

Benchmarking report of sinq20

September 19, 2025

1. Report of Changes

This report presents a benchmarking study of a quantum computer based on superconducting qubits, procured from IQM Machines and integrated with Keysight Technologies measurement solutions. Our objective is to evaluate device performance across key metrics (T1, T2, fidelity, ...) but also showcasing the performances of simple applications of quantum computers.

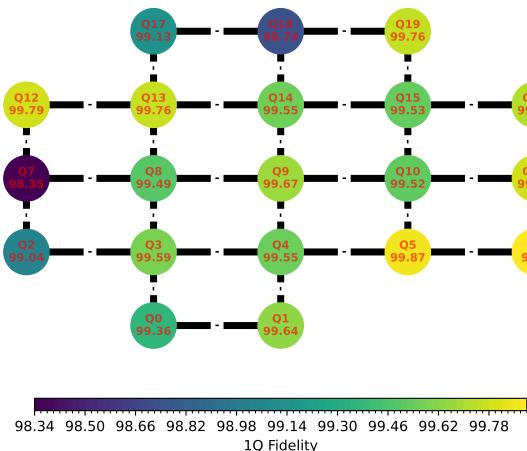
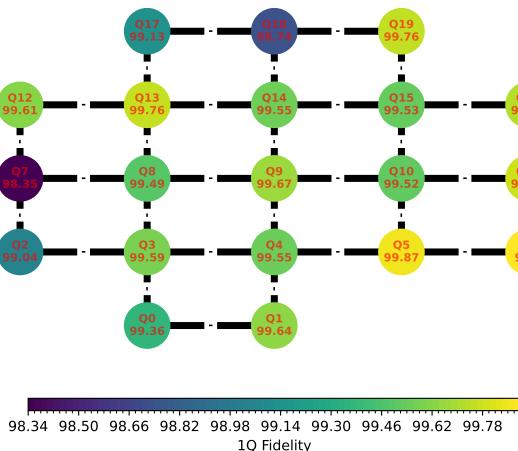


2. Version Comparison

Library	Version	Library	Version
qibo	0.2.19	numpy	2.2.6
qibolab	0.2.9	qibocal	0.2.3
matplotlib	3.10.3	scipy	1.15.3
scikit-learn	1.6.1	pandas	2.2.3
networkx	3.4.2	sympy	1.14.0
torch	2.7.0		

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3. One and two qubit fidelities



4. Statistics

	Average	Median	Min	Max
T1 (ns)	1.28e+04	1.23e+04	646	3.65e+04
T2 (ns)	2.36e+25	4.11e+03	125	9.43e+26
Fidelity	None	None	None	None
RO fidelity	0.794	0.777	0.777	0.927
Mermin Max	0.69			

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5. Benchmark Results

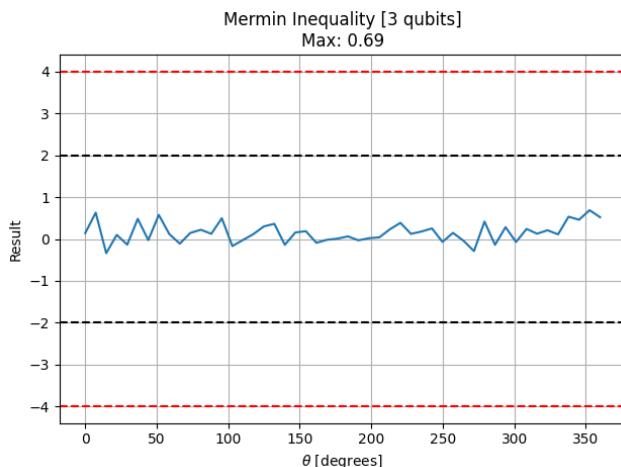
Qubit n	Fidelity	Error Bars
0	0.994	± 0.000465
1	0.996	± 0.000249
2	0.99	± 0.00117
3	0.996	± 0.000322
4	0.995	± 0.000816
5	0.999	± 0.000534
6	0.999	± 0.000308
7	0.983	± 0.00219
8	0.995	± 0.000549
9	0.997	± 0.000698
10	0.995	± 0.000441
11	0.998	± 0.000483
12	0.996	± 0.000371
13	0.998	± 0.000344
14	0.996	± 0.000846
15	0.995	± 0.000647
16	0.997	± 0.000463
17	0.991	± 0.0006
18	0.987	± 0.00163
19	0.998	± 0.00042

