The 920th IMS colloquium
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Colloquium on Lattice Gauge Annealing

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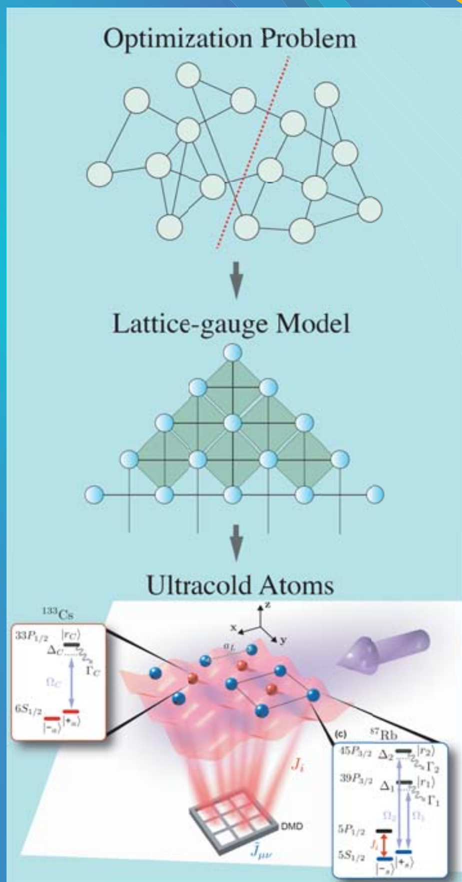
Date & Time: 2018/6/13 (Wed.) 16:00-

Place: IMS Research Building Room 201

In the quantum annealing paradigm an optimization problem is encoded in an infinite range spin model. Finding the ground state of spin model is equivalent to solving the optimization problem. Due to the large number of almost degenerate ground states, this problem is exponentially hard with classical algorithms. In quantum annealing, the problem is translated to a quantum adiabatic protocol. The system is initially prepared in the ground state of a trivial Hamiltonian which is then adiabatically transformed to the problem Hamiltonian. Using the quantum adiabatic theorem this process allows one to prepare the ground state of the problem Hamiltonian. In lattice gauge annealing, the infinite range spin glass is replaced by a lattice gauge model [1]. In this mapping, qubits are arranged in 2d on a square lattice and the optimization problem is encoded in the local fields. The interactions are problem independent 4-body interactions among nearest neighbors. This allows one to implement a programmable quantum annealing device in several state of the art qubit platforms [2]. The 4-body constraints are lattice gauge degrees of freedom and the problem Hamiltonian is independent of the choice of the gauge. However, the gauge degrees of freedom can be used to design the quantum paths of the adiabatic protocol. As an application, individually programmed constraints can be used to program the amplitudes of the superpositions of bit strings [3].



[1] W. Lechner, P. Hauke, and P. Zoller, Science Advances 1, e1500838 (2015).
[2] A. W. Glaetzle, R. M. W. van Bijnen, P. Zoller, and W. Lechner, Nature Communications 8, 15813 (2017).
[3] L.M. Sieberer and W. Lechner, arXiv preprint arXiv:1708.02533 (2017).

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