On highly relativistic deep electrons

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Starting from our study on the Electron Deep Orbits (EDO), we have particularly analyzed works based on the use of relativistic quantum equations, as it is to be expected that such electrons are relativistic. This hypothesis has been continuously confirmed throughout our study. Here, we quickly recall the results of a complete analysis and extension [1] [2] of the most-developed prior works [3] [4] based on the Dirac equation and the relativistic Schrödinger equation. Doing this, we discussed and countered the most common arguments found in the literature against ODEs. These arguments can be easily eliminated if we consider a nucleus of finite dimension $r_n > 0$, which removes the singularity at the origin. On another hand, as Special Relativity seems to be an essential element for obtaining EDO solutions, we showed [5] that it is actually the source of EDO's.

A second part of our work concerns the need to take into account the magnetic interactions near the nucleus. They are very energetic in the vicinity of the nucleus, but as the one-particle Dirac equation considers the Coulomb field as an external electrostatic field, it does not take into account the nuclear spin. We undertook [6] and continue the study of EM potentials that act on an electron in a deep orbit. Doing this, we are tackling two very important issues: do the EDOs satisfy the Heisenberg Uncertainty relation (HUR)? Are the orbits stable? A recent study [7], where we directly face the HUR for electrons confined in deep orbits, allows us to evaluate the coefficient γ of these highly relativistic electrons. Consequently, a high relativistic correction of the Coulomb potential yields an effective potential V_{eff} capable of confining such electrons. First approximate computations combining EM potentials, allow us to expect high-energy resonance near the nucleus. Moreover, radiative corrections could have a significant influence in this zone. Results published in the literature on the Lamb shift for heavy atoms reinforce this hypothesis. So, this paper presents some questions relating to the progress of our study:

- How to combine different attractive and repulsive EM potentials.
- From where is extracted the high kinetic energy of the deep electrons?
- The effective potential V_{eff} as a function of electron velocity and its distance to the nucleus?
- What is the order of magnitude of the radiative corrections for the EDO's?
- What is the relation between EDO solutions of the Dirac equation and high energy resonances corresponding to a semi-classical local minimum of energy?

References

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