Quantum ooga-booga basics

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Recap

$$|1\rangle, |0\rangle, H, X, Y, Z, R_X(\theta), R_Y(\theta), R_Z(\varphi)$$

alt text

$$|\psi\rangle = e^{i\gamma}(\cos\tfrac{\theta}{2}|0\rangle + e^{i\varphi}\sin\tfrac{\theta}{2}|1\rangle)$$

Superposition & entanglement

alt text

Phase kickback

alt text

Superdense coding

Bell states

$$|\Phi^+\rangle = \mathrm{CNOT}\,(H \otimes I)|0\rangle \otimes |0\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle),$$

encodes 00

$$|\Phi^-\rangle = \qquad (Z \otimes I)|\Phi^+\rangle = \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle),$$

encodes 10

$$|\Psi^+\rangle = \qquad (X \otimes I)|\Phi^+\rangle = \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle),$$

encodes 01

$$|\Psi^-\rangle = \qquad (iY \otimes I)|\Phi^+\rangle = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle),$$

Phase oracle & other

alt text