On-Chip Verified Measurement Based Quantum Computation with an Ion-Trap QPU

QCTiP 2025 - Dan Mills, Cica Gustiani, Dominik Leichtle, Jonathan Miller, Ross Grassie, Elham Kashefi
arXiv:2410.24133

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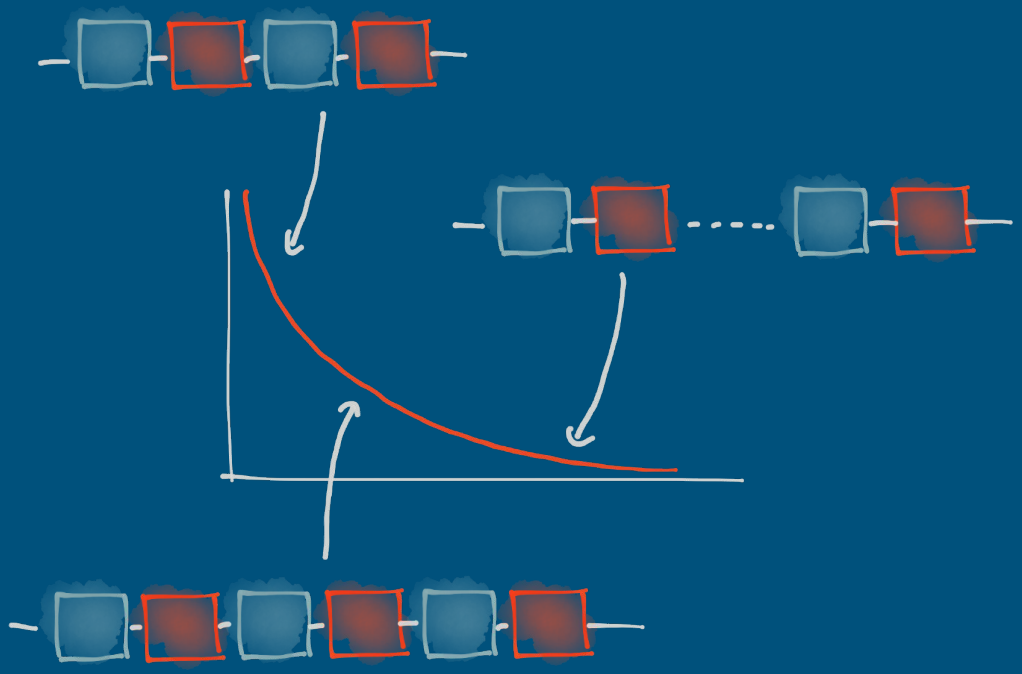
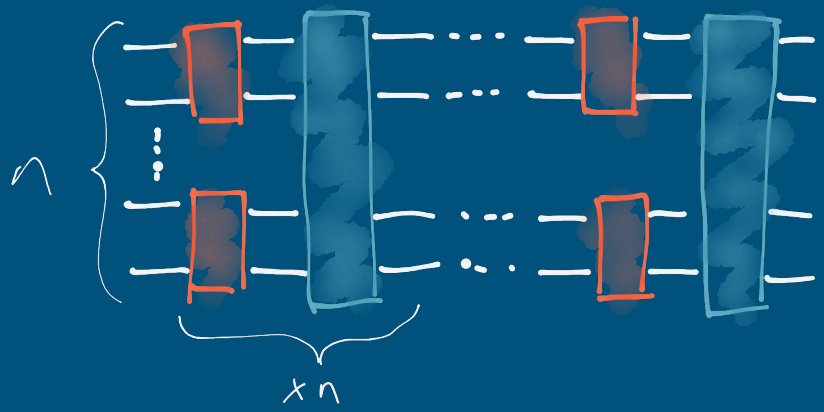
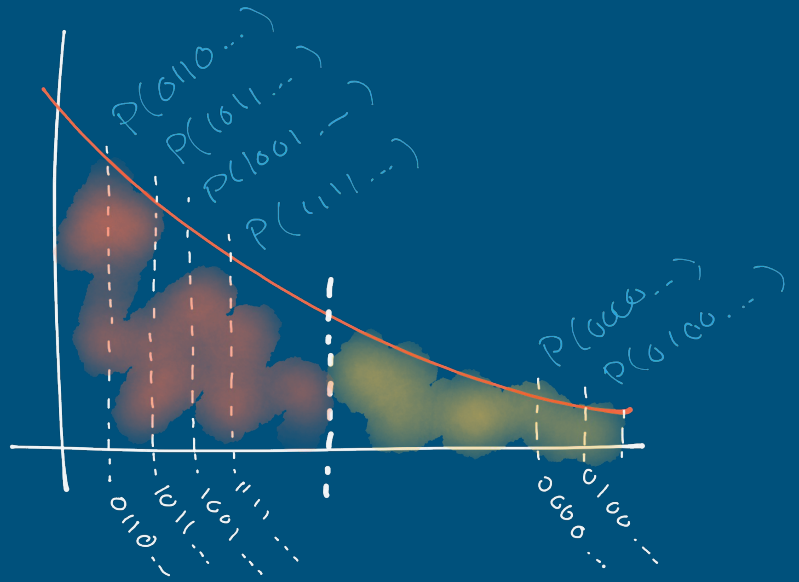
Building confidence in the outputs of quantum computers

