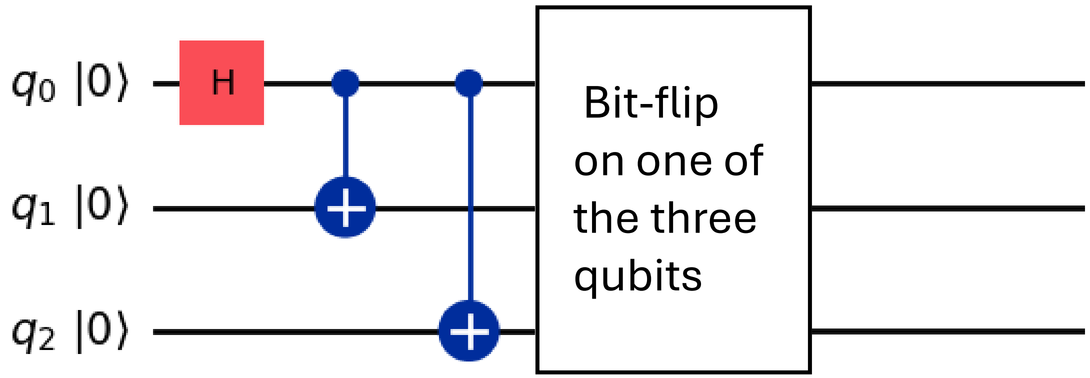
Nile University
جـامعة النيـــل

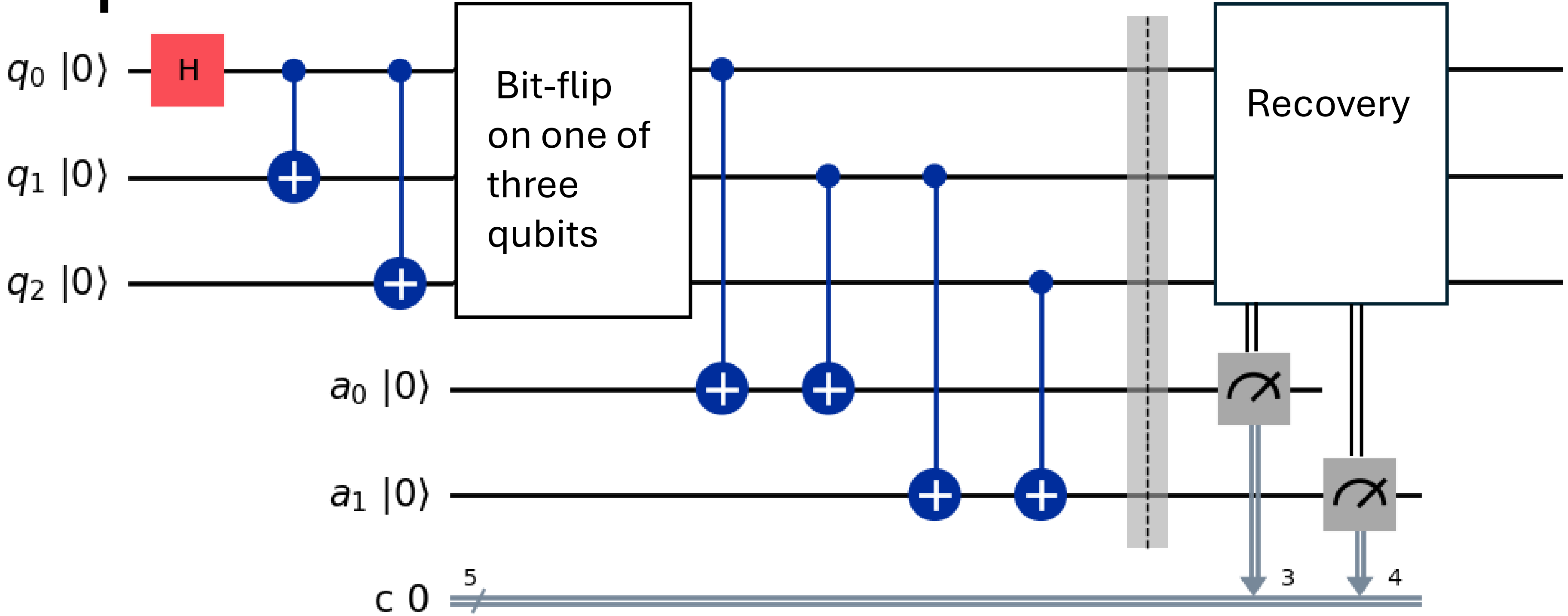
Noise Qiskit Lab

Bit-flip Noise

- Given this circuit, apply both the ideal and the noisy circuits.
- Measure the state fidelity between the ideal circuit and the noisy one.



