Abstract

Quantum Computation although is a revolutionary idea, is very hard to envisage for a practical use. The major problem behind this difficulty in building a scalable quantum computer is decoherence, or the loss of information to the environment, due to the interaction of the quantum state with the surroundings. There are two ways to overcome this difficulty. One at the software level, of which quantum error correcting codes is an example. Another more powerful way to deal with the above problem at the hardware level, is the topological quantum computation. In this scheme of quantum computation, states of matter, whose quasiparticle excitations are known as non-Abelian anyons, which exist in two dimensions are used to store information. The computation is carried out simply by moving the quasiparticles in two space dimensions around each other. These exchanges of quasiparticles in two space dimensions resemble the elements of braid group if their trajectory in 2+1 dimensional space-time is considered. Because the states are encoded non-locally, fault-tolerance is achieved beacuse all the errors are local in nature. There have been some experimentsl evidences which show that these topo- logical states, which are required for the topological quantum computation might exist in the fractional quantum Hall states. The fractional quantum Hall state at $\nu = 12/5$ were confirmed to carry these non-Abelian anyons, also known as Fibonacci anyons. Information can be stored in the composite of three Fibonacci anyons. Single-qubit gates and two-qubit gates can be approximated by simply weaving one or more Fibonacci anyons around other stationary Fibonacci anyons, using brute force search method. Many such gates have been calculated with an error of 1 part in 103 . In this thesis, those calculations have been reproduced and based on these determined braiding sequences, steps to a few algorithms have also been written out.