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Modern Physics & Nuclear Physics 2019: Atomic physics as the basis of quantum mechanics - Peter Enders - Taraz State Pedagogical University

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Quantum physics begun 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 harmonic oscillator. The Bohr orbitals result directly from Schrodinger'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. Without that, the tunnel effect remains a mystery provided that justification through an axiomatic deduction of the stationary and time-dependent Schrodinger 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 of the classical continuum not through the classical eigenvalue method, but using the intrinsic discreteness of the stationary Schrodinger 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. One can give decent details why reality cannot at all be represented by a continuous field.

From the Quantum phenomena it appears to follow with certainty that a finite system of finite energy can be completely described by a finite set of numbers (quantum numbers). This does not seen to be in accordance with a continuum theory and must lead to an attempt to find a purely algebraic theory of or the description of reality. It leads to the insight that, if gravity is a fundamental interaction and Quantum Mechanics is universally valid, the gravitational field will have to be quantized, not at least because of the inconsistency of semi-classical theories of gravity. The quantization must be adroitly sufficient, which implies specifically that the subsequent quantum hypothesis must be foundation autonomous. This can't be accomplished by methods for quantum field hypothetical procedures. The goal of a hypothesis of Quantum Gravity would then be to recognize the quantum properties and the quantum elements of the gravitational field. If this means to quantize General Relativity, the general-relativistic identification of the gravitational field with the space time metric has to be taken into account. The quantization must be reasonably sufficient, which implies specifically that the subsequent quantum hypothesis must be foundation free. This can't be accomplished by methods for quantum field hypothetical techniques. One of the fundamental prerequisites for such a quantization technique is, that the subsequent quantum hypothesis has a traditional breaking point that is (in any event roughly, and up to the known phenomenology) indistinguishable from General Relativity.

Be that as it may, should gravity not be an essential, yet an incited, lingering, developing connection, it could in all likelihood be an inherently old style marvel. Should Quantum Mechanics be regardless generally substantial, we needed to expect a quantum substrate from which gravity would result as a new traditional marvel. What's more, there would be no contention with the contentions against semi-old style hypotheses, in light of the fact that there would be no gravity at all on the substrate level.

The gravitational field would not have any quantum properties to be caught by a hypothesis of Quantum Gravity, and a quantization of General Relativity would not prompt any principal hypothesis. The target of a hypothesis of 'Quantum Gravity' would rather be the ID of the quantum substrate from which gravity results. The requirement that the substrate theory has General Relativity as a classical limit – that it reproduces at least the known phenomenology – would remain. The paper tries to give an overview over the main options for theory construction in the field of Quantum Gravity. Because of the still unclear status of gravity and space time, it pleads for the necessity of a plurality of conceptually different approaches to Quantum Gravity. The most essential motivations for the development of a theory of Quantum Gravity are generally supposed to be based on two (probably interrelated) types of problems (i) the mutual conceptual incompatibility between General Relativity on the one hand and Quantum Mechanics and Quantum Field Theory on the other hand.