100 Years of Quantum

On 4 February 2025, UNESCO's International Year of Quantum Science & Technology—celebrating 100 years of quantum mechanics—kicks off with an opening ceremony in Paris, France. Here we look at some key milestones along the way.

1900: BLACKBODY RADIATION – Max Planck suggests electromagnetic energy can only be emitted in quantized form.

1905: PHOTOELECTRIC EFFECT – Albert Einstein theoretically derives the equivalence of matter and energy.

1913: QUANTIZATION OF MATTER – Niels Bohr proposes a new model of the atom that includes quantized electron orbits.

1922: QUANTUM SPIN – Otto Stern and Walther Gerlach show that spatial orientation of angular momentum is quantized.

1924: MATTER WAVE HYPOTHESIS – Louis de Broglie hypothesizes that matter has wave properties.

1900
Quantum theory

1925
Quantum mechanics

1925: MATRIX MECHANICS – Werner Heisenberg, Max Born and Jordan Pascual develop the first conceptually autonomous and logically consistent formulation of quantum mechanics.

1926: WAVE MECHANICS – Edwin Schrödinger's wave equation describes the behavior of particles as wave functions, giving rise to the concept of wave–particle duality.

1927: UNCERTAINTY PRINCIPLE – Werner Heisenberg states that certain pairs of physical properties, like position and momentum, cannot be precisely measured simultaneously.

1927: DIRAC EQUATION – Paul Dirac presents a relativistic theory of the electron that predicts the existence of antimatter.

1932: THE NEUTRON – James Chadwick discovers a subatomic particle with no net electrical charge.

1935: EPR PARADOX – Albert Einstein, Boris Podolsky and Nathan Rosen argue that quantum mechanics is not a complete description of physical reality.

1936: QUANTUM LOGIC – Garrett Birkhoff and John von Neumann attempt to reconcile the apparent inconsistency of classical, Boolean logic with Heisenberg's uncertainty principle.

1948: QUANTUM ELECTRODYNAMICS – Richard Feynman states the path integral formulation of quantum mechanics.

1964: BELL'S INEQUALITIES – John Bell proposes a method to test whether quantum mechanics provides the most complete description of a system.

1980: QUANTUM COMPUTING – Paul Benioff proposes using the principles of quantum mechanics to perform computations exponentially faster than classical computers.

1982: QUANTUM ENTANGLEMENT – Alain Aspect performs an experimental test of Bell's inequalities and confirms the completeness of quantum mechanics.

1994: SHOR'S ALGORITHM – Peter Shor develops a quantum computing algorithm for finding prime factors of integers.

1997: QUANTUM TELEPORTATION – Two different research groups, led by Sandu Popescu and Anton Zeilinger, successfully transfer quantum information from a sender at one location to a receiver at another location.

2001: QUBIT TEST – Researchers at IBM implement Shor's algorithm on a quantum computer with seven qubits.

2025 International Year of Quantum Science and Technology

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