Randomised Benchmarking

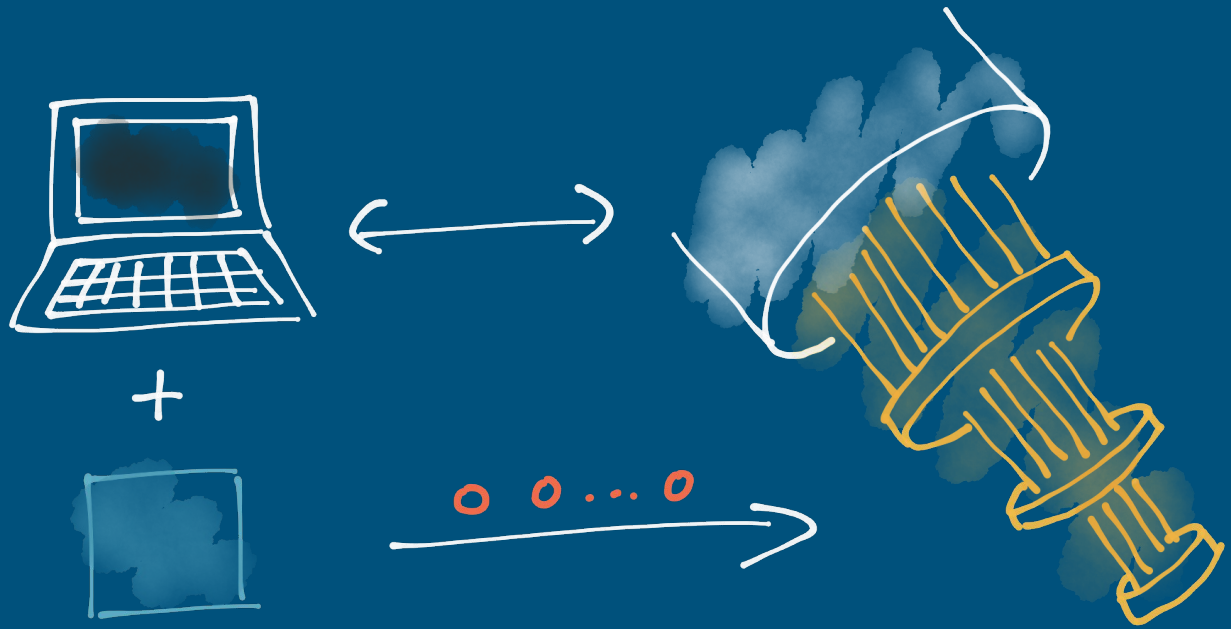


Random Circuit Sampling

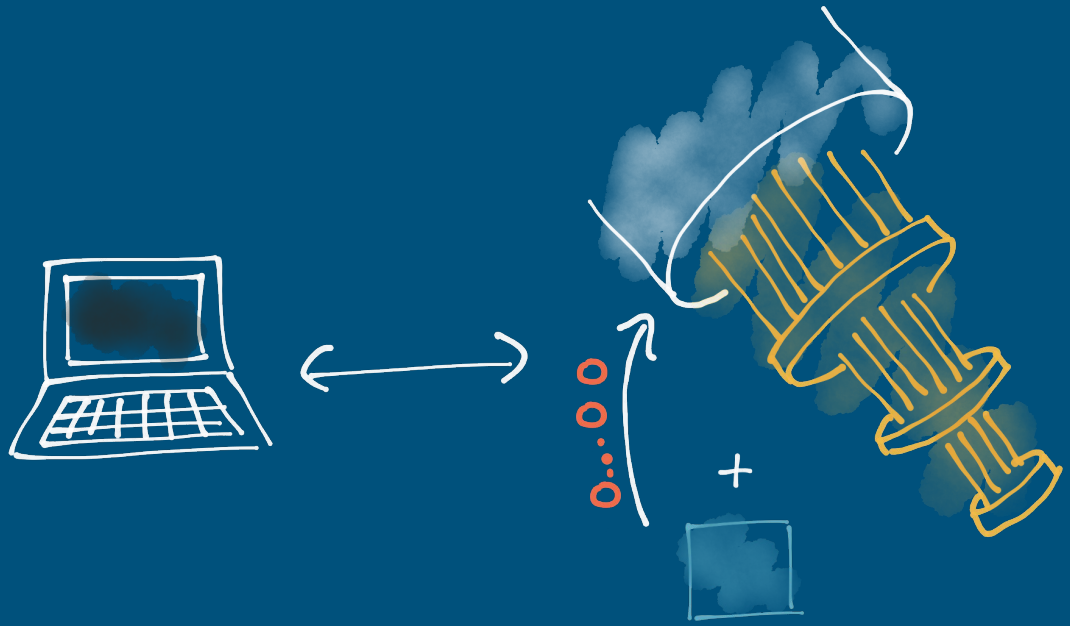




VUBQC



VUBQC



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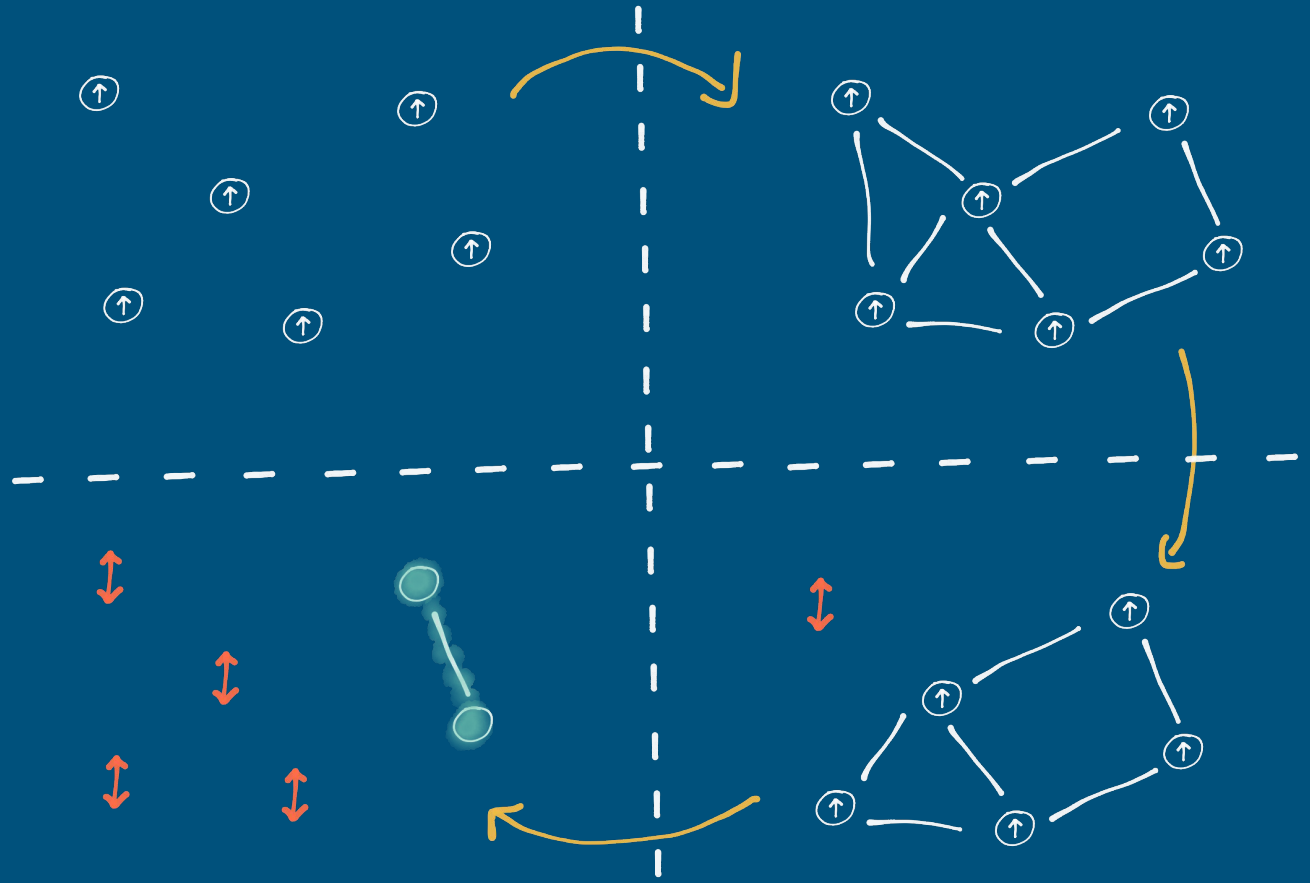
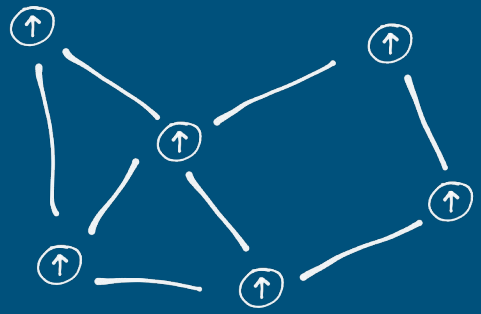
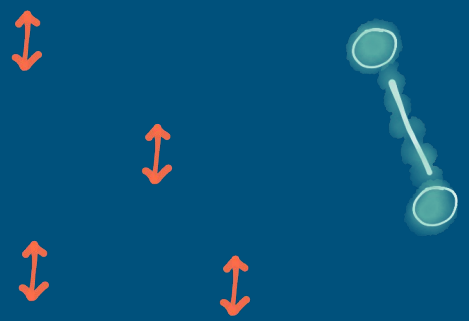
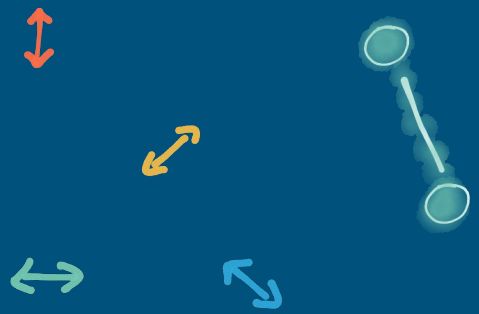
Measurement Based Quantum Computation