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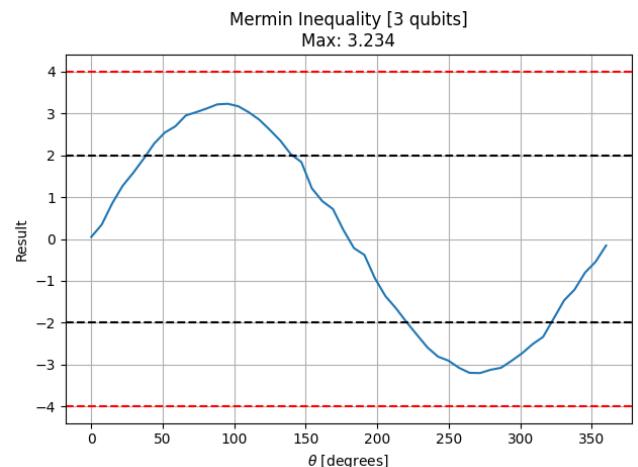
6. 5 Qubit Mermin

Mermin's algorithm for 3 qubits.

- **Runtime:** 3.68042 seconds.



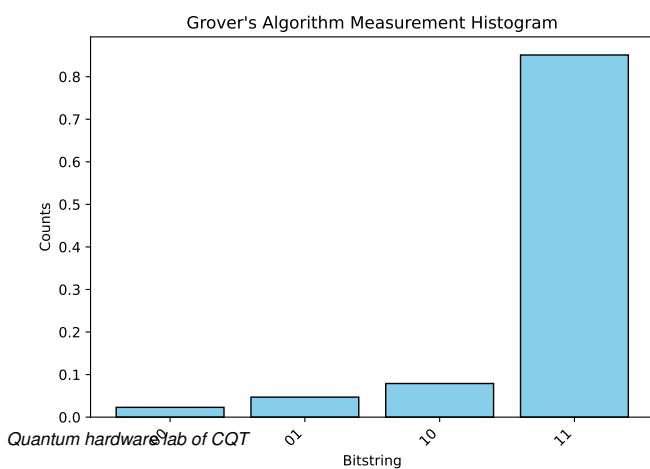
- **Runtime:** 14.46782 seconds.



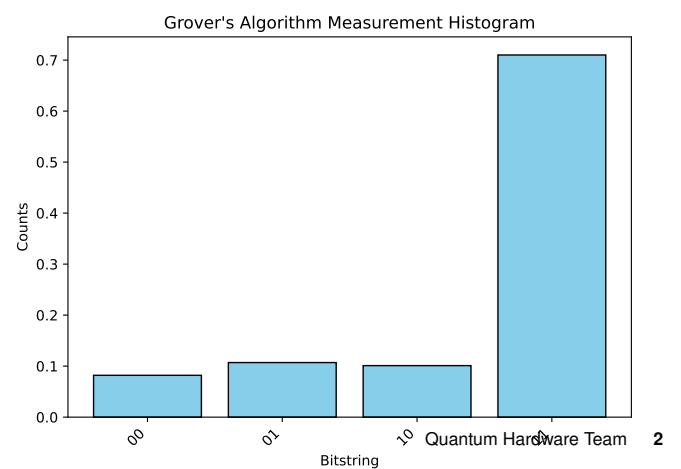
7. Grover - 2 qubits

Grover's algorithm for 2 qubits executed on sinq20 backend with 1000 shots per circuit. We measure the success rate of finding the target state '11' for each pair of qubits in [[0, 1]].

- **Runtime:** 6.37453 seconds.



