Benchmark Report

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.

sinq20
32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

sinq20
41f4570fce52da0c4bbb483f6fb7d870a551df65

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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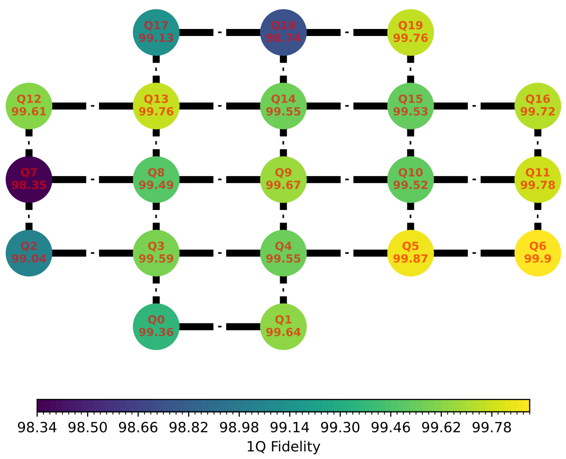
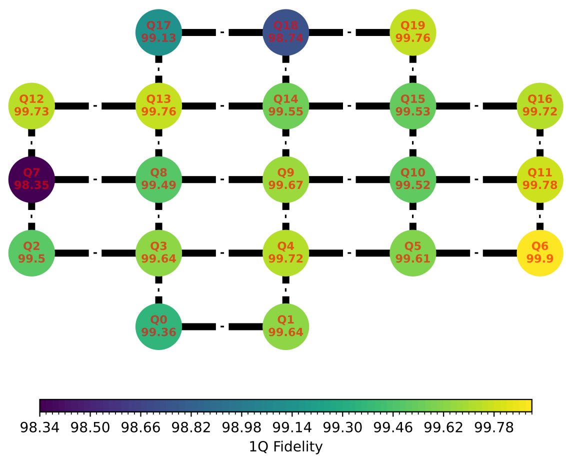
torch	2.7.0		

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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Mermin Max	0.69			

5. Benchmark Results

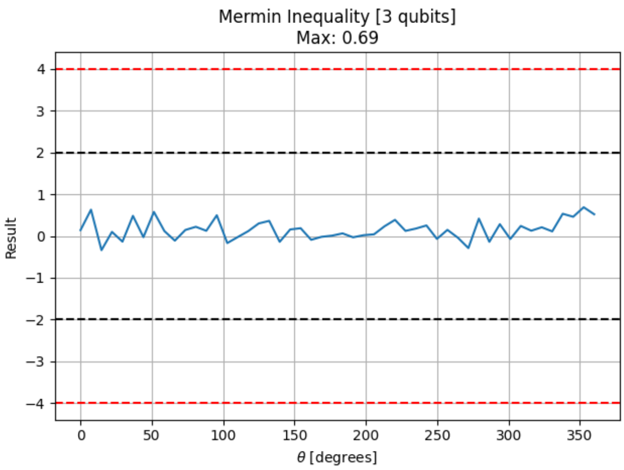
Qubit n	Fidelity	Error Bars
0	0.994	± 0.000465
1	0.996	± 0.000249
2	0.99	± 0.00117
3	0.996	± 0.000322
4	0.995	± 0.000816
5	0.999	± 0.000534
6	0.999	± 0.000308
7	0.983	± 0.00219
8	0.995	± 0.000549
9	0.997	± 0.000698
10	0.995	± 0.000441
11	0.998	± 0.000483
12	0.996	± 0.000371
13	0.998	± 0.000344
14	0.996	± 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

Qubit n	Fidelity	Error Bars
0	0.994	± 0.000465
1	0.996	± 0.000249
2	0.995	± 0.000448
3	0.996	± 0.000282
4	0.997	± 0.000582
5	0.996	± 0.000421
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	0.997	± 0.000318
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

