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Topological Transitions in a Superconducting Qubit

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Topological Transitions in a Superconducting Qubit

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Topology, as it pertains to quantum objects, has become an important area of research because of recent discoveries pertaining to topological phases and insulators in condensed matter physics. It can be used as a tool to accurately describe phenomena in many different quantum systems. I present my study of topology as it pertains to two level systems, and experiments to probe the topology of transmon qubits. These simple quantum circuits allow for a high level of control which makes them good candidates to study topological properties and to model more complicated systems. Specifically, topological transitions of the first Chern number arise when manipulating the Hamiltonian of the system to form closed manifolds in Hilbert space, and watching the Berry phase of the transmon throughout the drive. There were problems having to do with the varying rotation of the qubit state based on the drive, which could be tackled by attempting to rotate the data, or by rotating the measurement procedure. This information has strong ties to quantum information processing, but will also eventually be used to more accurately simulate and study condensed matter.