PAULO TEOTONIO-SOBRINHO, Instituto de Fisica - São Paulo University

Topological Order in Higher Gauge Theories and Cohomology

Quantum double models are good examples of quantum systems with topological order. They are lattice gauge theories with a finite gauge group. The lattice is described by a finite simplicial complex X whereas gauge configurations are maps from the set of 1-simplices into the gauge group. Recently, higher gauge theory generalizations have appeared in the literature. Examples where a 2-group plays the role of the usual gauge group lead to interesting models and new topological phases.

In this talk we are going to present a model with topological order that generalizes some of the ideas above. In our construction, the lattice is replaced by a chain complex C of finitely generated free abelian groups and the gauge group is replaced by a chain complex G of finite abelian groups. From this initial data, we construct a Hilbert space $\mathcal{H}$ and a frustration free Hamiltonian. Topological order is manifest when we describe the ground state space $\mathcal{H}_0 \subset \mathcal{H}$ in terms of a cohomology with coefficients in a finite chain complex. This cohomology, denoted by $H^0(C,G)$, was first introduced by Ronald Brown in 1964. He proved that H^0 is isomorphic to a product of usual cohomology groups. This results allows us to compute the ground state degeneracy and to find a convenient set of quantum numbers that labels the states of $\mathcal{H}_0$. Abelian examples of 1-gauge and 2-gauge theories are recovered as special cases.