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Quantum simulation using a D-Wave 2000Q quantum annealing processor

- 講師** : **Dr. Andrew Berkley**
D-Wave Systems Inc.
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概 要

The D-Wave 2000Q (www.dwavesys.com) is a physical implementation of the quantum annealing algorithm based on the transverse Ising model. It is built using 2048 superconducting flux qubits operated at a temperature of 10 millikelvin. While much work using the D-Wave 2000Q has focused on the application of the quantum annealing algorithm to attack classical optimization problems, we have recently been investigating its use as a tool for quantum simulation. I will present two experiments using the quantum processor as a quantum simulator. First, we measured a Kosterlitz-Thouless phase transition in a 2D lattice of 1800 qubits, induced by the interplay between quantum fluctuations and geometrical frustration. Second, we studied a prototypical quantum magnetic system, an $8 \times 8 \times 8$ cubic lattice of effective Ising spins: by tuning the transverse magnetic field and the degree of disorder, we demonstrate transitions between paramagnetic, antiferromagnetic, and spin glass phases. Finally, I will discuss work on our next generation quantum annealing processor focusing on improved coherence and connectivity.

連絡教員 物理学系 西森 秀稔 (内線 2488)