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**Quantum Vertex Model for Reversible Classical Computing**

CLAUDIO CHAMON, Boston University, EDUARDO MUCCILOLO, University of Central Florida, ANDREI RUCKENSTEIN, ZHICHENG YANG, Boston University — We present a planar vertex model that encodes the result of a universal reversible classical computation in its ground state. The approach involves Boolean variables (spins) placed on links of a two-dimensional lattice, with vertices representing logic gates. Large short-ranged interactions between at most two spins implement the operation of each gate. The lattice is anisotropic with one direction corresponding to computational time, and with transverse boundaries storing the computations input and output. The model displays no finite temperature phase transitions, including no glass transitions, independent of circuit. The computational complexity is encoded in the scaling of the relaxation rate into the ground state with the system size. We use thermal annealing and a novel and more efficient heuristic annealing with learning to study various computational problems. To explore faster relaxation routes, we construct an explicit mapping of the vertex model into the Chimera architecture of the D-Wave machine, initiating a novel approach to reversible classical computation based on quantum annealing.

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