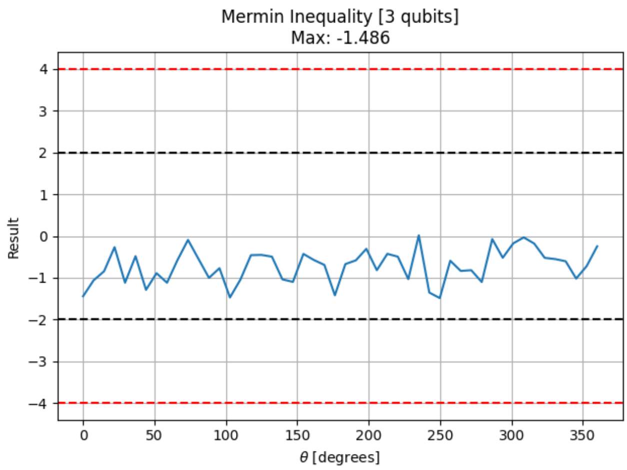
6. 5 Qubit Mermin

Mermin's algorithm for 3 qubits.

- **Runtime:** 3.68042 seconds.



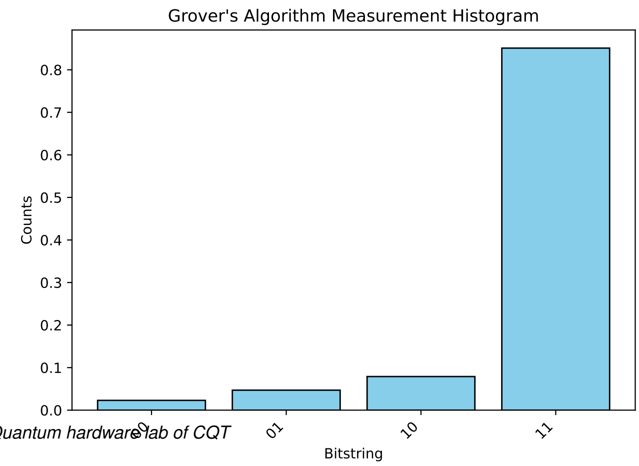
- **Runtime:** 10.05998 seconds.



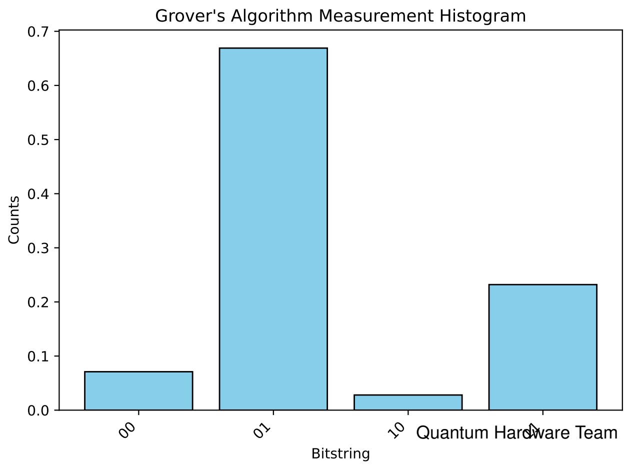
7. Grover - 2 qubits

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.



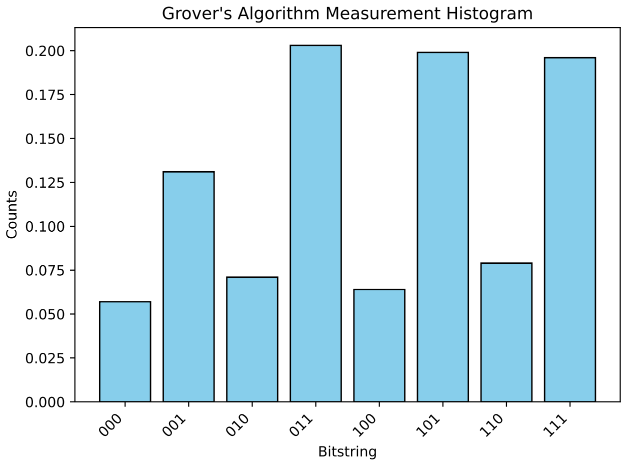
- **Runtime:** 5.04459 seconds.