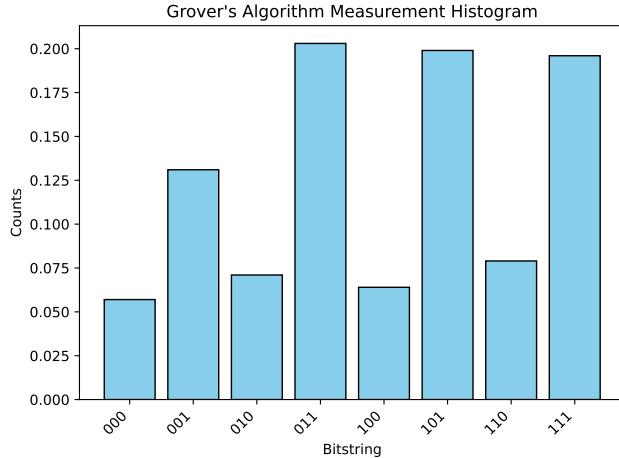
- **Runtime:** 9.12857 seconds.



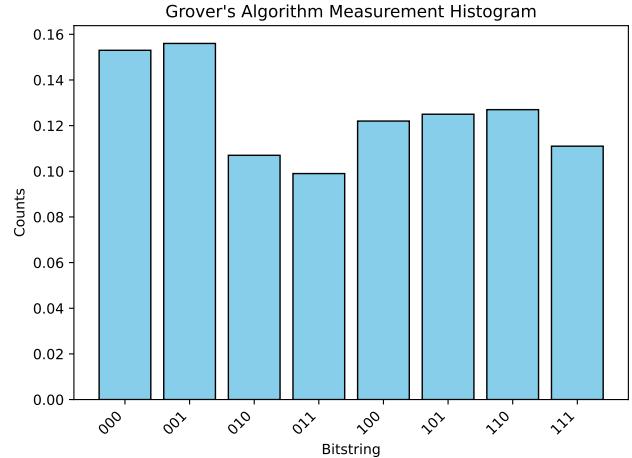
8. Grover - 3 qubits

Grover's algorithm for 3 qubits executed on *sinq20* backend with 1000 shots per circuit. We measure the success rate of finding the target state '111' for each pair of qubits in $[[0, 1, 3, 4]]$.

- **Runtime:** 8.25056 seconds.



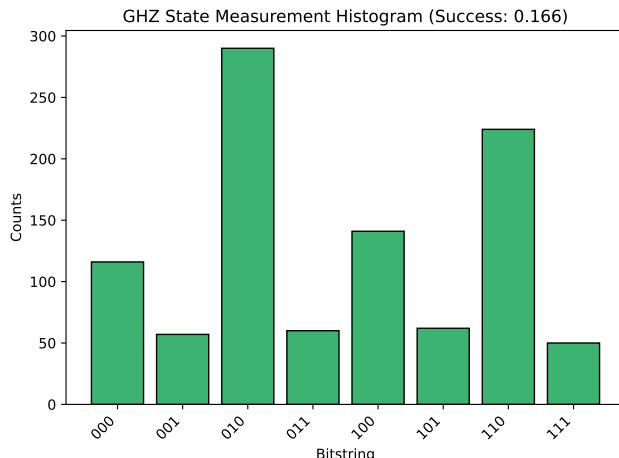
- **Runtime:** 10.87659 seconds.



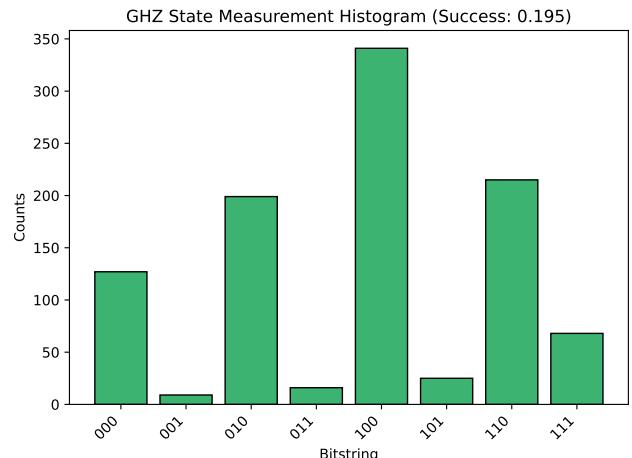
9. GHZ state preparation

GHZ circuit with 3 qubits executed on *sinq20* backend with 1000 shots. We measure the success rate of obtaining the GHZ state (all 0s or all 1s).

