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Consequences of a Deterministic Equation for the Hydrogen Atom

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*If you want to know the past look at the present that is the result.
If you want to know the future look at the present that is the cause.*

Abstract

The *quantum wave mechanics* proposed in 1926 by Erwin Schrödinger for the *hydrogen atom* was a mixture of *success* and *failure*. Astonishing and extraordinary success resulted from Schrödinger self adjoint Hamiltonian energy *linear operator* $H = -\nabla^2 + V$. This mathematical object allows the calculation of *stationary energies* $-\lambda_n = -Ry/(n+1)^2$ and *stationary electron configurations* $[\psi_n]$ with $\psi_n \in E_n = \ker(H + \lambda_n T)$. On the other hand the Schrödinger *time dependent equation* was such a *dramatic failure* that it led to the establishment of the current *Quantism*, or *Quantum doctrine*, or *Copenhagen interpretation of quantum mechanics* based on the postulates listed in **1** below, or variations of these. This paper discusses the *implications* that the deterministic time dependent equation — proposed in [2] and elsewhere— has for Quantism.

§1 Introduction

1. Let $H = -\nabla^2 + V$ denote the Schrödinger self adjoint Hamiltonian energy *operator* and consider the *Schrödinger time dependent equation* (STDE) $\partial\psi/\partial t = (-i/\hbar)H(\psi)$, an energy conservative and seemingly causal equation that specifies the movement of waves. Quantism is a *physical theory* that *postulates* the:

QP1.- Schrödinger time dependent equation as a *law of nature*, extensible beyond hydrogen to atoms in general, molecules, photons and other microscopic particles.

QP2.- Interpretation of *wave amplitudes* as *probability densities*.

QP3.- Existence of *intrinsically random transitions of state* or *quantum jumps*.

QP4.- *Principle of uncertainty*: precise values of position imply uncertain values of momentum, and conversely. Extensible to conjugate pairs of observables.

QP5.- *Principle of indeterminacy*: Values of observables do not exist, or are not determined, or are not assumed by the system, until actually measured, as with entangled spin.

QP6.- *Wave-particle duality*: Microscopic entities are both (alt. neither) waves that occupy a volume and have structure within the volume and (alt. nor) are particles occupying infinitely small positions in space.

QP7.- *Denial* of *continuity of processes*, as when discontinuous quantum jumps occur.

QP8.- *Denial* of *causality*, when quantum jumps violate the postulated causal STDE.

This list reflects the author bias. Some postulates may be distorted and others missing; expect discrepancies with your own versions.

2. The *basic quantum wave postulate* is QP1. The seven remaining postulates, QP2 to QP8, are the *accessory postulates*, somehow *reminiscent* of the 2013 *Bohr model* for hydrogen.

3. When examined in detail all these *postulates* can be *understood*, *expanded* and *applied* in a multitude of *different manners*. The subject is too extensive to be treated beyond a listing, as heroically attempted in [1].
4. The *basic quantum mechanics* has a number of *descendant theories* like Quantum Electrodynamics, Quantum Field Theory, Quantum Chromodynamics, Quantum Gravity, etc. The use of unitary group representations reveals the deep *influence* of quantum mechanics on theoretical *high energy physics*.

