Measurement-based Quantum Computing & Efficient variational simulation of non-trivial quantum states

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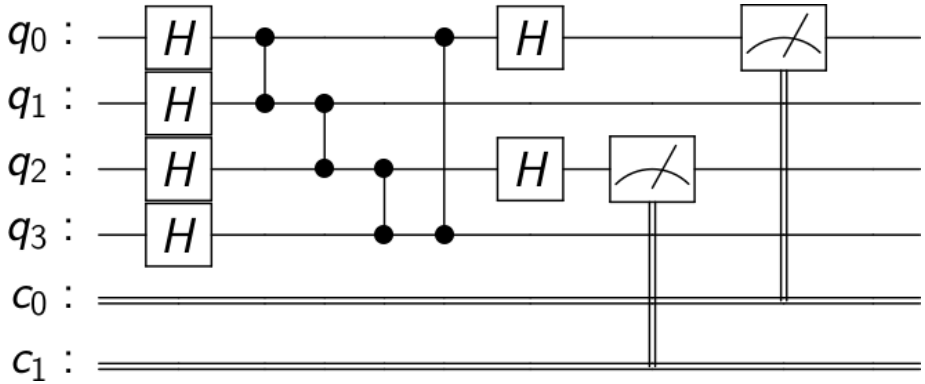
Layout

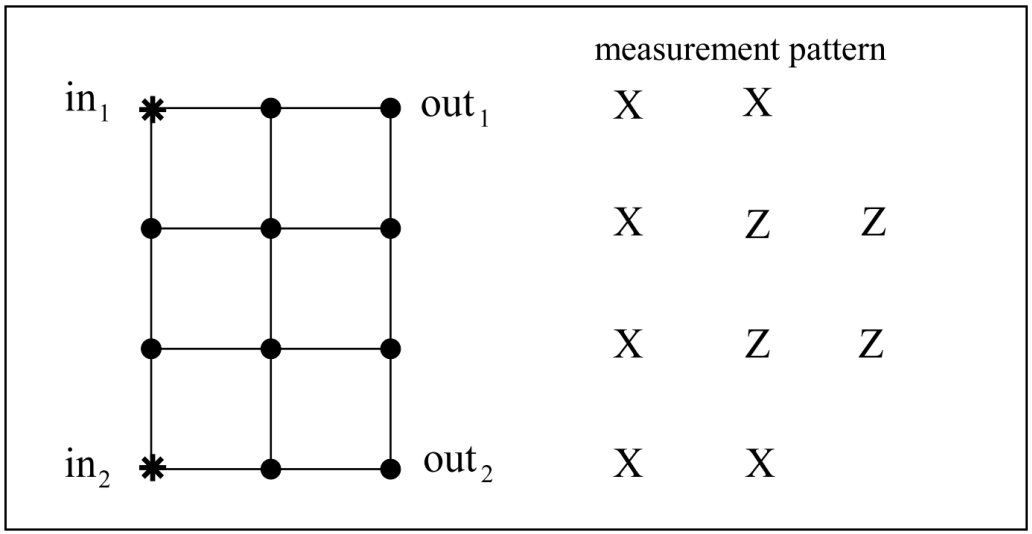
- Measurement-based quantum computing (MBQC)
- Variational simulation of non-trivial quantum state
- Research question: MBQC as an efficient simulation?

MBQC: One-way quantum computer [RB01]

Conventional quantum circuit models:

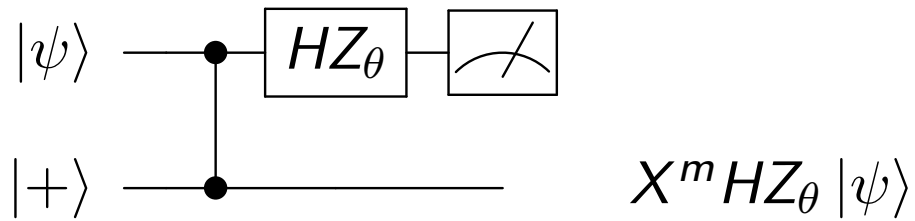


Cluster state: [Joz06]