- **Runtime:** 6.48023 seconds.



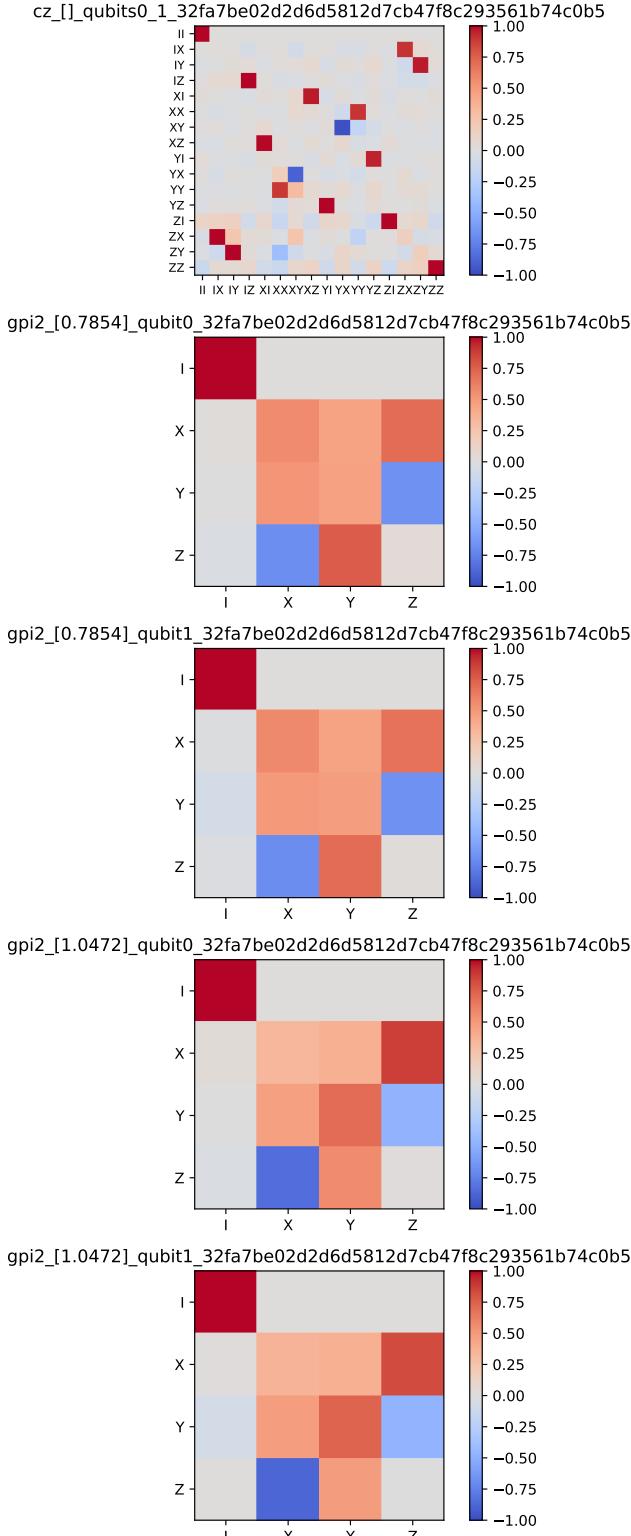
- **Runtime:** 7.29113 seconds.