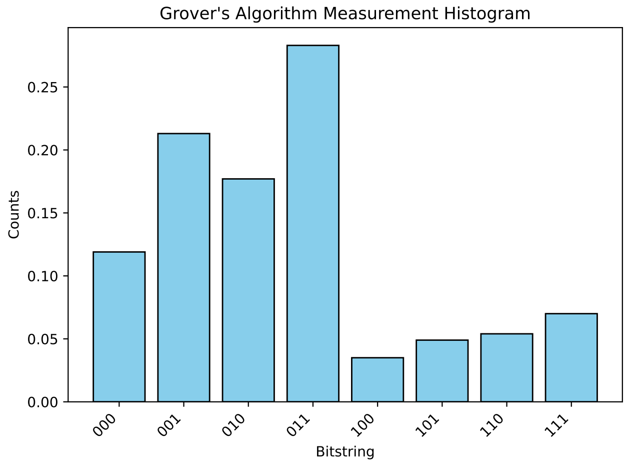
8. Grover - 3 qubits

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.



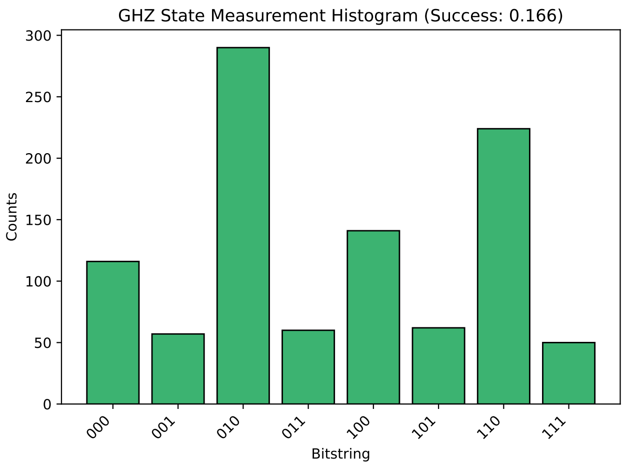
- **Runtime:** 6.08750 seconds.



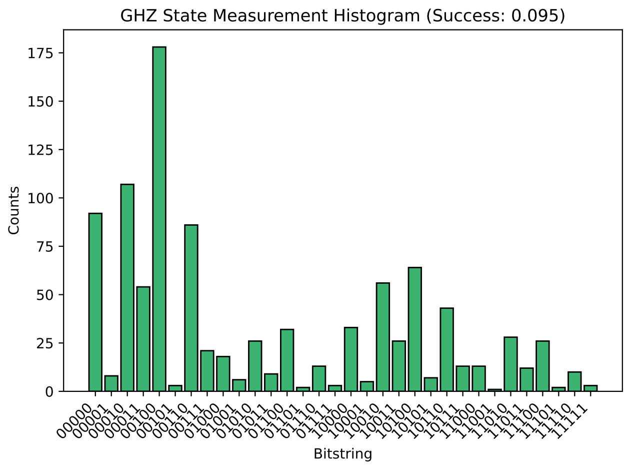
9. GHZ state preparation

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.



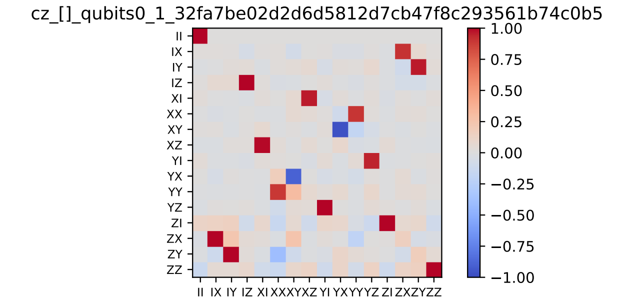
- **Runtime:** 14.30596 seconds.

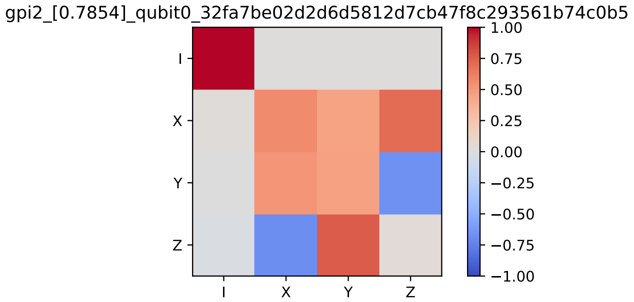


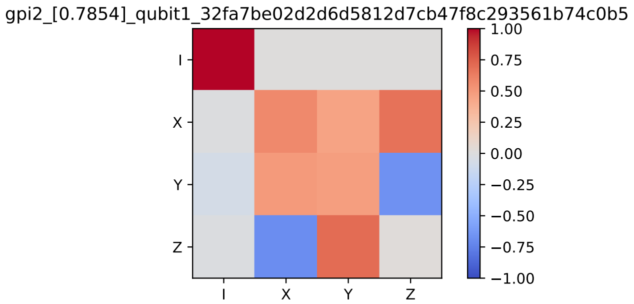
10. Process Tomography state preparation

