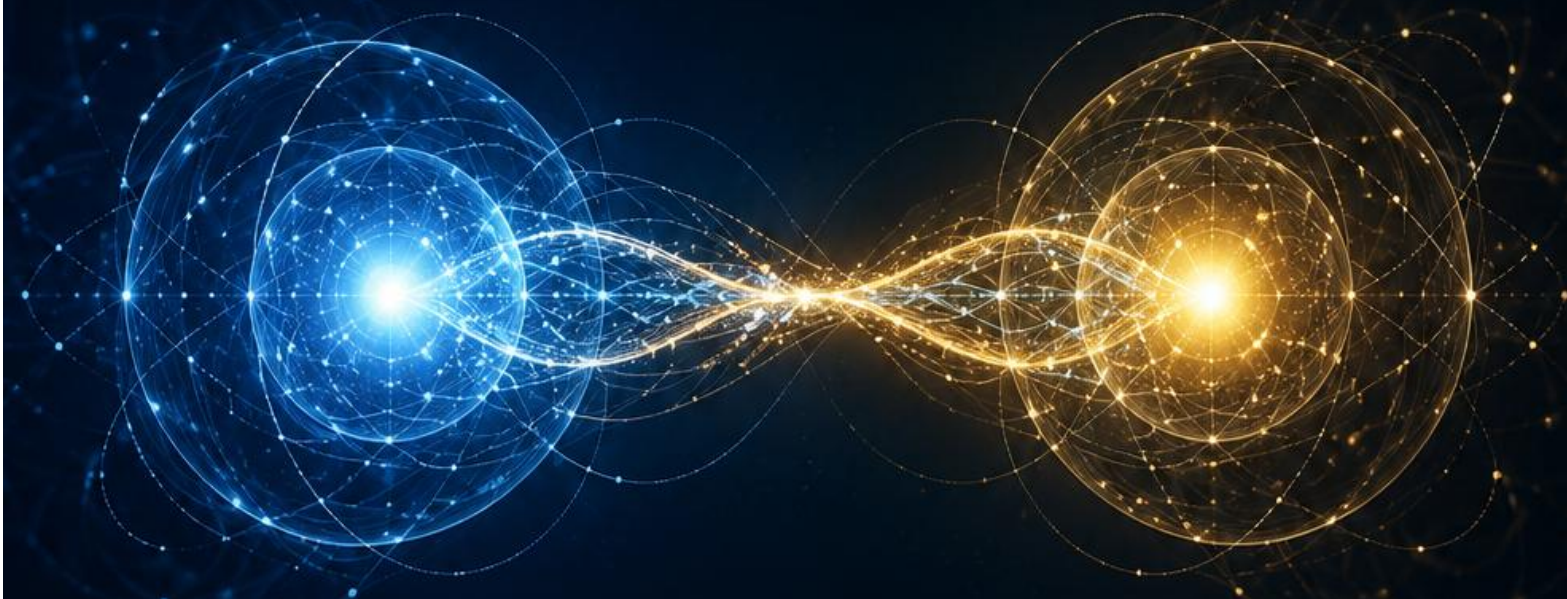
GLOSSARY OF KEY QUANTUM TERMS

AN ESSENTIAL GUIDE TO THE LANGUAGE OF QUANTUM SCIENCE



ENTANGLEMENT | SUPERPOSITION | WAVE FUNCTIONS

UNCERTAINTY | PARTICLE BEHAVIOR | AND MORE

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Quantum Mechanics

The branch of physics that deals with the behavior of matter and energy at the smallest scales, typically atomic and subatomic levels. It is fundamentally characterized by the probabilistic nature of physical properties.

Quantum

A discrete quantity of energy proportional in magnitude to the frequency of the radiation it represents. It is a fundamental concept in quantum mechanics where energy, angular momentum, or other properties are quantized.

Superposition

The principle that a quantum system can exist in multiple states or configurations simultaneously until it is measured. Once observed, the system appears to collapse into one of the possible states.

Entanglement

A quantum phenomenon where particles become so closely linked that the state of one cannot be described independently of the state of another, regardless of the distance separating them. Changes to one entangled particle affect its partner instantaneously, a property Einstein referred to as "spooky action at a distance."

Wave Function

A mathematical description of the quantum state of a system. The wave function is central to quantum mechanics and encodes the probabilities of all possible outcomes of measurements made on the system.

Heisenberg Uncertainty Principle

A fundamental theory in quantum mechanics formulated by Werner Heisenberg, stating that it is impossible to simultaneously know both the exact position and the exact velocity of a particle. This principle reflects the inherent limitations in measuring quantum phenomena.

Quantum Tunneling

A quantum phenomenon where a particle passes through a potential barrier that it classically should not be able to pass. This is important in phenomena such as nuclear fusion and semiconductor physics.

Quantum Entropy

A measure of uncertainty or randomness associated with the state of a quantum system. It plays a critical role in quantum information theory and thermodynamics.

Quantum Fluctuation

Temporary changes in the amount of energy in a point in space, as allowed by the Heisenberg Uncertainty Principle. These fluctuations are believed to play a part in the formation of the universe.

Quantum Field Theory

A theoretical framework that combines classical field theory, special relativity, and quantum mechanics. It describes the interaction of fields (like electromagnetic fields) with matter using quantum mechanics.

Quantum Decoherence

The process by which a quantum system interacts with its environment in a manner that causes it to lose its quantum properties, such as superposition and entanglement. It is a key factor in transitioning from quantum to classical systems.

Quantum Chromodynamics (QCD)

The theory of the strong interaction between quarks and gluons, which are the fundamental particles that make up composite particles such as protons and neutrons.

Quantum Electrodynamics (QED)

The relativistic quantum field theory of electrodynamics that describes how light and matter interact. It is one of the most accurate theories in physics. Bell's Theorem: A theorem that suggests if quantum mechanics is correct, then the world is non-local, meaning that events happening at one location can instantaneously affect events at another location without any communication between them.

Schrodinger's Cat

A thought experiment devised by Erwin Schrödinger that illustrates the concept of superposition in quantum mechanics. The experiment poses a scenario in which a cat in a sealed box can be simultaneously alive and dead, a state known as a quantum superposition until an observation is made.

Pauli Exclusion Principle

A quantum mechanical principle that states that no two identical fermions (particles with half-integer spin) may occupy the same quantum state simultaneously. This principle explains a wide variety of physical phenomena, including the structure of atoms and the stability of matter.

Spin

A fundamental property of particles, much like mass or charge, which describes the intrinsic angular momentum of a particle. Spin is quantized in units of the reduced Planck constant.

Planck's Constant

A fundamental constant that sets the scale of quantum effects, denoted as h. It appears in the basic formulations of quantum mechanics and determines the size of quanta in processes such as energy emission.

These terms form the building blocks of understanding quantum mechanics and its applications. As research progresses, the definitions and implications of these terms may evolve, reflecting deeper insights into the nature of the universe.