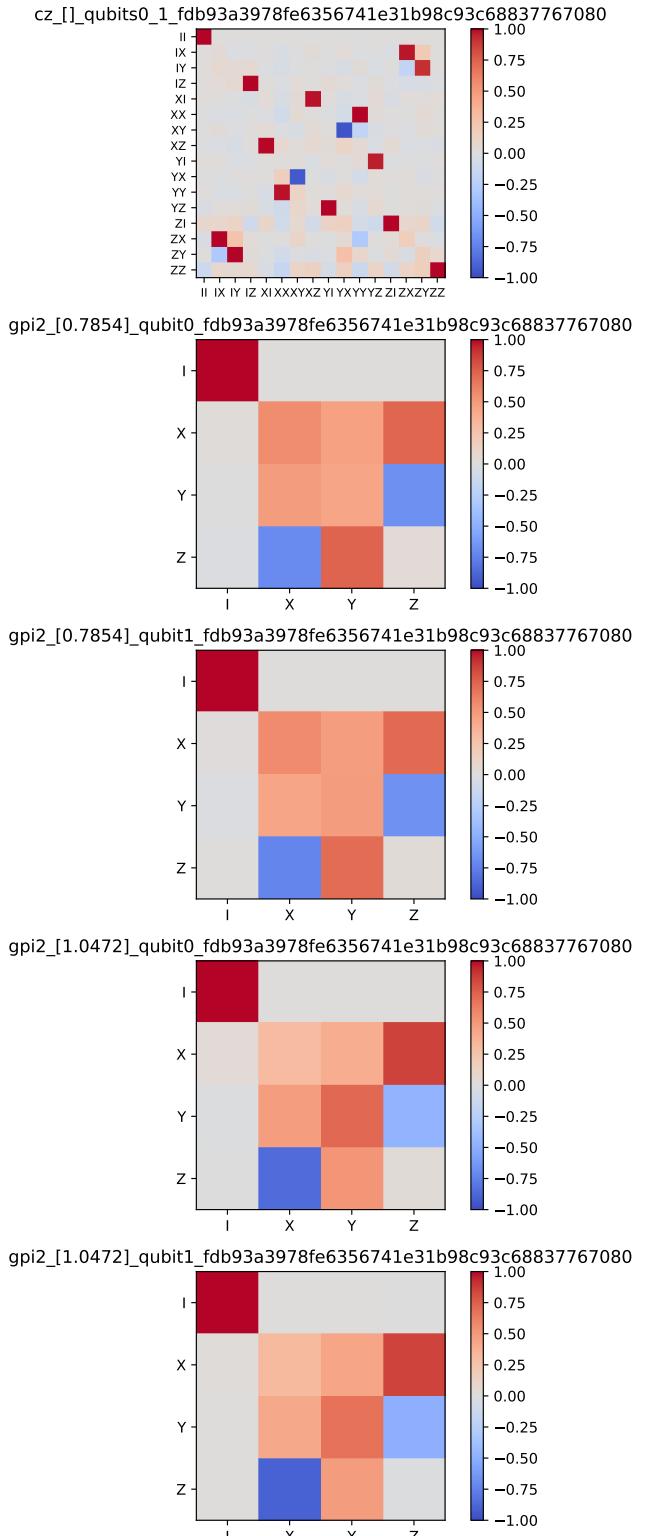
10. Process Tomography state preparation

Process tomography involves preparing a circuit particular set of states, appending a gate (process) to the circuit, and measuring the circuit in the Pauli basis. The data is processed to get the Pauli Liouville representation of a process (gate). - Single qubit process tomography executed on qubits: [0, 1] - Two qubit process tomography on coupled qubits: [[0, 1]] Total execution time for process tomography is 1089.6939131673425 seconds.

- **Runtime:**



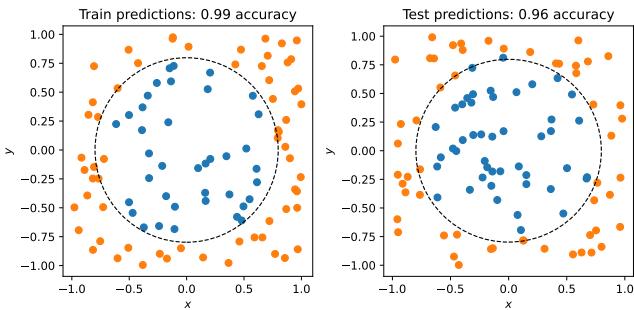
- **Runtime:**



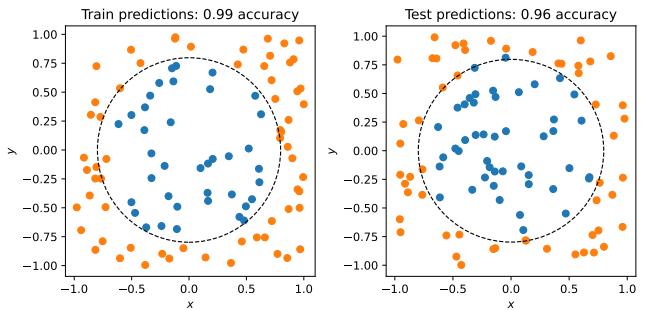
11. Reuploading Classifier

Reuploading classifier with 1 qubits, 10 layers, depth of 20, 500 shots.