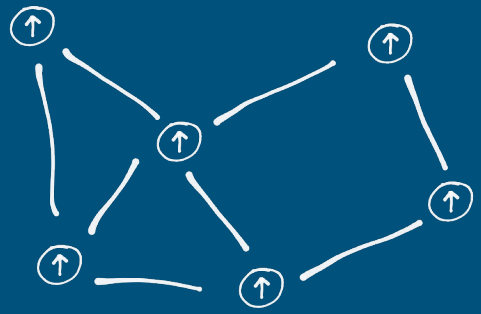


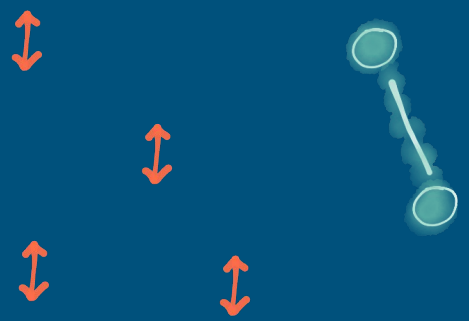


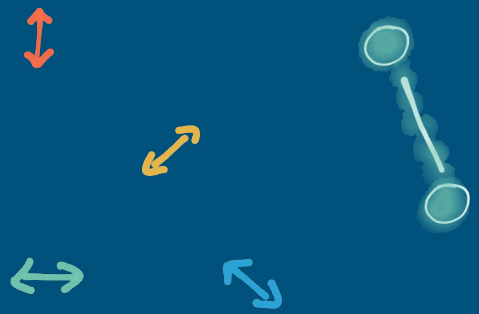


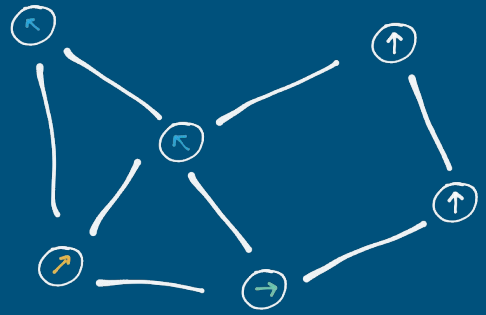


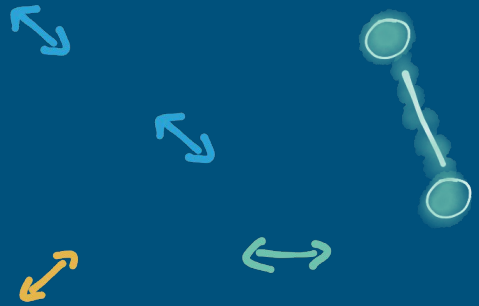
Verified Measurement Based Quantum Computation

