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Title

Topological Quantum Computing

Speaker

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Abstract

The computational power of a quantum-mechanical Hilbert space is potentially far greater than that of any classical device. However, it is difficult to harness it because much of the quantum information contained in a system is encoded in phase relations which one might expect to be easily destroyed by its interactions with the outside world (`decoherence'). Therefore, one must keep the error rate low and represent information redundantly so that errors can be diagnosed and corrected. Remarkably, there are phases of electrons (`topological phases') in which this can occur automatically. Topological phases occur in the quantum Hall regime and may occur in other correlated electronic materials. In these phases, the low-energy states are sensitive only to the topology of the system, so interactions with the environment, which are presumably local, cannot cause errors. Some examples of such phases will be discussed as well as some ideas about how quantum information could be stored and manipulated in them.