

School of Basic and Applied Sciences

Course Code : BSCP3001

Course Name: QUANTUM MECHANICS

Quantum Mechanics

Covered Topics

- ❖ Postulates of quantum mechanics
- ❖ References

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Program Name: B.Sc. (Hon.) Physics

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Uncertainty Principle (Heisenberg 1932 Nobel)

. **Uncertainty Principle** is an important consequence of the wave-particle duality of matter and radiation and is **inherent** to the quantum description of nature

. Simply stated, it is **impossible** to know both the exact position and the exact momentum of an object simultaneously

A fact of Nature!

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"We can't know the future because we can't know the present"

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Uncertainty in
Position :

Δx

$$\Delta x \Delta p_x \geq \frac{h}{4\pi}$$

Uncertainty in
Momentum:

Δp_x

energy-time uncertainty relation

$$\Delta E \Delta t \geq \frac{h}{4\pi}$$

Consequences: The more accurately we know the energy of a body, the less accurately we know how long it possessed that energy

The energy can be known with perfect precision ($\Delta E = 0$), only if the measurement is made over an infinite period of time ($\Delta t = \infty$)

- applies to all "conjugate variables"

Uncertainty Principle: Statement

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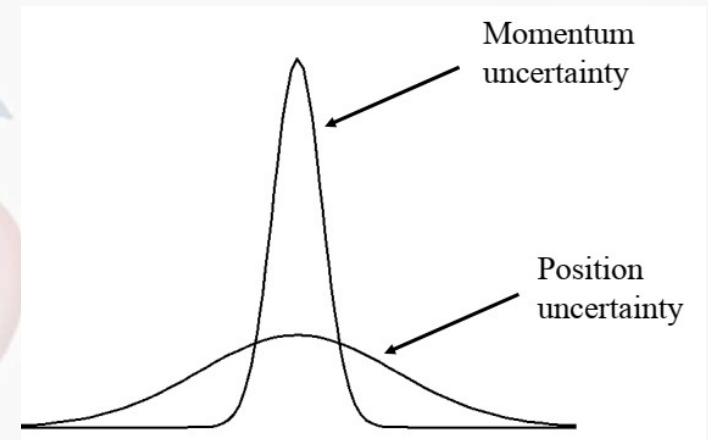
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Consequences of the Uncertainty Principle

- > The path of a particle (trajectory) is **not well-defined** in quantum mechanics.
- > Electrons cannot exist inside a nucleus.
- > Atomic oscillators possess a certain amount of energy known as the **zero-point energy**, even at absolute zero.



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