

Munushian Visiting Seminar Series

KEYNOTE LECTURE

F. Duncan M. Haldane

Sherman Fairchild University Professor of Physics at Princeton University
Nobel Laureate, Physics 2016

"Topological Quantum Matter, Entanglement, and the Second Quantum Revolution"

Monday, April 22, 2019
2:00 - 3:30 pm, MCB 102
Reception in lobby at 3:30pm

Abstract While the laws of quantum mechanics have remained unchanged and always validated for the last eighty-five years, new discoveries about the exotic states that they allow, entanglement, and ideas from quantum information theory have greatly changed our perspective, so much so that some talk of a "second quantum revolution" that is currently underway. The discovery of unexpected "topological states of matter", and their possible use for "topologically-protected quantum information processing" is one of the important themes of these developments, and will be reviewed. Some of the early work in the 1980's that began to expose topological quantum matter has already earned Nobel Prizes, including the experimental discoveries of von Klitzing (Integer Quantum Hall Effect, Nobel 1985), and Stormer and Tsui (Fractional Quantum Hall Effect, Nobel 1998), the theoretical discovery of its description by Laughlin (co-laureate, 1998), and the work honored by the recent 2016 prize, which also occured in the 1980's. Given the surprising nature of subsequent recent developments, and the excitement they have generated, it seems likely that more will follow, especially if the current attempts to demonstrate "braiding" become successful. It is no exaggeration to say that, at least in Condensed Matter Physics, the concepts and language used to describe quantum states of matter have dramatically changed since about 1980 as a result of all these developments, in which the quantum property of "entanglement" plays a key role.

Biosketch Duncan Haldane, who shared the 2016 Nobel Prize for Physics with David Thouless and Michael Kosterlitz, is the Sherman Fairchild University Professor of Physics at Princeton University, a Fellow of the Royal Society of London, and a Foreign Associate of the U.S. National Academy of Sciences. He is also a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the American Physical Society, and the Institute of Physics (UK).

He was awarded a share of the Nobel Prize for his theoretical work on "topological states of matter", including pioneering work on unexpected (and initially controversial) "topological quantum states" of one-dimensional systems of magnetic atoms (for which he had previously received the 1993 Oliver Buckley Prize of the American Physical Society), and on the 1988 theoretical prediction of (ferromagnetic) topological insulators exhibiting the "quantum anomalous Hall effect" (finally observed experimentally many years later in 2013) for which he shared the 2012 Dirac medal of the International Center for Theoretical Physics (Trieste) with Charles Kane and Shou-Cheng Zhang. His work helped to open up new directions and ways of thinking about quantum effects in condensed matter, and in recent years, "topological quantum matter" has grown into a very active experimental field which many believe may provide platforms for "quantum computing". He also initiated the field of "topological photonics". He currently works on "quantum geometry" in the "fractional quantum Hall effect".

Dr. Haldane received his Ph. D. in theoretical condensed matter physics from Cambridge University, under the direction and mentorship of Philip W. Anderson (Nobel Laureate in Physics 1977), and, before his appointment at Princeton University, worked at the Institut Laue-Langevin (Grenoble, France), the University of Southern California, Bell Laboratories, and the University of California, San Diego. Haldane was born in London in 1951, of mixed Scottish and Slovenian origins. Despite also having three forenames, he is unrelated to the famous biologist J. B. S. Haldane.