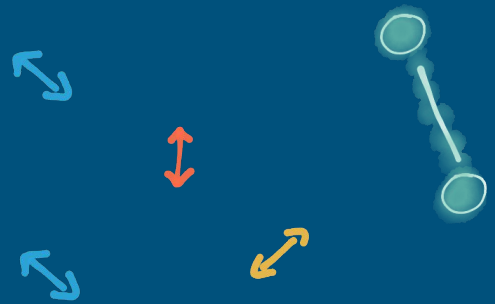


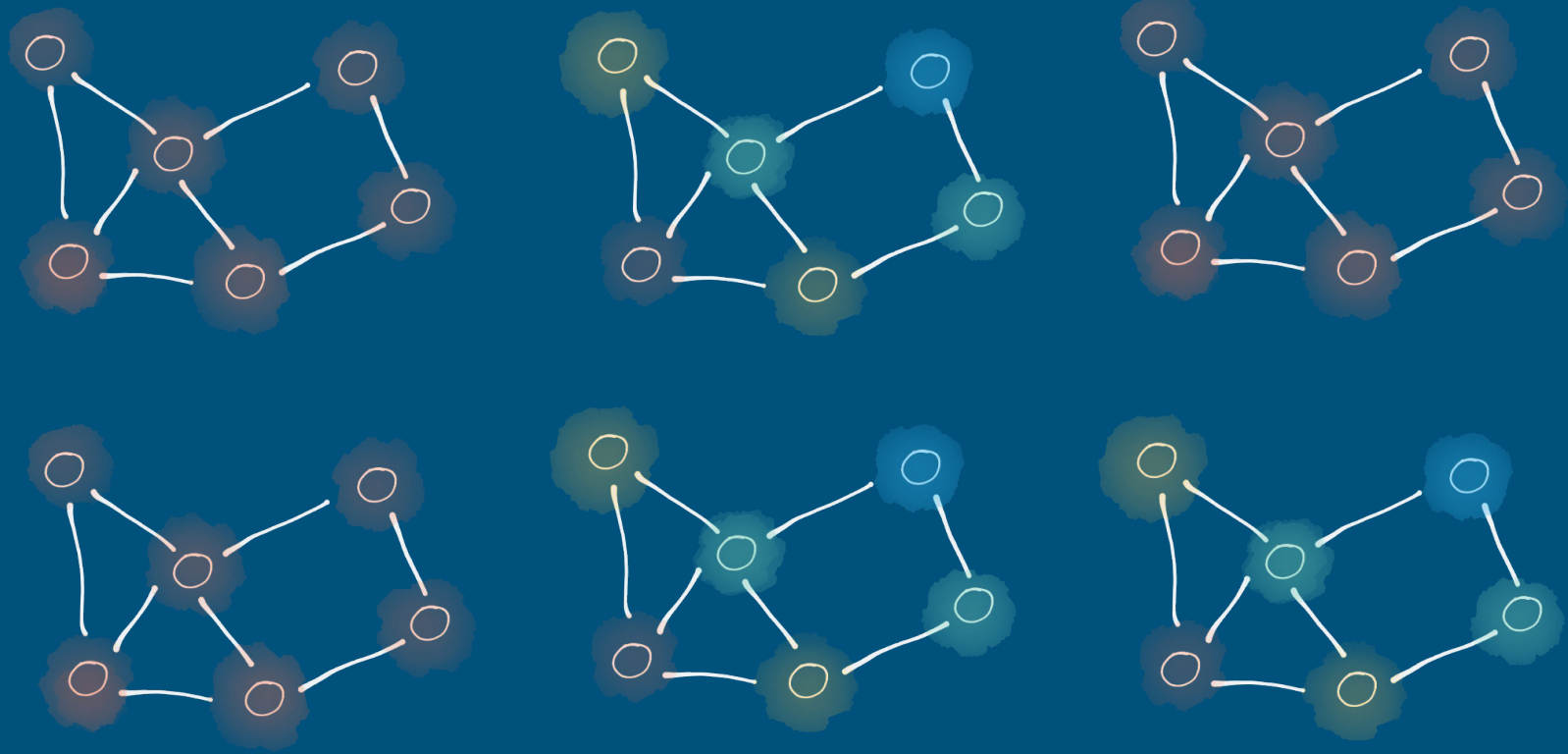












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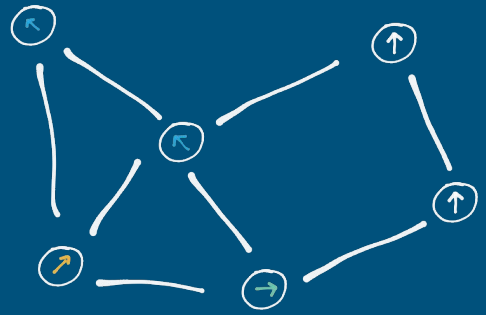

