

## Benchmark Report

# Benchmarking of NQCH's sinq20

October 6, 2025

## 1. Report of Changes

**Platform:** sinq20

**Calibration-id:** fdb93a3978fe6356741e31b98c93c68837767080

**Calibration date:** 19-09-2025 17:03

**Experiment date:** 06-10-2025 04:59

**Note:** chore(sinq20): 1q tuneup, q11, q12, q18

**Platform:** sinq20

**Calibration-id:** fdb93a3978fe6356741e31b98c93c68837767081

**Calibration date:** 19-09-2025 17:03

**Experiment date:** 30-09-2025 12:10

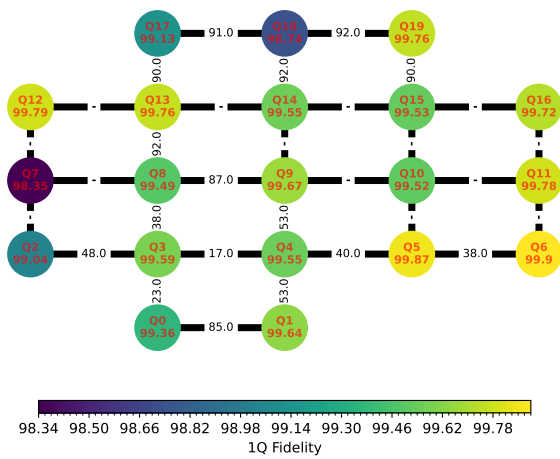
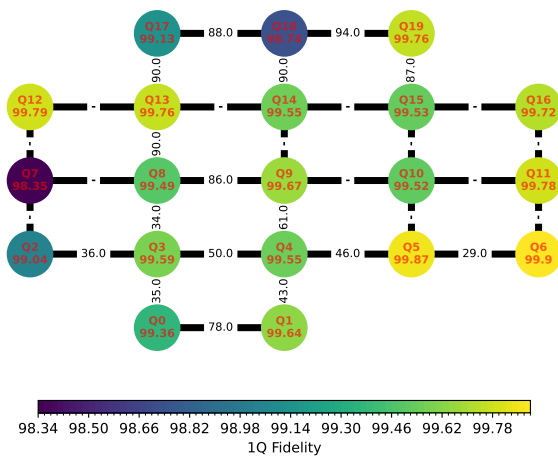
**Note:** chore(sinq20): 1q tuneup, q11, q12, q18

## 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. Best Qubits Selection

k-qubits	Best Qubits	Fidelity
2	18, 19	0.940
3	14, 18, 19	0.922
4	17, 14, 18, 19	0.908
5	13, 17, 14, 18, 19	0.907

k-qubits	Best Qubits	Fidelity
2	18, 19	0.925
3	14, 18, 19	0.925
4	17, 14, 18, 19	0.921
5	17, 14, 18, 15, 19	0.916

## 5. 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	3.246			

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## 6. Benchmark Results

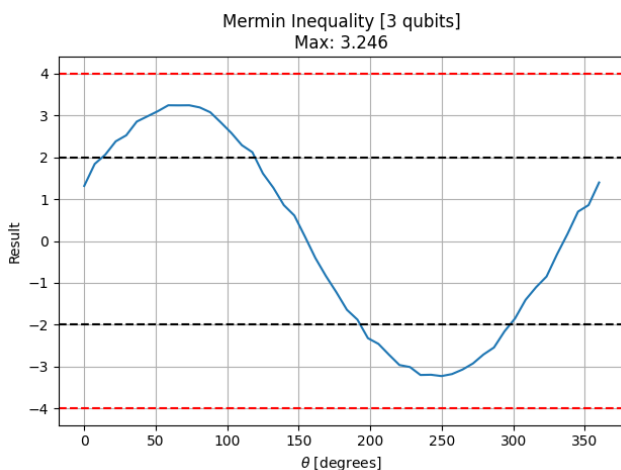
Qubit n	Fidelity	Error Bars
0	0.994	$\pm 0.000465$
1	0.996	$\pm 0.000249$
2	0.99	$\pm 0.00117$
3	0.996	$\pm 0.000322$
4	0.995	$\pm 0.000816$
5	0.999	$\pm 0.000534$
6	0.999	$\pm 0.000308$
7	0.983	$\pm 0.00219$
8	0.995	$\pm 0.000549$
9	0.997	$\pm 0.000698$
10	0.995	$\pm 0.000441$
11	0.998	$\pm 0.000246$
12	0.998	$\pm 0.000396$
13	0.998	$\pm 0.000344$
14	0.996	$\pm 0.000846$
15	0.995	$\pm 0.000647$
16	0.997	$\pm 0.000463$
17	0.991	$\pm 0.0006$
18	0.987	$\pm 0.00163$
19	0.998	$\pm 0.00042$

