Knots, Spin Networks and Anyonic Topological Quantum Computing

Louis H. Kauffman
University of Illinois at Chicago

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(Tea 3:30 pm Math Lounge)

Abstract

Quantum Computing is a technology in the throes of creation. On the theoretical side, quantum computing is the art of formulating algorithms in terms of compositions of unitary transformations and subsequent "measurements" of the results of those transformations. A relatively small set of unitary transformations suffice to generate all the transformations needed for such computation. One needs elements of $SU(2)$ and at least one other "gate" such as the famous controlled not gate $CNOT$. It turns out that certain unitary representations of the Artin Braid Group can generate quantum computation. In this way topology enters the subject of quantum information theory and promises the possibility of quantum computers based on physical braiding such as the anyons in the fractional quantum Hall effect. This talk will discuss the mathematical side of these issues. We will show how unitary representations of the braid group arise naturally from the structure of the bracket model of the Jones polynomial and generalizations of the Penrose theory of spin networks. This talk will be self-contained and accessible to advanced undergraduate students. We intend to discuss many ideas in the interface between topology and quantum information theory.

This talk should be accessible to undergraduates.