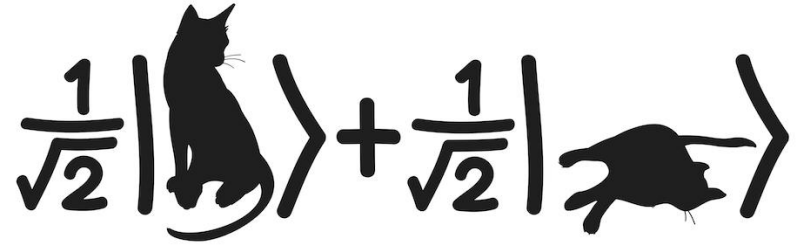


# Quantum Mechanics & Quantum Computation

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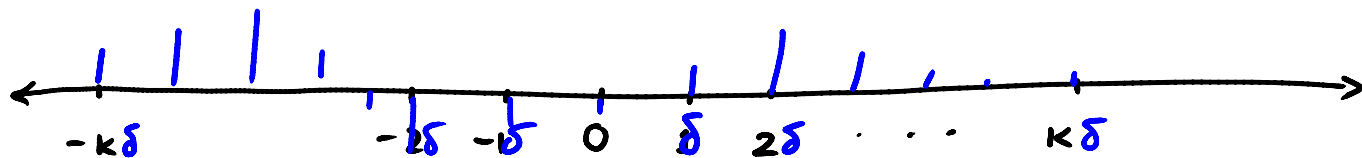
## Lecture 9: Continuous quantum states, Schrödinger's equation, uncertainty principle

Continuous quantum states

represent continuous quantum state?  
observables?

Schrödinger's eqn for free particle in 1D.

Uncertainty principle - position & momentum.



$$|\psi\rangle = \sum_{j=-k}^k \alpha_j |j\rangle$$

$$||\psi\rangle|^2 = \sum |\alpha_j|^2 = 1$$

$$\alpha_j = \psi(j)$$

$$\delta \rightarrow 0 \quad k \rightarrow \infty$$

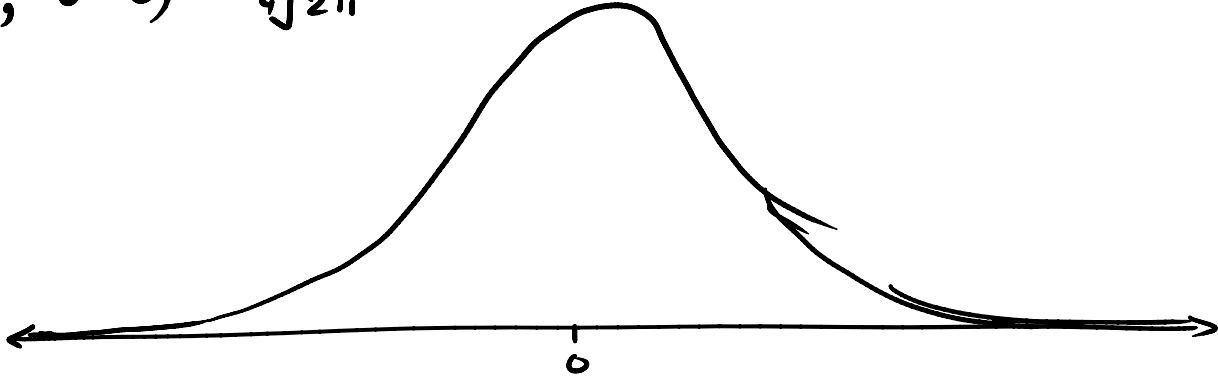
$$\psi(x) : \mathbb{R} \rightarrow \mathbb{C}$$



wavefunction  $\psi(x)$

$$\int_{-\infty}^{\infty} \psi(x)^* \psi(x) dx = \int_{-\infty}^{\infty} |\psi(x)|^2 dx = 1$$

$$\Psi(x, t=0) = \frac{1}{\sqrt{2\pi}} e^{-x^2}$$



• How does  $\Psi(x, \underline{t})$  evolve with time?

• What is the velocity of the particle?

momentum

$mv$