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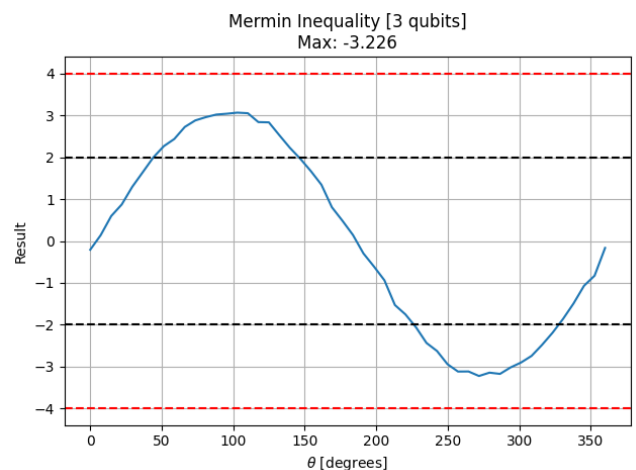
## 7. Mermin

Mermin's algorithm for 3 qubits.

- **Runtime:** 0.70308 seconds.
- **Qubits used:** [[13, 17, 18]]



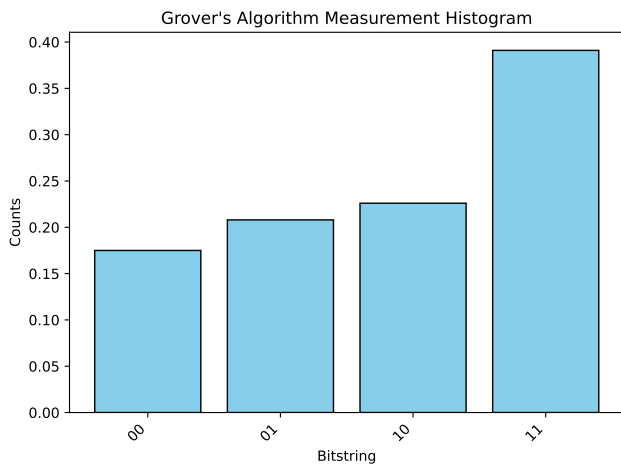
- **Runtime:** 19.05328 seconds.
- **Qubits used:** [[13, 17, 18]]



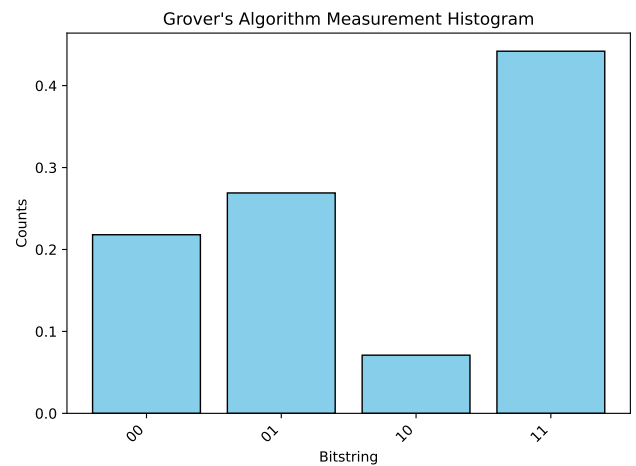
## 8. Grover - 2 qubits

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 [[13, 14]].

