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Collaborative Innovation Center for Quantum Matter

Topological Quantum Computation

Prof. Sankar Das Sarma

University of Maryland

Time: 4:00pm, July. 9, 2014 (Wednesday)
时间: 2014年7月9日 （周三） 午4:00
Venue: Room 607, Science Building 5
地点: 理科五号楼607会议室

Abstract

I will discuss the revolutionary new concept of topological quantum computation, which is fault-tolerant at the hardware level with no need, in principle, of any quantum error correction protocols. Errors simply do not occur since the physical qubits and the computation steps are protected against decoherence by non-local topological correlations in the underlying physical system. The key idea is non-Abelian statistics of the quasiparticles (called 'anyons' as opposed to fermions or bosons), where the space-time braiding of the anyons around each other, i.e. quantum 'knots', form topologically protected quantum gate operations. I will describe in detail the theoretical principles guiding the experimental search for the appropriate topological phases of matter where such non-Abelian anyons, which are low-dimensional solid state versions of the elusive and exotic Majorana fermions hypothesized seventy-five years ago, may exist. I will critically discuss the recent experimental claims of observing the Majorana modes in semiconductor nanowire structures following earlier theoretical proposals, outlining the future developments which would be necessary to eventually build a topological quantum computer.

About the Speaker

Sankar Das Sarma is a Distinguished University Professor at the University of Maryland. He is also a professor of physics, a Fellow of the Joint Quantum Institute, and the Director of the Condensed Matter Theory Center at Maryland. Das Sarma received his PhD from Brown University in 1979, and has been a faculty member at Maryland since 1980. Das Sarma's research interests are the quantum theory of matter, statistical mechanics, and quantum information. His publications and expertise are broad, ranging over topics as disparate as topological quantum computation, fluctuations in financial markets, physics of high-speed transistors, and exotic quantum properties of solids and atoms at ultra low temperatures and in ultrahigh magnetic fields. Das Sarma has mentored more than 25 PhD students and more than 100 postdoctoral fellows at Maryland during the last thirty years.