On space-time in hydrogenoid atoms

Guillem Gómez i Blanch [♭1] and Màrius Josep Fullana i Alfonso [♮]

(♭♮) Institut de Matemàtica Multidisciplinària. Universitat Politècnica de València.
Camí de Vera s/n 46022 València, Spain.

Abstract

We present a line of work related with the atomic systems, the General Relativity and the Causal Quantum Mechanics [1]. A novelty of our approach is its dialectical conception, where not only the wave guides the particle (as in de Broglie-Bohm theory, also called the pilot-wave theory), but also the particle (the mass-energy and moment of the microphysic system) determines the causes that guide the particle, so the wave. So we look for a closed system of cause and effect. We partially exposed this conception in two papers ([2]) and ([3] and in the thesis ([4]).

We develop the hypothesis that the atomic electrons follow geodesic trajectories in a space-time curved under the action of both the electric and quantum potential.

We start from the de Broglie-Bohm prediction for the orbits in the particularly simple hydrogenoid atoms with principal quantum number $n > 1$. Then we elaborate a transition of *local* character to a Lorentzian manifold. We use the concept of Euclidean tangent metric ([5]) to locally connect a point of the Lorentzian manifold to the Euclidean tangent space-time and to the Euclidean space-time of reference, where is described the de Broglie-Bohm trajectory of the particle.

From the properties of that transition, we establish the geodesic equations of the electron in the Lorentzian manifold. we use the connectors of Levi-Civita because they unify the metric and affine geodesics. We obtain a bundle of geodesics that across the selected point in the form of an equation between some metric's components.

Furthermore, we can establish the relation between the elemental distance ds^2 of the manifold, the tangent space-time and the space-time of reference. Then, an additional equation is obtained that result in a particularization of one geodesic of the a. m. bundle.

The obtained result strongly suggests the metric of Lanczos -Van Stockum ([6]) that we considered in ([2]) and in the thesis ([4]). It allows completing the metrics of the Lorentzian manifold previously obtained. It is of type I in the Petrov's classification and shows a positive scalar curvature.

This approach to the geometrical structure of the Lorentzian manifold in the frame of our hypothesis is only a first step, because it is known that the Einstein's field equations are not valid in microphysics. To go deeper in the subject, we must address the 3+1 model of the General Relativity, in particular the ADM theory and its quantization within the Wheeler deWitt theory. We follow the way opened by the groups around Shojai ([7]) ([8]) and Dürr([9]), that establish the Einstein's quantum field equation. In this approach, particularized for the particle ontology by Struyve et alii ([10]), one arrives to the conclusion that the energy-momentum tensor has in each component an additional term of quantum character, where the quantum potential has a great relevance.

Therefore, it is opened an avenue to modify the previously obtained metric in this new context and we present the lasts results that we have obtained in this field.

[1] guigobla@doctor.upv.es

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