- **Runtime:** 14.16246 seconds.
- **Qubits used:** [[13, 14]]



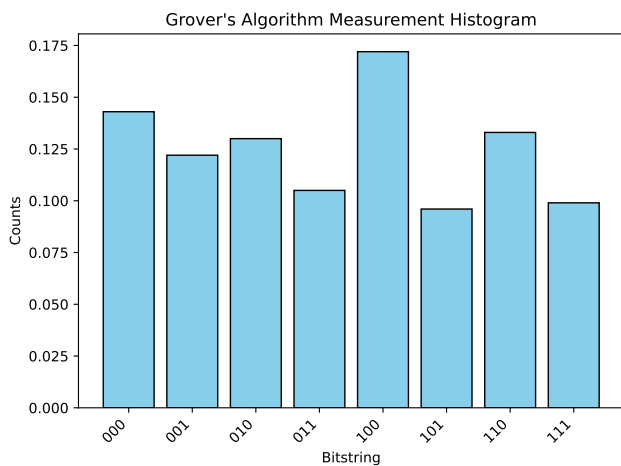
- **Runtime:** 11.27258 seconds.
- **Qubits used:** — No “qubits\_used” provided. —



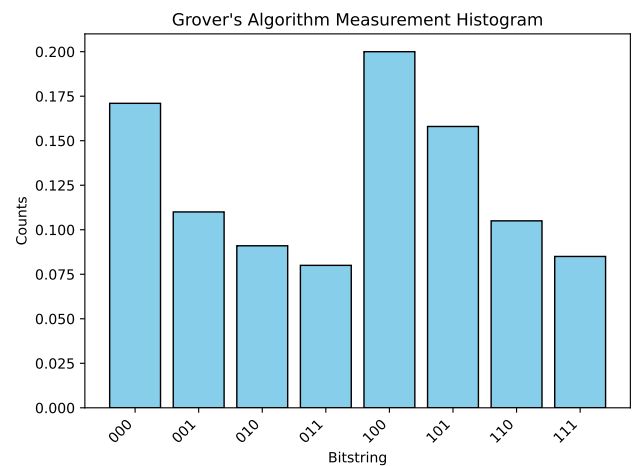
## 9. Grover - 3 qubits

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 [[17, 13, 18, 14]].

- **Runtime:** 12.10485 seconds.
- **Qubits used:** [[17, 13, 18, 14]]



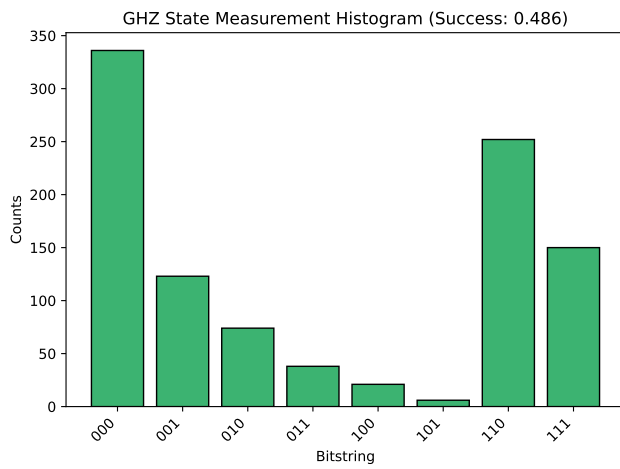
- **Runtime:** 16.51933 seconds.
- **Qubits used:** [[17, 13, 18, 14]]



