1106-18-2090 **Xiao-Gang Wen*** (wen@dao.mit.edu), 6c-317, Dept. of Physics, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139. *Patterns of many-body entanglement and tensor category theory.*

Many-body entanglement (i.e. quantum phases of matter with topological order) is a truly new phenomenon. A new phenomenon in physics usually requires new mathematics to describe it. The continuous mechanical motion studied by Newton requires calculus. The general relativity of Einstein requires Riemannian geometry. Quantum phenomena require linear algebra. Right now, we are facing a similar situation: many-body entanglement and new topological phases of matter requires new mathematics, such as tensor category theory, to describe it. In this talk, I will explain how tensor category theory, group cohomolgy, etc may become the mathematical foundation for many-body entanglement and new topological phases of matter. The topological degeneracy in topological phases of matter can be used as qubits that naturally resists decoherence. So topological matter is a natural medium (and the only medium) to perform fault tolerant quantum computation. This becomes the field of topological quantum computation. (Received September 15, 2014)