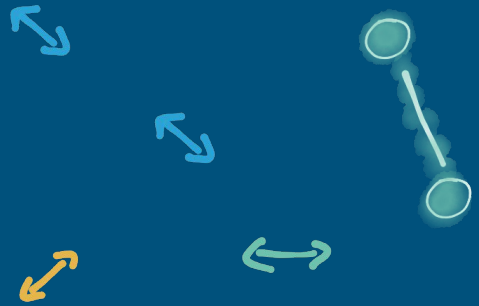

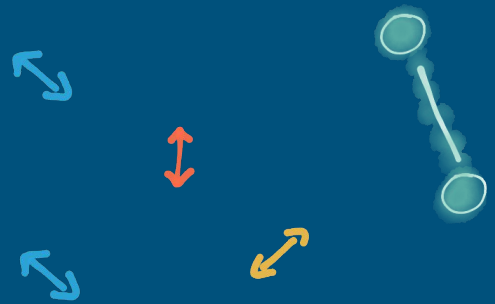

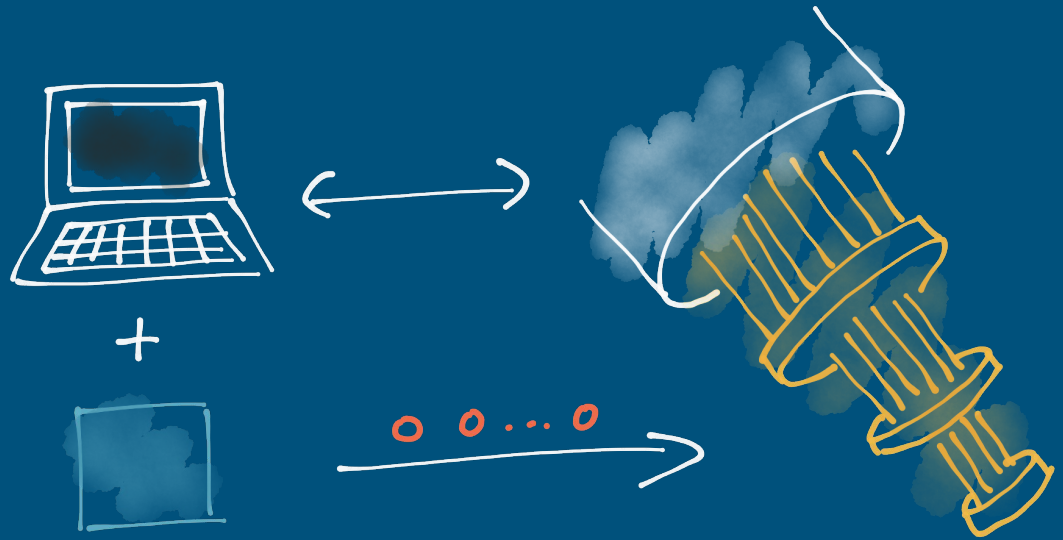

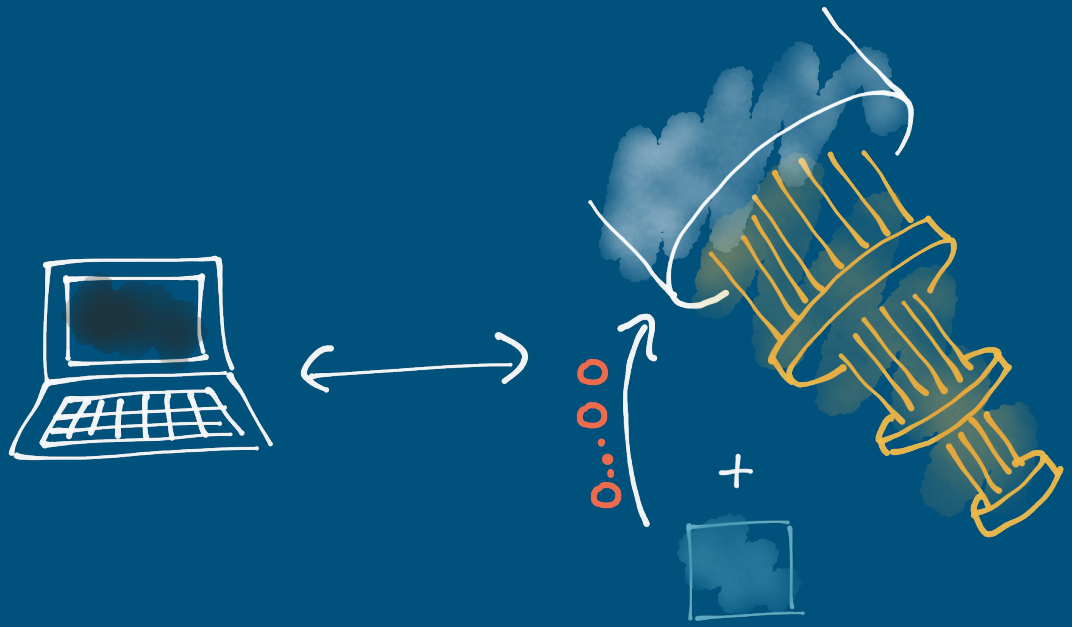