Correction Using the Three-qubit Bit-Flip Repetition Code



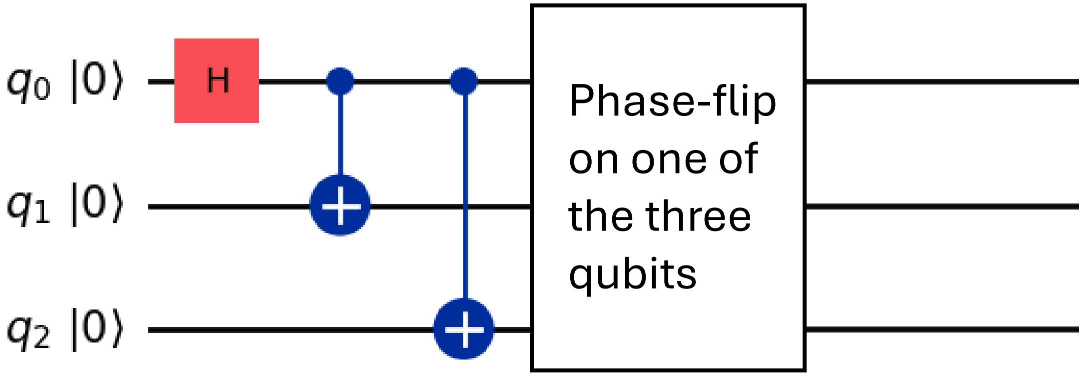
$\vert\psi\rangle$ After Bit-flip	M_{a_0}	M_{a_1}	Recovery	$\vert\psi\rangle$ After Recovery
$\alpha\vert000\rangle + \beta\vert111\rangle$	0	0	$I \otimes I \otimes I$	$\alpha\vert000\rangle + \beta\vert111\rangle$
$\alpha\vert001\rangle + \beta\vert110\rangle$	0	1	$I \otimes I \otimes X$	$\alpha\vert000\rangle + \beta\vert111\rangle$
$\alpha\vert100\rangle + \beta\vert011\rangle$	1	0	$X \otimes I \otimes I$	$\alpha\vert000\rangle + \beta\vert111\rangle$
$\alpha\vert010\rangle + \beta\vert101\rangle$	1	1	$I \otimes X \otimes I$	$\alpha\vert000\rangle + \beta\vert111\rangle$

Note:

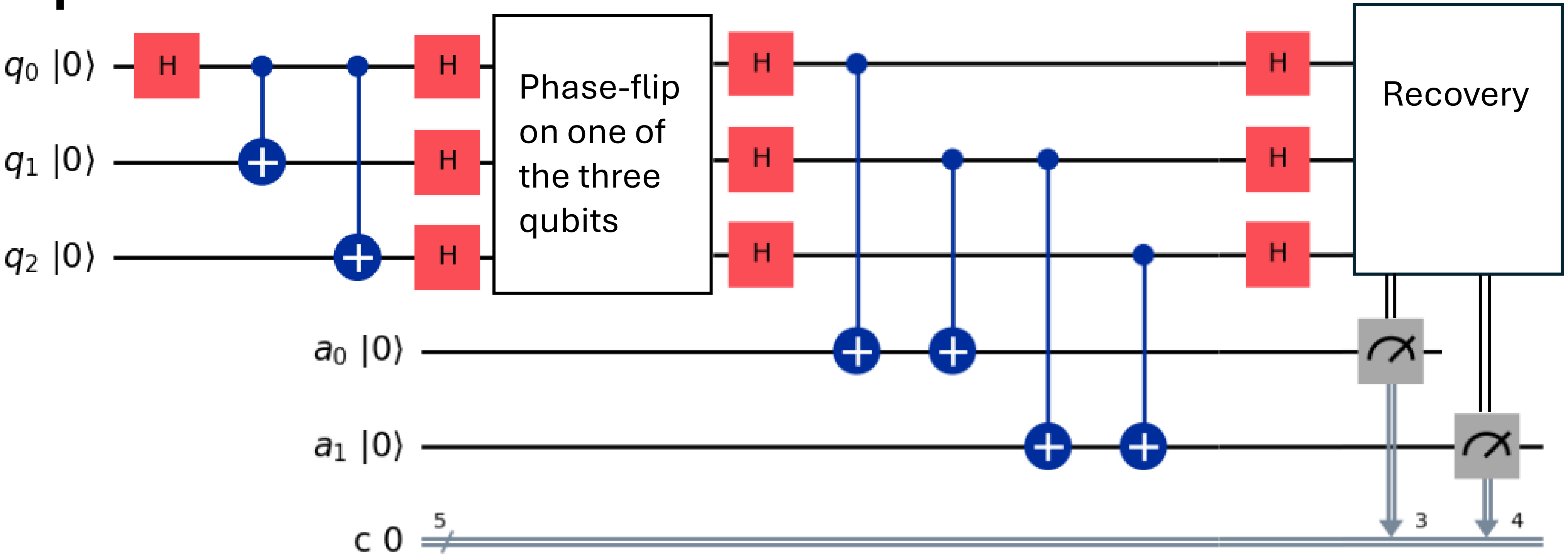
$$\alpha = \beta = \frac{1}{\sqrt{2}}$$

Phase-flip Noise

- Given this circuit, apply both the ideal and the noisy circuits.
- Measure state fidelity between the ideal circuit and the noisy one.



Correction Using the Three-qubit Bit-Flip Repetition Code



$\|\psi\rangle$ After Noisy Channel	M_{a_0}	M_{a_1}	Recovery	$\|\psi\rangle$ After Recovery
$\alpha\|++\,+\rangle + \beta\|--\,-\rangle$	0	0	$I \otimes I \otimes I$	$\alpha\|++\,+\rangle + \beta\|--\,-\rangle$
$\alpha\|++\,-\rangle + \beta\|--\,+\rangle$	0	1	$I \otimes I \otimes Z$	$\alpha\|++\,+\rangle + \beta\|--\,-\rangle$
$\alpha\|-+\,+\rangle + \beta\|+-\,-\rangle$	1	0	$Z \otimes I \otimes I$	$\alpha\|++\,+\rangle + \beta\|--\,-\rangle$
$\alpha\|+-\,+\rangle + \beta\|-+\,-\rangle$	1	1	$I \otimes Z \otimes I$	$\alpha\|++\,+\rangle + \beta\|--\,-\rangle$

Note:

$$\alpha = \beta = \frac{1}{\sqrt{2}}$$