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In compatible observables

$$[\hat{A}, \hat{B}] = \hat{A}\hat{B} - \hat{B}\hat{A} = 0$$

→ in any state $|\psi\rangle$

either $\Delta A = 0$ or $\Delta B = 0$

or both

Example: \hat{x}, \hat{p}

$$\hat{x}\hat{p}\psi(x) = x \cdot (-i\hbar \frac{d\psi}{dx})$$

$$\hat{p}\hat{x}\psi(x) = -i\hbar \frac{d}{dx} (x \cdot \psi(x))$$

$$= x \cdot (-i\hbar \frac{d\psi}{dx}) - i\hbar \frac{dx}{dx} \psi(x)$$

$$(\hat{p}\hat{x} - \hat{x}\hat{p})\psi(x) = -i\hbar \psi(x)$$

$$[\hat{p}, \hat{x}]|\psi\rangle = -i\hbar|\psi\rangle$$

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