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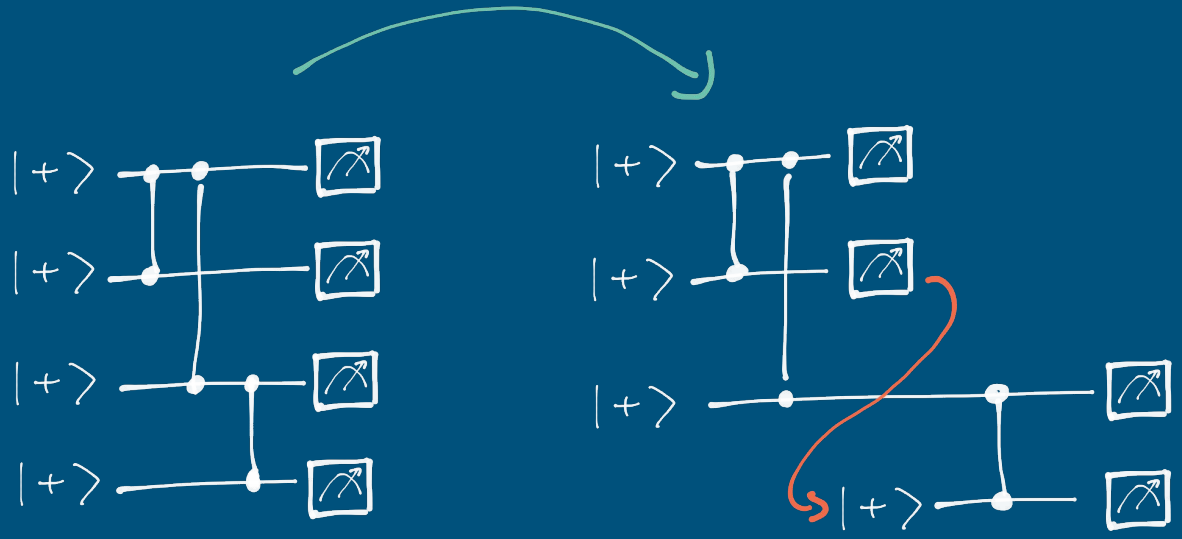
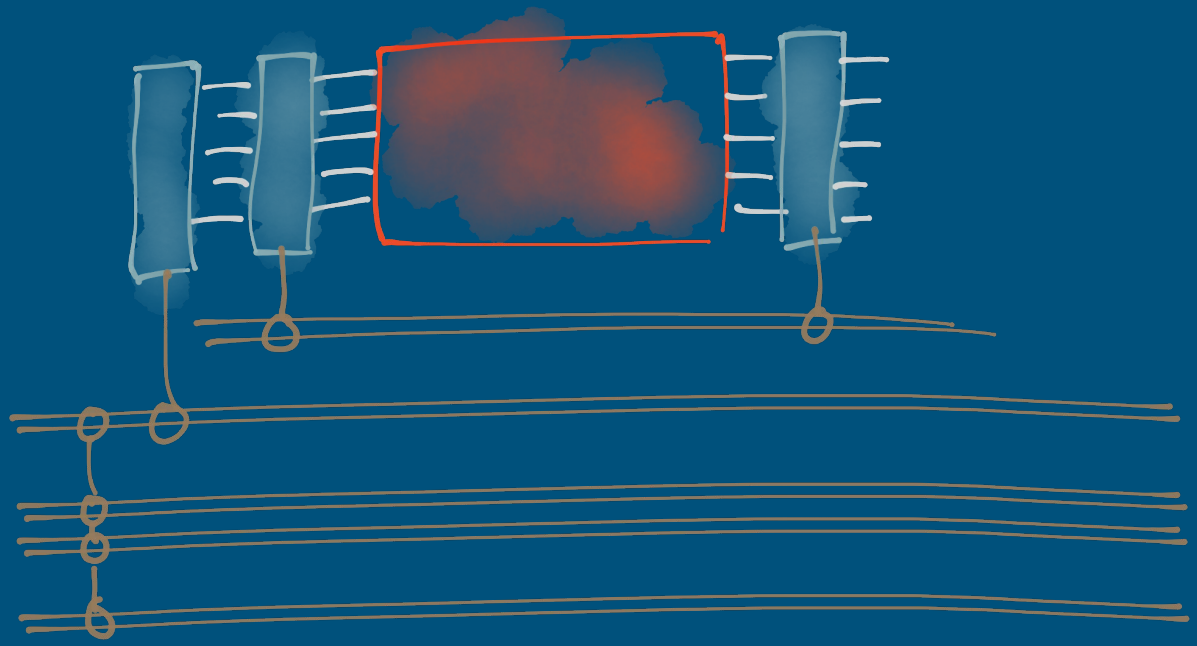