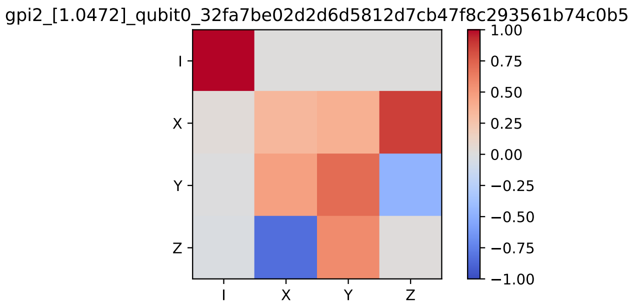
Process tomography involves preparing a circuit particular set of states, appending a gate (process) to the circuit, and measuring the circuit in the Pauli basis. The data is processed to get the Pauli Liouville representation of a process (gate). - Single qubit process tomography executed on qubits: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

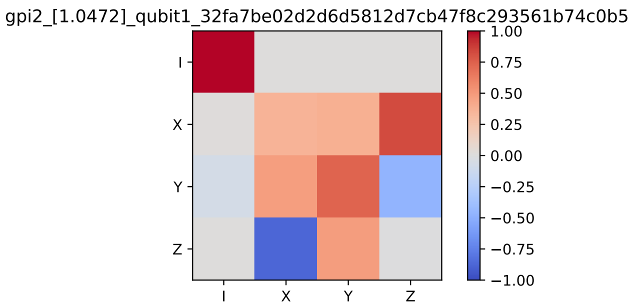
- **Runtime:**



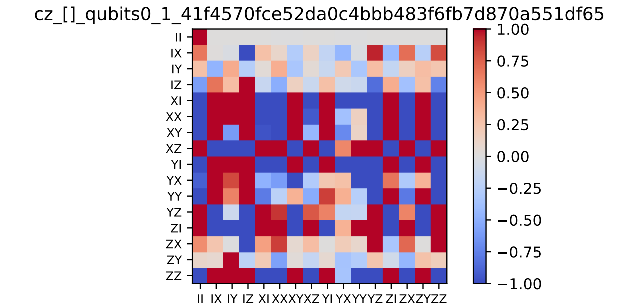


