



$$U = \begin{matrix} & \begin{matrix} \langle 00| & \langle 01| & \langle 10| & \langle 11| \end{matrix} \\ \begin{matrix} |00\rangle \\ |01\rangle \\ |10\rangle \\ |11\rangle \end{matrix} & \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & U_{11} & U_{12} & 0 \\ 0 & U_{21} & U_{22} & 0 \\ 0 & 0 & 0 & U_{33} \end{bmatrix} \end{matrix} \begin{matrix} \\ \\ \text{measure} \\ \end{matrix}$$

*init*

Example: Measure  $U_{21}$

Choose  $|\psi_0\rangle$

$$|\psi_0\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} \implies U |\psi_0\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} U_{00} + U_{01} \\ U_{10} + U_{11} \\ U_{20} + U_{21} \\ U_{30} + U_{31} \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ U_{11} \\ U_{21} \\ 0 \end{bmatrix}$$

Choose  $\hat{O}$

$$\hat{O} = (\sigma^x + i\sigma^y) \otimes I$$

$$\langle \psi_f | \hat{O} | \psi_f \rangle = \begin{bmatrix} 1 & U_{11}^* & U_{21}^* & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ U_{11} \\ U_{21} \\ 0 \end{bmatrix} = U_{21}$$