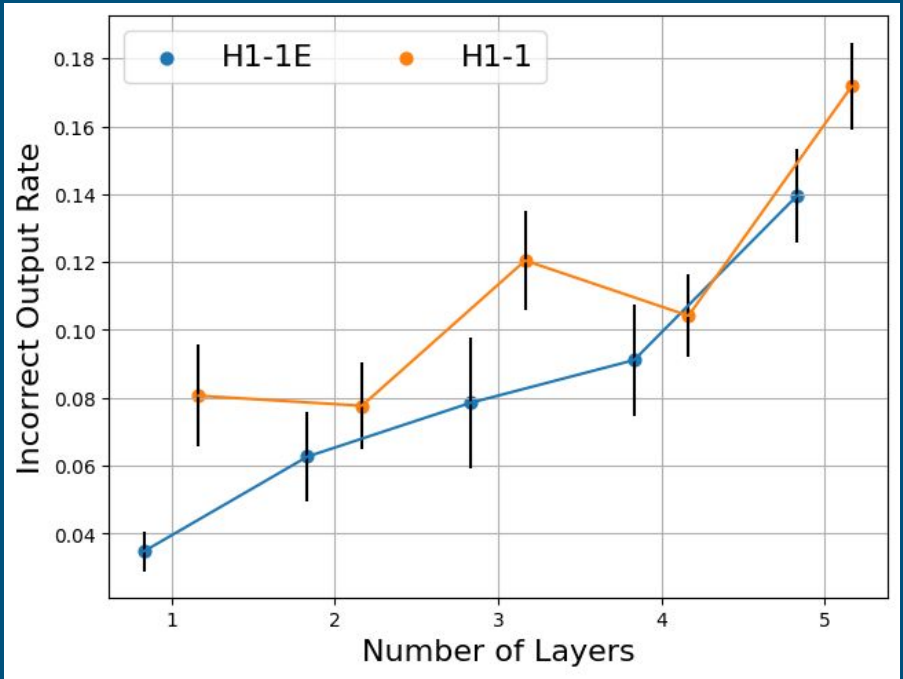
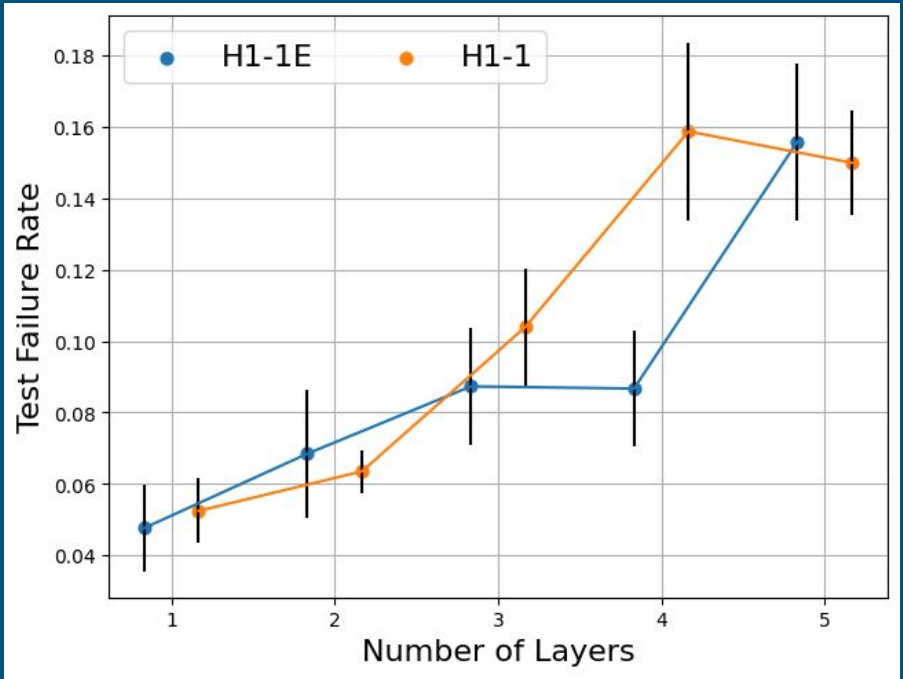
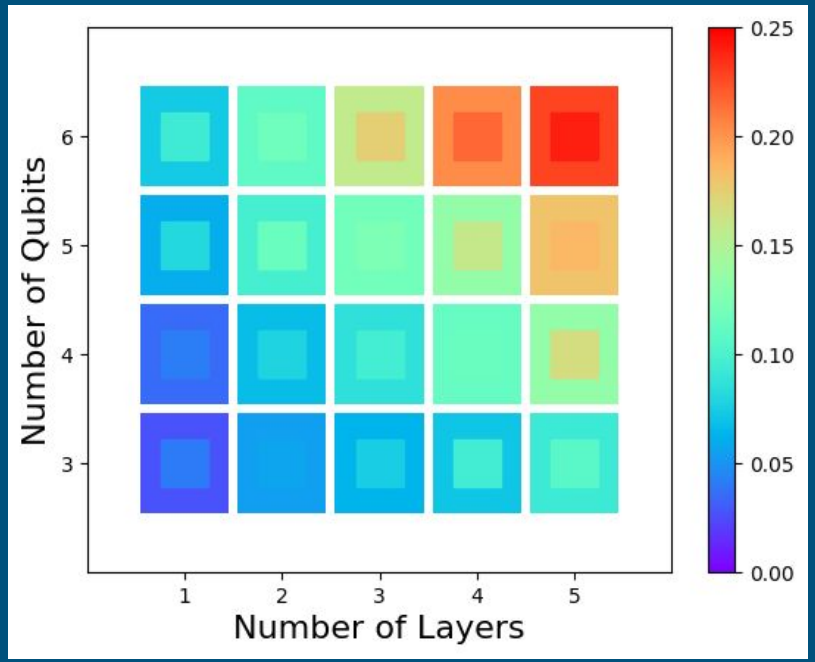
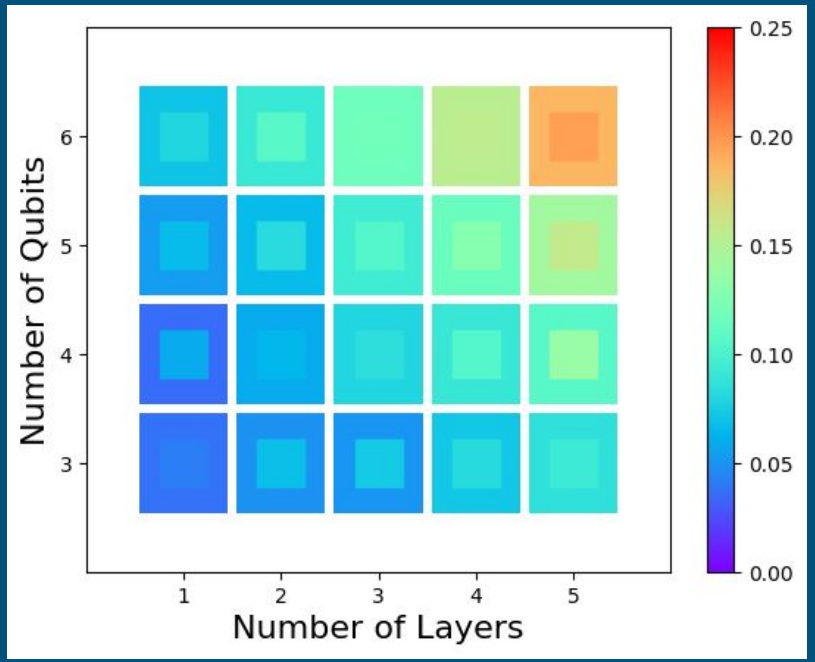