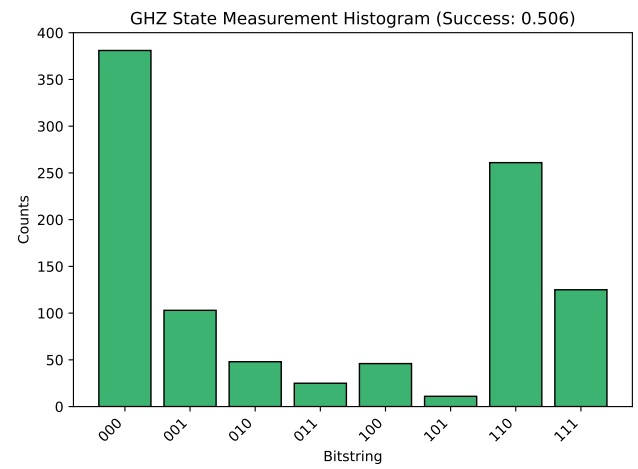
## 10. GHZ state preparation

GHZ circuit with 3 qubits executed on `sinq20` backend with 1000 shots.

- **Runtime:** 8.10020 seconds.
- **Qubits used:** [0, 1, 2]



- **Runtime:** 22.51014 seconds.
- **Qubits used:** [0, 1, 2]

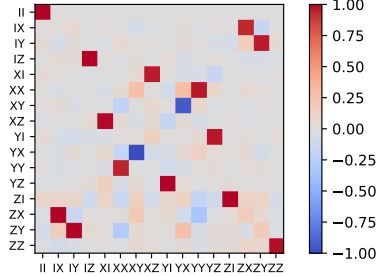


## 11. Process Tomography state preparation

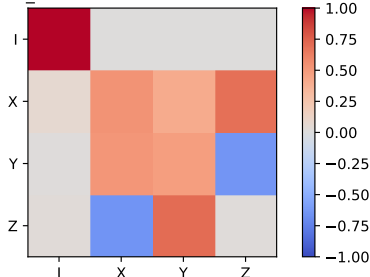
Process tomography involves preparing a circuit particular set of states, appending a gate (process) to the circuit, and measuring the circuit in the Pauli basis. The data is processed to get the Pauli Liouville representation of a process (gate). - Single qubit process tomography executed on qubits: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

- **Runtime:** 1198.93892 seconds.
- **Qubits used:**

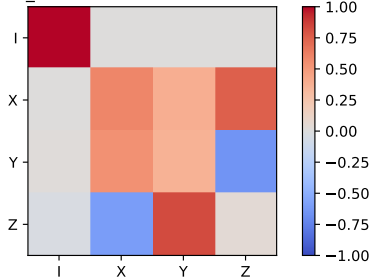
cz\_[1]\_qubits0\_1\_fdb93a3978fe6356741e31b98c93c68837767080



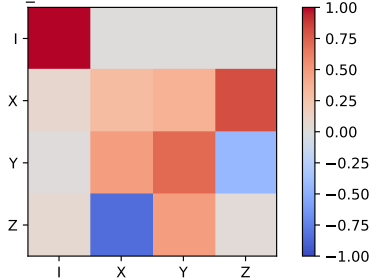
gpi2\_[0.7854]\_qubit0\_fdb93a3978fe6356741e31b98c93c68837767080



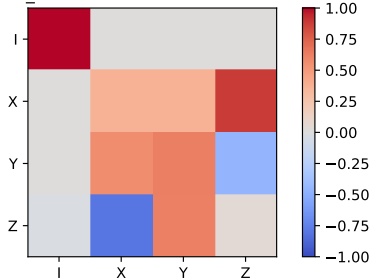
gpi2\_[0.7854]\_qubit1\_fdb93a3978fe6356741e31b98c93c68837767080



