AN ANALYTICALLY EXACT DERIVATION OF THE g-FACTOR OF THE ELECTRON IN THE HYDROGEN ATOM

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In his famous 1933-paper "the Lagrangean in Quantum Mechanics", Paul Dirac has linked Quantum Mechanics with Hamilton-Jacobi classical mechanics. The 2-particle problem of an electron bound to a proton, the hydrogen atom H, is the only system that one may be able to exactly solve classically. The Lagrangean is a non-relativistic approximation, and here we report a study, using modern computer algebra, of a fully relativistic calculation. The results of our analysis indicate the existence of stable orbits, resulting from a competition of the Coulomb force (attracting as $1/r^2$) and the magnetic interaction between the proton- and electron-spins (repulsive at short distances as $1/r^{5/2}$). We view the result as classically-derived "quantum mechanics".
The analysis also provides a simple geometric explanation for the g-factor of the electron to 6 digits. By including an applied magnetic field, the Zeeman effect of the two spin systems could be evaluated in the spherically symmetric, orbital S ground state: hence we can derive the effective magnetic moments (i.e. μ_{B}) of electron and proton from first principles. The outcome of the analysis is that we can construct a calculable standard for the magnetic field, and in an experiment fix the strength of the magnetic field in terms of fundamental constants with uncertainties much less than 1 ppm. This could provide a Euromet standard for the SI-Tesla, easily transfered using NMR probes, ensuring magnetic field measurement traceability up to 7 digits or an uncertainty of 0.1 ppm.

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