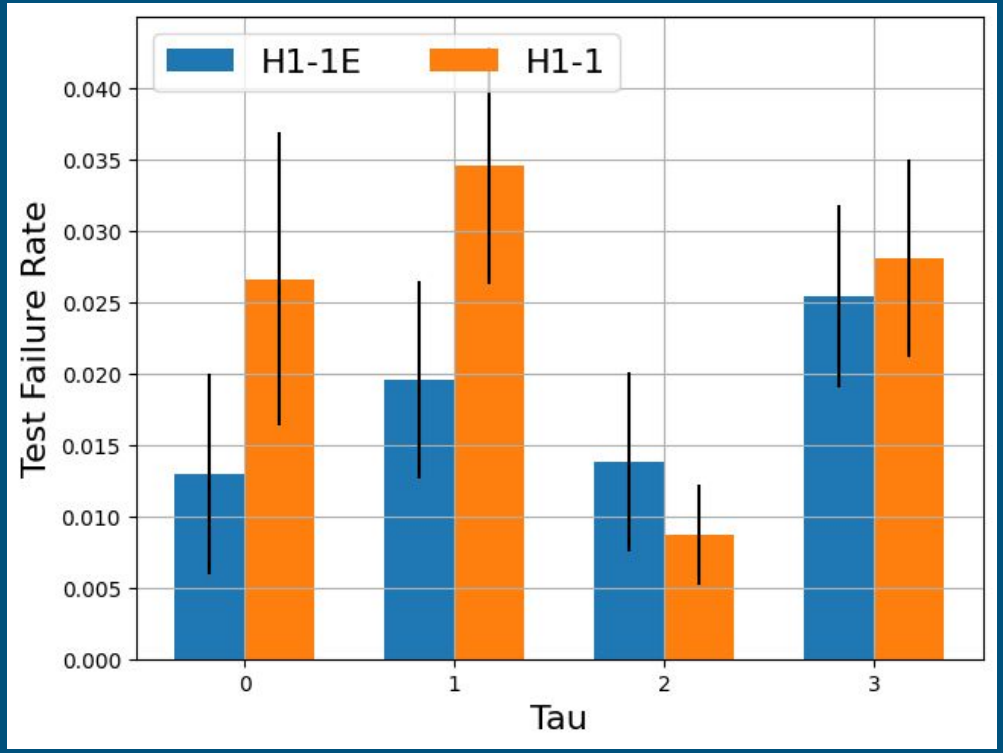



H1-1E
H1-1
Incorrect Output Rate
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
1
2
3
4
5
Number of Layers


H1-1E
H1-1
Test Failure Rate
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
1
2
3
4
5
Number of Layers


Number of Qubits
6
5
4
3
1
2
3
4
5
Number of Layers
0.25
0.20
0.15
0.10
0.05
0.00


Number of Qubits
6
5
4
3
1
2
3
4
5
Number of Layers
0.25
0.20
0.15
0.10
0.05
0.00


H1-1E
H1-1
Test Failure Rate
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
1
2
3
Tau

Conclusions

The three pillars of quantum advantage: application, error correction, and verification.

More experiments and formalisation:

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