Quantum annealing, gauge theories, and optimal control

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Quantum optimal control allows finding the optimal strategy to drive a quantum system in a target state. We review an efficient algorithm to optimally control many-body quantum dynamics and apply it to quantum annealing, going beyond the adiabatic strategy. We report some theoretical and experimental applications of optimal quantum annealing, among which, its application to Rydberg atoms in optical lattices and to the gauge theory resulting from the mapping of classical hard problems to short-range quantum Hamiltonians. Finally, we present an information theoretical analysis of quantum optimal control processes and speculate on their implications on quantum annealing.

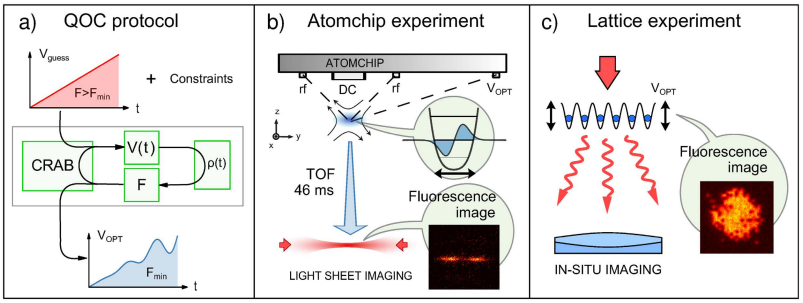

Figure 1. Optimal control protocols applied to quantum technologies experiments, from [2].

[1] J. Cui et al. Quantum Sci. Technol. **2**, 35006 (2017).
[2] S. van Frank et al. Sci. Rep. **6**, 34187 (2016).
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[4] S. Lloyd and S. Montangero, Phys. Rev. Lett. **113**, 10502 (2014).