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Counter-intuitive results in atomic and molecular physics

The talk presents the following counterintuitive theoretical results breaking several paradigms of quantum mechanics and providing alternative interpretations of some important phenomena in atomic and molecular physics. 1) Singular solutions of the Schrödinger and Dirac equations should not have been always rejected. They can explain the experimental high-energy tail of the linear momentum distribution in the ground state of hydrogenic atoms. This is a unique way to test intimate details of the nuclear structure by performing atomic (rather than nuclear) experiments and calculations. 2) Charge exchange is not really an inherently quantal phenomenon, but rather has classical roots. It also has application in continuum lowering in plasmas. 3) The most challenging problem of classical physics that led to the development of quantum mechanics is the failure to explain the stability of atoms which can be solved within a classical formalism that has its roots in Dirac's works. The result is the appearance of classical non-radiating states coinciding with the corresponding quantal stationary states. The underlying physics can be interpreted as a non-Einsteinian time dilation. It is also an advanced classical description of electronic degrees of freedom in chemical physics.

Biography

Eugene Oks received his PhD from the Moscow Institute of Science and Technology, and later the highest degree of Doctor of Sciences from the Academy of Sciences of the USSR. He worked in Moscow (USSR) as the Head of a research unit (Center for Studying Surfaces and Vacuum), then – at Ruhr-University-Bochum (Germany) as the Invited Professor, and for the last 26 years – at the Physics Department of the Auburn University (USA) in the position of Professor. His research areas: Atomic/molecular physics, plasma physics, laser physics, nonlinear dynamics, and astrophysics. He founded/co-founded and developed new research fields: Intra-Stark spectroscopy, microwave "lasing" without inversion, quantum chaos. He developed a large number of advanced spectroscopic methods for diagnosing various laboratory and astrophysical plasmas. He published over 300 papers and 4 books. He is the Chief Editor of the journal "International Review of Atomic and Molecular Physics", a member of the Editorial Boards of the two other journals (International Journal of Spectroscopy and Open Journal of Microphysics), a member of the International Program Committees of the two conferences (Spectral Line Shapes and Zvenigorod Conference on Plasma Physics and Controlled Fusion).

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