

Latex Practice

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June 2025

1 Introduction to Quantum Mechanics

Quantum mechanics is a fundamental theory in physics that explains the behavior of particles at the atomic and subatomic scales. It departs from classical physics by introducing probabilistic outcomes, quantized energy levels, and wave-particle duality.

1.1 wave-particle Duality

Particles such as electrons exhibit both wave-like and particle-like properties. This duality is demonstrated by the double-slit experiment, where electrons produce interference pattern characteristics of waves.

1.2 The Uncertainty Principle

Heidelberg's inequality principle limits the precision with which the position and momentum can be simultaneously applied:

$$\Delta x \cdot \Delta p \geq \frac{\hbar}{2} \quad (1)$$

This principle introduces a fundamental limit. measurement in quantum systems.

1.3 The Schrodinger Equation

The Schrodinger equation governs the evolution of quantum systems. The time-independent version is:

$$\hat{H}\psi = E\psi \quad (2)$$

Where \hat{H} is the Hamiltonian operator, ψ is the wave function, and E is the energy eigenvalue.

1.4 Quantum Tunneling

Quantum tunneling is a phenomenon in which particles penetrate potential barriers even without sufficient classical energy. This is explained by the nonzero probability amplitude of the wave function in forbidden regions.

1.5 Application of Quantum Mechanics

Quantum mechanics underpins technologies such as semiconductors, lasers, quantum computing, and MRI. It also explains the structure of atoms and the periodic table.

2 Quantum vs classical physics

Aspect	Classical physics	Quantum Mechanics
Determinism	Predictable	Probabilistic
Energy	Continuous	Quantized
Position	Exact	Uncertain
Wave-particle Nature	Separate	Duality

Table 1: Comparison of Classical and Quantum Physics

3 Figure

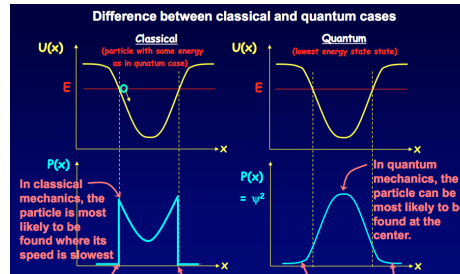


Figure 1: Probability density of a Particle in Quantum well

4 Key Features of Quantum Mechanics

- Describes microscopic particle behavior.
- Incorporates probabilistic predictions.
- Involves wave functions and operators.
- Fundamental to modern physics and technology.

As seen in Equation 1, uncertainty is a built-in feature of quantum systems. A comparison with classical concepts is shown in Table 1. Figure 1 illustrates the spatial probability distribution of a quantum particle.