Quantum Physics Lecture Notes

An Introduction to Quantum Physics

Quantum Physics (sometimes called Quantum Mechanics) is a branch of physics that concerns itself with matter and energy physics at the atomic and subatomic scales. It describes things that are not possible to explain with classical physics, e.g. how electrons orbit atoms or how particles may take several states simultaneously.

Important Fundamental Principles of Quantum Physics

1. Quantization

Energy does not flow continuously but is emitted in package form in something known as quanta.

Illustration: Atoms have certain permitted energy levels of the electrons within them.

2. Wave-Particle Duality

The nature of particles is both caustic and waves, typically electrons and photons.

Famous Experiment: Double Slit Experiment exhibits interference even using individual particles.

3. Uncertainty Principle of Heisenberg

The precise location of a particle cannot be known together with the precise momentum.

Formula:

- $\Delta x \cdot \Delta p \geq 4\pi h$

4. Superposition Principle

Quantum mechanics assume that a particle can be in more than one state at a time and only goes into a state upon observation.

The underlying principle of Quantum Computing and Quantum Encryption.

5. Entanglement

The state of one particle immediately causes the state of another, at any distance, when they become linked.

Important Experiments

Experiment	Contribution
Photoelectric Effect	Einstein proved light is particles:(photons).
Double-Slit	Showcased wave-particle duality.
Stern-Gerlach	icterid particle spin quantization.
Davisson-Germer	Proved electrons have waves.

Uses of Quantum Physics

Quantum Computing: Applies qubits and superposition in using less time to solve a problem than classical computers.

Lasers: Basically, stimulated photon emission.

MRI: Nuclear magnetic resonance (nuclear spin characteristics) is used.

Outline of modern electronics Principle: Transistors and Semiconductors.