gpi2\_[1.0472]\_qubit0\_fdb93a3978fe6356741e31b98c93c68837767080

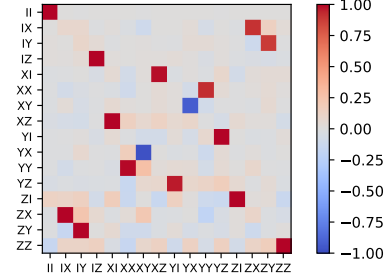


gpi2\_[1.0472]\_qubit1\_fdb93a3978fe6356741e31b98c93c68837767080

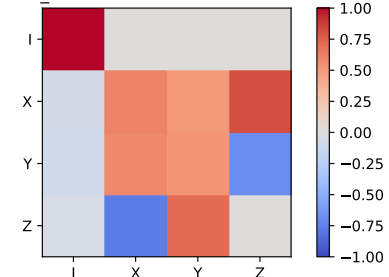


- **Runtime:** 2068.71072 seconds.
- **Qubits used:**

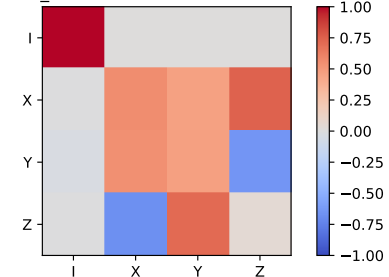
cz\_[1]\_qubits0\_1\_fdb93a3978fe6356741e31b98c93c68837767081



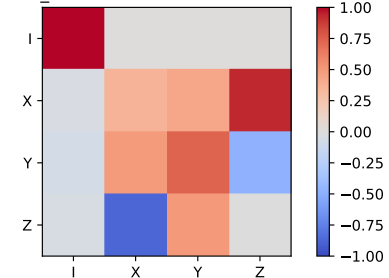
gpi2\_[0.7854]\_qubit0\_fdb93a3978fe6356741e31b98c93c68837767081



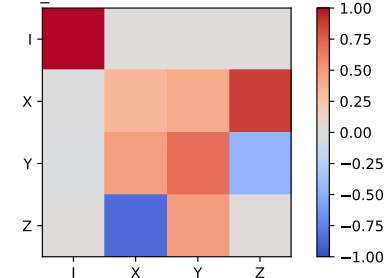
gpi2\_[0.7854]\_qubit1\_fdb93a3978fe6356741e31b98c93c68837767081



gpi2\_[1.0472]\_qubit0\_fdb93a3978fe6356741e31b98c93c68837767081



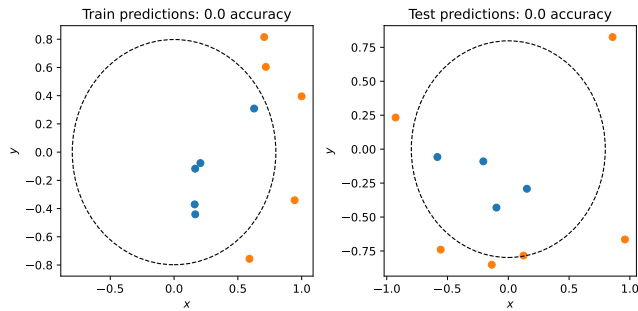
gpi2\_[1.0472]\_qubit1\_fdb93a3978fe6356741e31b98c93c68837767081



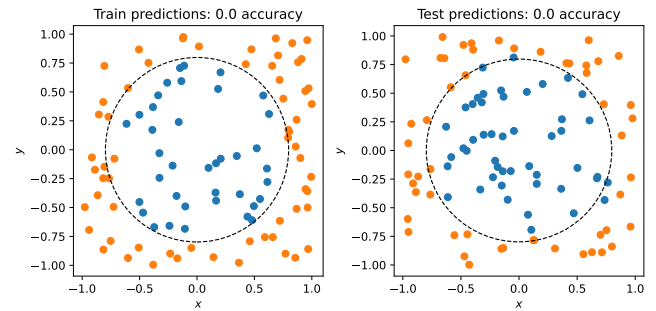
## 12. Reuploading Classifier

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

- **Runtime:** 17.91492 seconds.
- **Qubits used:** [9]



