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## Atomic physics as the basis of quantum mechanics

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Quantum physics began with discretising the energy of resonators (Planck 1900). Quantum systems exhibit a substantially smaller amount of stationary states than classical systems (Einstein 1907). Planck's and Einstein's worked within statistical physics and electromagnetism. The first step toward quantum mechanics was, perhaps, Bohr's 1913 atom model. The task was to explain the stability of the atoms and the frequencies and intensities of their spectral lines. Two of these three tasks concern stationary properties. Heisenberg's 1925 matrix mechanics mastered them through a radical "reinterpretation of kinematic and mechanical relations", where that article tackles the anharmonic oscillator. The Bohr orbitals result directly from Schrödinger's 1926 wave mechanics, though the discretisation method is that of classical resonators. The reuse of the classical expressions for the kinetic and potential energies needs justification (Schrödinger 1926). Without that, the tunnel effect remains a mystery. Suisky & Enders 2005 provided that justification through an axiomatic deduction of the stationary and time-dependent Schrödinger equations from Euler's and Helmholtz's rather than Newton's and Hamilton's representations of classical mechanics. Referring to Einstein, the stationary quantum states are selected out off the classical continuum not through the classical eigenvalue method, but using the intrinsic discreteness of the stationary Schrödinger equation and energy conservation. Unbound states are naturally included. The effective potential energy is always smaller than the total energy; a quantum particle does not 'tunnel' through a barrier, but jumps over a hill. The smooth transition from classical to quantum mechanics facilitates to teach and understand the latter one.

## Biography

Peter Enders obtained a diploma in physics and Dr. rer. nat. habil. degree from Humboldt University at Berlin, his PhD from Moscow State Lomonosov University and the honorary professor from Kazakh National Pedagogical Abai University in Almaty. His interests include quantum chemistry, optoelectronics, telecommunication, axiomatic and unity of physics. He was a guest scientist and lecturer at several universities in Kazakhstan, UK and USA. He has authored and coauthored numerous papers on physics, logistics, linguistics, politics, and a textbook on the axiomatic foundation of quantum mechanics from classical mechanics (2006/2019).

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