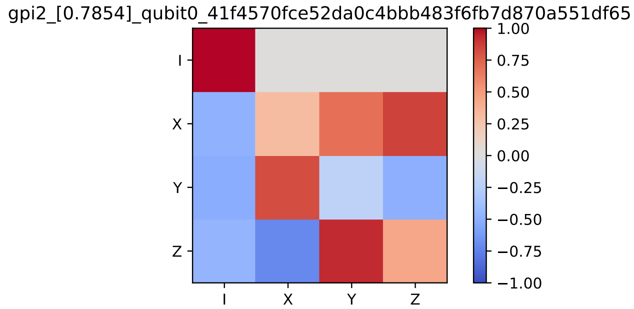


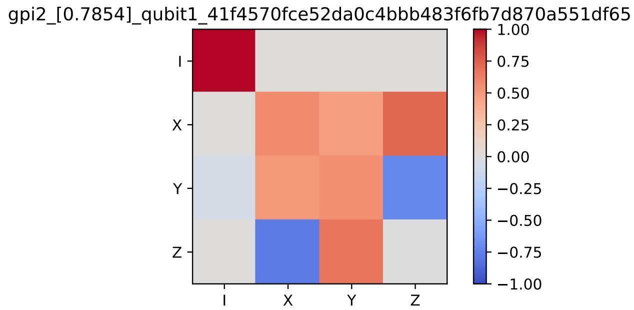


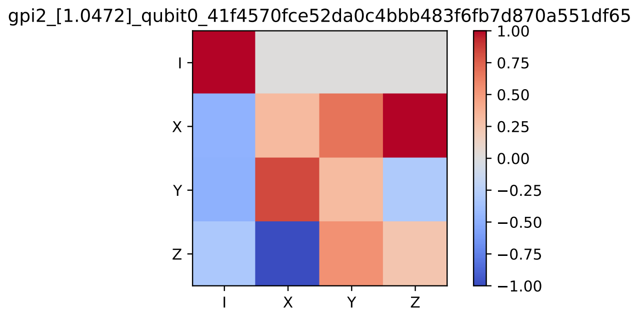


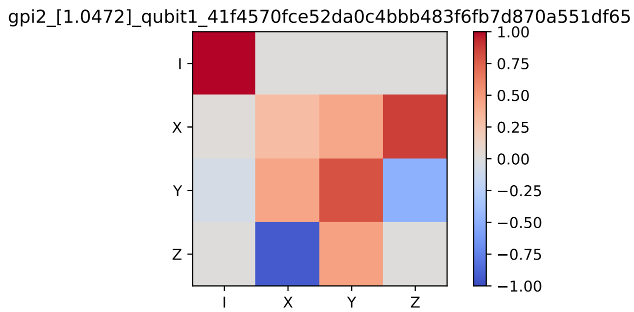
- **Runtime:**







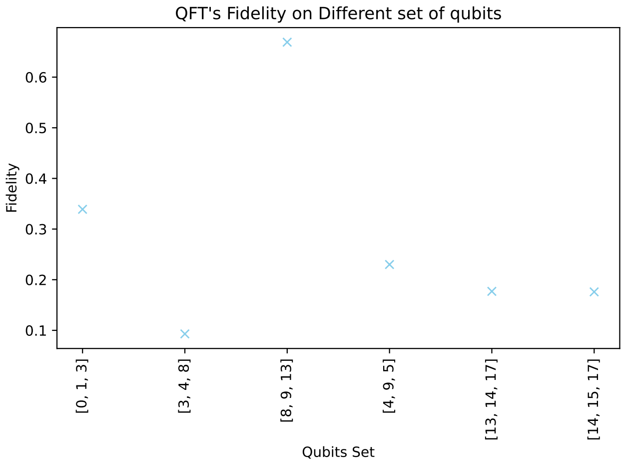




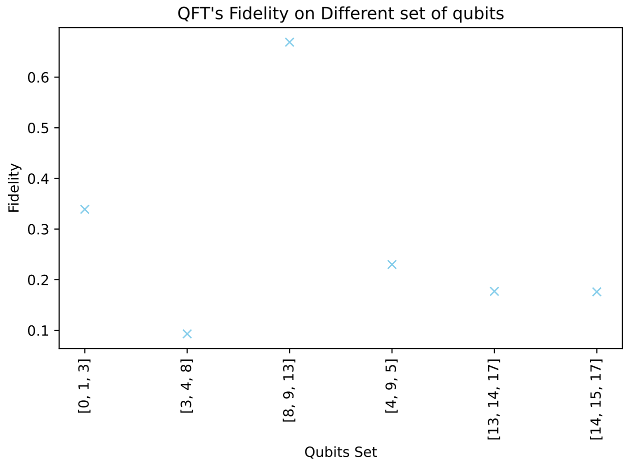
11. QFT Plots

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



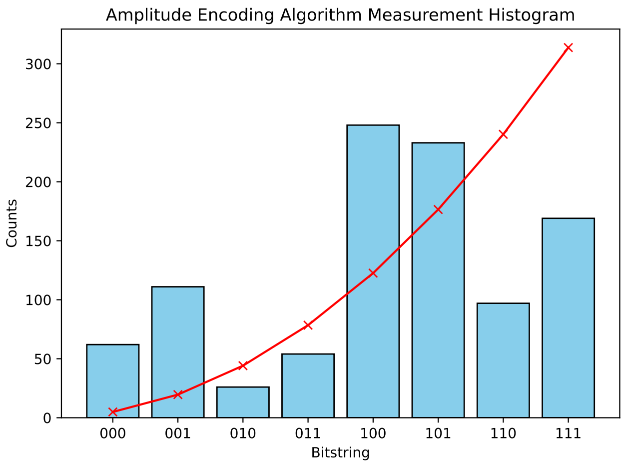
- **Runtime:** 6.765514938160777



12. 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. —