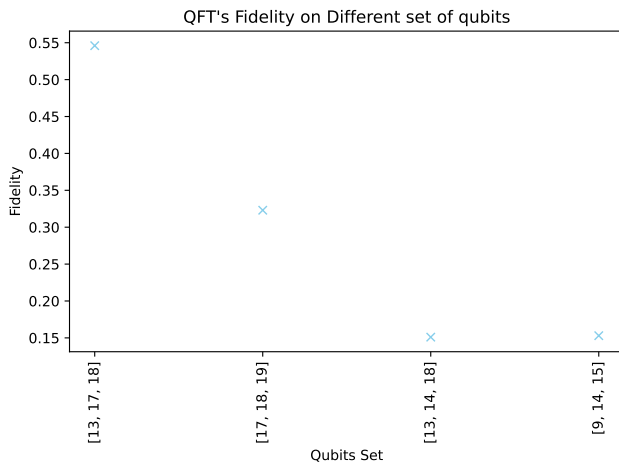
- **Runtime:** 3393.40321 seconds.
- **Qubits used:** [9]



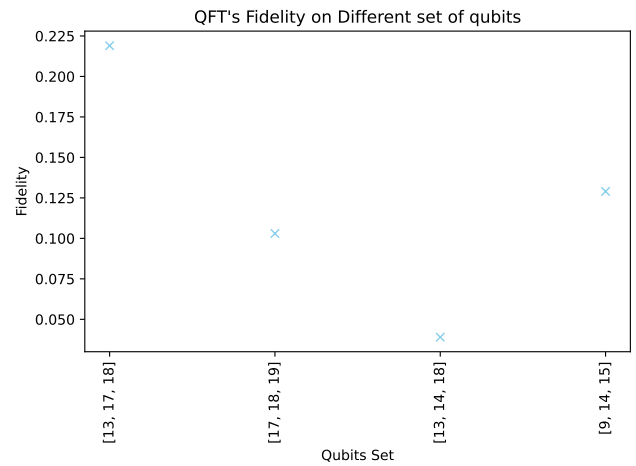
### 13. QFT Plots

Implementation of the Quantum Fourier Transform on different subsets of three qubits. The number of gates is 12, the depth of the circuit is 7

- **Runtime:** 5.15412 seconds.
- **Qubits used:** [[13, 17, 18], [17, 18, 19], [13, 14, 18], [9, 14, 15]]



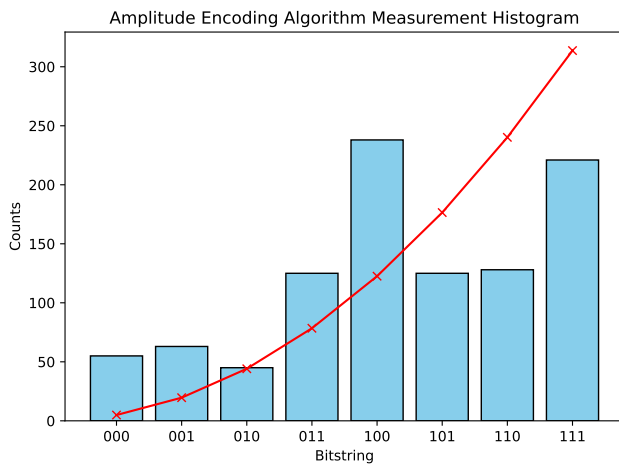
- **Runtime:** 18.82738 seconds.
- **Qubits used:** [[13, 17, 18], [17, 18, 19], [13, 14, 18], [9, 14, 15]]



### 14. 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]. The number of gates is 16, the depth of the circuit is 12 and the runtime execution is 5.849ms

- **Runtime:** 5.84914 seconds.
- **Qubits used:** [0, 1, 4]



- **Runtime:** 16.46720 seconds.
- **Qubits used:** [0, 1, 4]

