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Hybrid Quantum-Classical QAOA Quantum Simulation with Trapped Atomic Ions[1] KATE COLLINS, PATRICK BECKER, HARVEY B. KAPLAN, ANTONIS KYPRIANIDIS, WEN LIN TAN, ANIRUDDHA BAPAT, LUCAS BRADY, GUIDO PAGANO, ALEXEY V. GORSHKOV, University of Maryland Department of Physics and NIST, STEPHEN JORDAN, Microsoft Quantum, CHRISTOPHER MONROE, University of Maryland Department of Physics and NIST — Hybrid quantum-classical algorithms, such as quantum approximate optimization algorithms (QAOA)[2], are a promising tool to provide an approximate set of solutions to combinatorial optimization problems and to prepare non-trivial quantum states[3]. Here we report the implementation of a shallow-depth QAOA protocol with trapped atomic ions to compute the ground state energy of the transverse field Ising model with tunable long-range interactions. We performed an exhaustive search of the variational parameters to optimize the algorithm and investigated its performance as a function of system size. We plan to interface our quantum simulator with a classical optimization algorithm to find a set of parameters that minimize the energy output of QAOA.

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[2]E. Farhi et al., arXiv:1411.4028v1
[3]W. W. Ho & T. H. Hsieh, arXiv:1803.00026v3

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