WEBINAR RECAP

The Current State and Future of Quantum Computing

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Our UW–Madison Department of Physics is home to the Wisconsin Quantum Institute, a research and development enterprise with connections to several other departments at UW and collaborative agreements on national projects with other midwestern universities. The director of the Institute, physics professor Mark Saffman, presented a UWRA webinar in January entitled “What is Quantum Computing and Why Should I Care?” He discussed the basic physics of quantum computing, the characteristics of quantum computers that distinguish them from “classical” computers, the state of progress in the field, and the history of quantum computing at UW.

Quantum computing depends on two strange properties of suitably conditioned photons, atoms, or small molecules: “superposition” and “entanglement.” Harnessing these properties and managing the interactions of these “qubits” to solve problems is a huge technological challenge. However, once accomplished to form a quantum computer, the amount of information that can be processed at one time in a quantum computer can exceed the capacity of a classical computer by many orders of magnitude. For some problems, quantum computers are also much faster than classical ones, although the exact reason for this is not understood. Consequently, quantum computers can solve problems beyond the capacity of ordinary computers, such as the factoring of very large numbers (key to the security of messages sent over the Internet) and complex graphing problems of the sort encountered by businesses trying to map the shortest route for delivering packages to multiple addresses. Ultimately, quantum computers will supplement, not replace, classical computers.

Here at UW–Madison, research in quantum computing is addressing the physical design of quantum computers—what materials are best for making qubits and what architectures and operating conditions work best?