- **Duration:** None



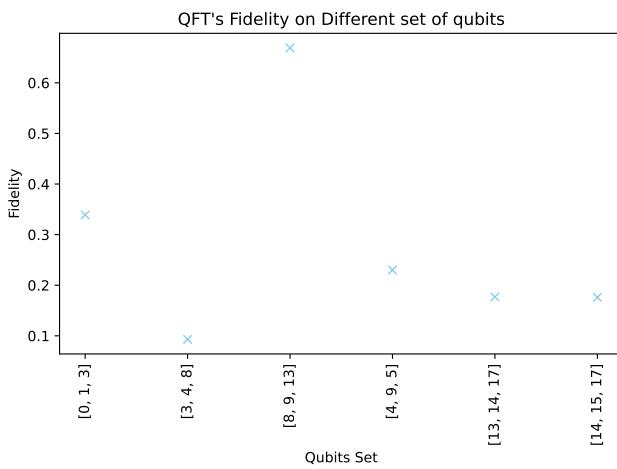
- **Duration:** None



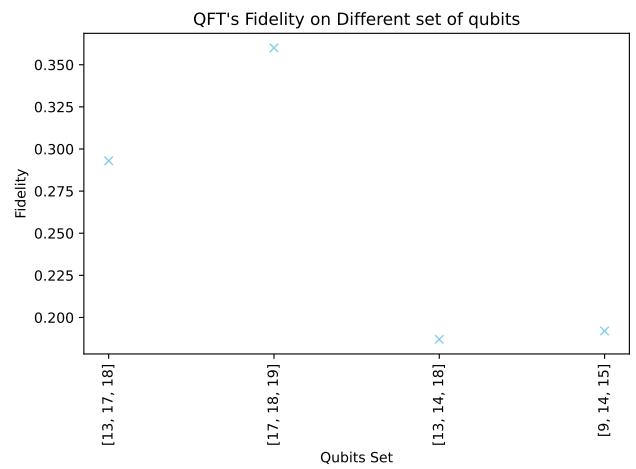
12. QFT Plots

Implementation of the Quantum Fourier Transform on different subsets of three qubits $[[0, 1, 3], [3, 4, 8], [8, 9, 13], [4, 9, 5], [13, 14, 17], [14, 15, 17]]$. The number of gates is 12, the depth of the circuit is 7

- **Runtime:** 6.765514938160777



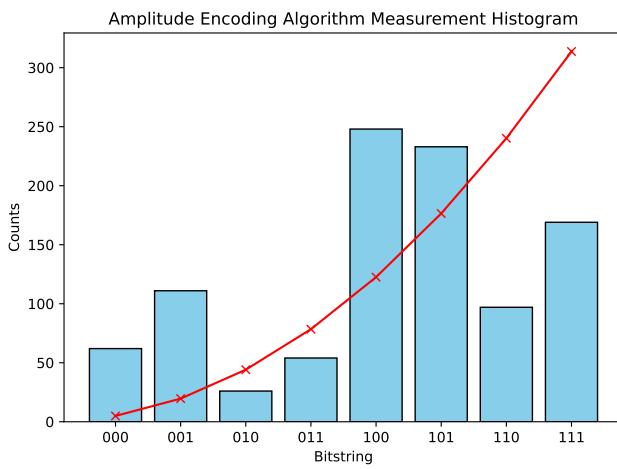
- **Runtime:** 14.460805583745241



13. Amplitude Encoding

Encoding of a vector of numerical data into the amplitudes of a quantum state. The input vector is $[1, 2, 3, 4, 5, 6, 7, 8]$, encoded in the qubits $[0, 1, 4]$. The number of gates is 16, the depth of the circuit is 12 and the runtime execution is 5.497ms

- **Runtime:** — No runtime provided. —



- **Runtime:** — No runtime provided. —

