

# Lev B. Ioffe

Department of Physics & Astronomy  
Rutgers University



## The Challenge of Fault Tolerant Quantum Computation

Department of Physics Colloquium

The classical computation is made possible by error correction that allows one to completely eliminate errors produced by solid state elements. In contrast to a discrete logical state of a classical computer, its quantum analogue is described the continuous wave function. Nevertheless, the ability to measure the quantum state in different basis allows error correction for quantum computation as well. Both classical and quantum error corrections can be implemented at a hardware level by a proper choice of the Hamiltonian which is characterized by the global (topological) symmetry, the quantum logical states correspond to degenerate ground state characterized by different values of the topological order parameter.

The most promising implementation of the Hamiltonians with topological symmetry is provided by Josephson junction circuits. Furthermore, these circuits and corresponding Hamiltonians allow not only the error corrections but also discrete quantum operations, e.g. fault tolerant computation. I will show the experimental data that confirm theoretical predictions.