

## Multi-dimensional quantum paths to optimization problems

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Quantum annealing is a generic algorithm to solve combinatorial optimization problems using quantum fluctuations to search for the optimal state in the phase space. It is a quantum-mechanical counterpart of simulated annealing, in which one makes an ingenious use of classical thermal fluctuations in a controlled manner. In the present talk, I will first give an overview of quantum annealing for those who are not familiar with it [1]-[9]. Then I will describe our recent results on how to overcome the difficulties encountered in a very simple problem of the ferromagnetic many-body Ising model [10]. In particular, a method to avoid problematic first-order phase transitions is described, which is essential for the effectiveness of quantum annealing [11, 12].

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