Nishimori Group

Basic theory of quantum annealing

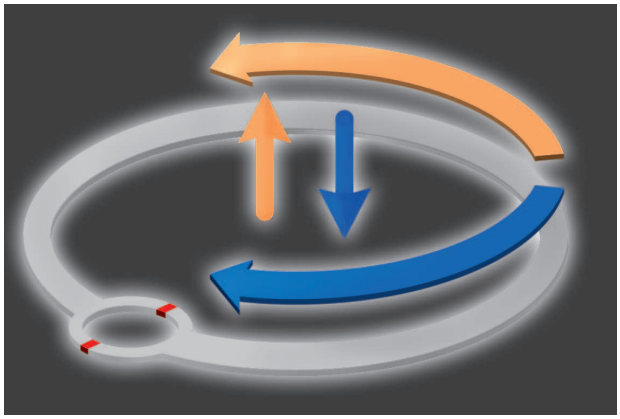
Quantum Computing Unit

http://www.qa.iir.titech.ac.jp/

- Performance enhancement of quantum annealing
- Error correction in quantum annealing
- Many-body phenomena in quantum spin systems

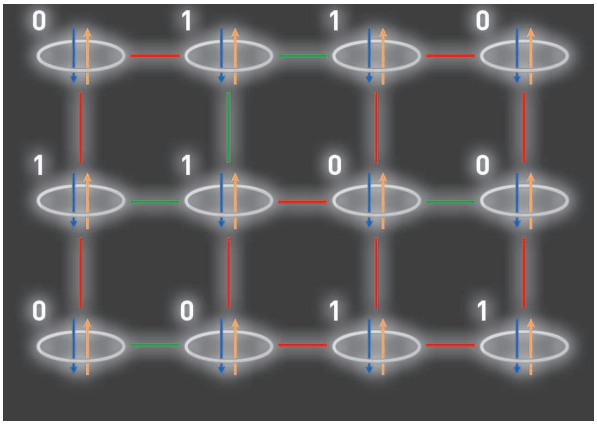
Quantum annealing, a term taken from the metallurgy technique "annealing", is a metaheuristic (generic approximate algorithm) for optimization problems. Basic theories are still to be established on the mechanisms of enhancement of its performance. The Unit thus focuses on the following topics:

(1) Possible enhancement of the performance by the introduction of new mechanisms.
(2) Error correction in quantum annealing.
(3) General many-body phenomena in quantum spin systems



Qubit by superconductor

In the quantum world, very small metal circuits at ultra-low temperature accommodate electric currents circling clockwise and anti-clockwise simultaneously, which are used to represent "0" and "1" simultaneously in a quantum bit (qubit). This is in marked contrast to the conventional computer, which uses bits that can only be set to a single state of "0" or "1".



How quantum annealing works

As we turn on the interactions between qubits, the possibility of superposition of two states "0" and "1" is reduced at each qubit, and the system eventually settles to a single state.