MBQC: One-way quantum computer

Quantum teleportation = Entanglement + Measurement



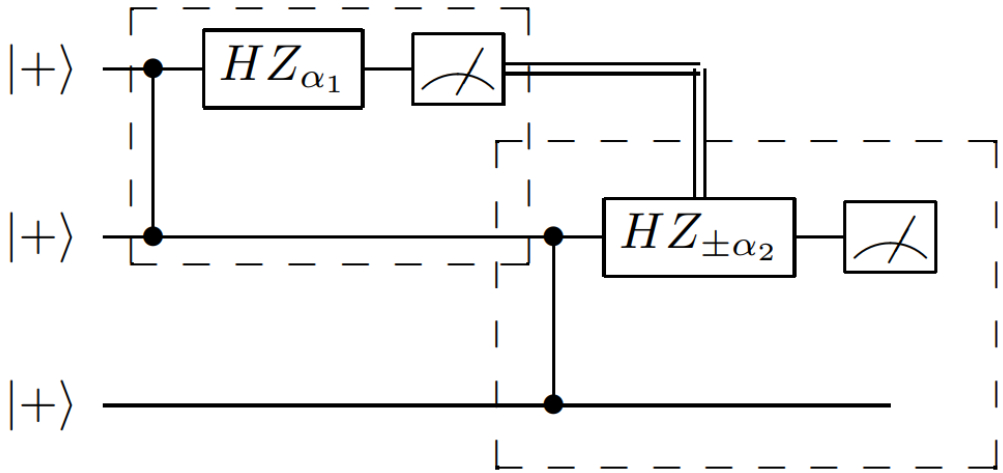
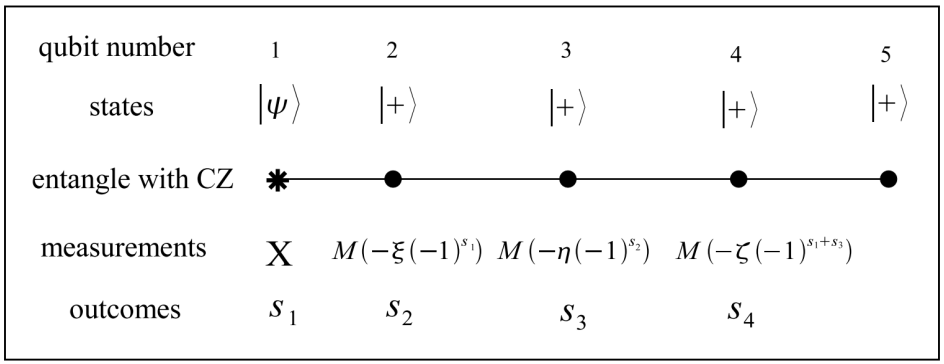


Figure: From [Nie06]

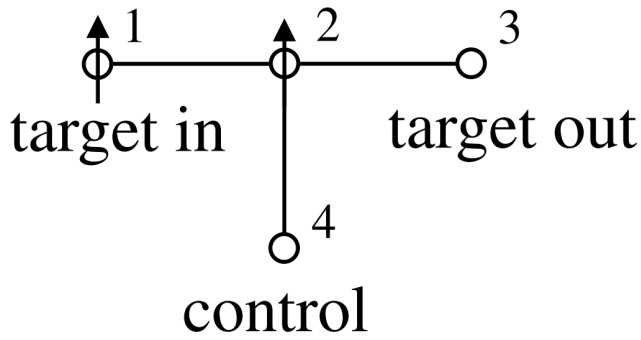
MBQC: One-way quantum computer

Universality: Quantum circuit model $\equiv$ Cluster state formulation

- Transfer of information by teleportation
- Any qubit rotation can be done on a chain of qubits
- The CNOT gate can be implemented in a "T" configuration



(a) From [Joz06]



(b) From [RB01]

Variational simulation of non-trivial quantum states

QAOA:

Measurement-based QAOA

Can we do better?

How robust is QAOA?

Consider the TFIM without translation invariance:

$$\mathcal{H} = \sum_j Z_j Z_{j+1} + \sum_j g_j X_j$$

Summary

References

- Richard Jozsa, *An introduction to measurement based quantum computation*, NATO Science Series, III: Computer and Systems Sciences. Quantum Information Processing-From Theory to Experiment **199** (2006), 137–158.
- Michael A. Nielsen, *Cluster-state quantum computation*, Reports on Mathematical Physics **57** (2006), no. 1, 147 – 161.
- Robert Raussendorf and Hans J. Briegel, *A one-way quantum computer*, Phys. Rev. Lett. **86** (2001), 5188–5191.