§2 The deterministic equation

5. The deterministic time dependent equation of [2] is to be now reviewed. The *photon* will be explicitly expressed by wave functions *conjugate* to the electron wave variable, that is, by infinite dimensional variables of the same type than, and orthogonal to, ψ ; other than that, the original 1926 viewpoint of Schrödinger about the proton and the electron is adopted.
6. In detail, let the *linear space of waves* be the sum $E = E_0 + E_1 + \dots + E_n + \dots$ of the real eigenspaces $E_n = \ker(H + \lambda_n T)$ of H . The proton, electron and photon will be deterministically represented as follows:
 - 1.- The *proton* by means of its *Coulomb potential* $V = V(r) = V(x, y, z)$.
 - 2.- The *electron* by the *ray* $[\psi] = \{\mu\psi \mid \mu \in \mathbb{R}\}$ of the wave function $0 \neq \psi \in E$.
 - 3.- The *photon* when *mounted* on an electron configuration $[\psi]$ is a pair $([\psi], \phi)$ where $[\psi]$ is the configuration being mounted and the *photon wave function* ϕ is *orthogonal* to ψ , $\phi \in [\psi]^\perp$.
7. The above mathematical entities give rise to several *smooth manifolds* required to adopt the perspective of *dynamical systems*:
 - 1.- The linear space E of *wave functions* is an infinite dimensional *inner product vector space* (being non complete it cannot be a Hilbert space), is also a smooth Riemannian manifold and contains the unit sphere SE as a Riemannian submanifold.
 - 2.- The space of *electron configurations* is the *real projective space* PE , a smooth, Riemannian, highly non-linear manifold. The double cover antipodal identification map $SE \rightarrow PE$ is locally isometric hence PE is locally a sphere and globally a somewhat convolved sphere.
 - 3.- The *subspace* of *states* that are *mounted* on the *electron configuration* $[\psi]$ is by definition the *cotangent vector space* of PE over the configuration that is being mounted, $T_{[\psi]}^*PE = \{([\psi], \phi) \mid \langle \psi, \psi \rangle = 0\}$. This is an inner product vector space is equal to the Cartesian product of the singleton $\{[\psi]\} \subseteq PE$ and the hyperplane $[\psi]^\perp \subseteq E$.
 - 4.- The full *space of states* of the hydrogen atom is the *cotangent manifold* of the *projective of E*, $T^*PE = \bigcup\{T_{[\psi]}^*PE \mid [\psi] \in PE\} \subseteq PE \times E$.

8. Let $e_H([\psi]) = \langle H(\psi), \psi \rangle / \langle \psi, \psi \rangle$. The total energy function for hydrogen is the sum of *three terms*, $e_T = e_{\text{Int}} + e_V + e_K = e_H + e_K : T^*PE \rightarrow \mathbb{R}$, namely:
- 1.- The *internal energy* of the electron configuration, $e_{\text{Int}}([\psi], \phi) = \langle \nabla\psi, \nabla\psi \rangle / \langle \psi, \psi \rangle = -\langle \nabla^2\psi, \psi \rangle / \langle \psi, \psi \rangle$.
 - 2.- The *electrostatic interaction energy* $e_V([\psi], \phi) = \langle V, \psi^2 \rangle / \langle \psi, \psi \rangle = \langle V\psi, \psi \rangle / \langle \psi, \psi \rangle$.
 - 3.- The *photon kinetic energy* $e_K([\psi], \phi) = (1/2)\langle \phi, \phi \rangle / \langle \psi, \psi \rangle$.
9. It cannot be overemphasized that the Schrödinger *self adjoint operator* H provides *numerical values* and *explicitly defined waves* (numerically expressible functions) in the form of *eigenvalues* and *eigenfunctions* that are in fact the *critical energy values* and *critical states* of the total energy function e_T , hence are undoubtedly related to the *stationary energies*, *stationary electron configurations* and *stationary states* of the hydrogen atom.
10. The statements in 8 and 9 show that the operator H , with eigenvalues and eigenfunctions honorably placed over high pedestals, fits in a *natural manner* within the DTDE below. A substantial part of the considerable body of results obtained since 1926 by quantum *physicists* and *chemists* should be *assimilable* by the coming post-quantum deterministic developments.
11. The *deterministic time dependent equation* for the hydrogen atom, abbreviated **DTDE**, is the Hamilton equation of the total energy

$$\frac{\partial([\psi], \phi)}{\partial t} = \left(\frac{\partial e_T}{\partial \phi}, -\frac{\partial e_T}{\partial [\psi]} \right)$$

§3 Consequences of determinism

12. Contrary to the central role presently —and at all future times to be— occupied by the self adjoint operator H , the *Schrödinger time dependent equation* will be *abandoned* because it is a *fake physical law*, as Niels Bohr discovered already in 1926. See [2].
13. Apparently Bohr did not *understand*, or did not correctly *interpret*, or did not want to *accept* his own *important contribution*. Instead he proceeded to employ his connections within the scientific community to successfully *impose* the **STDE** and the various accessory postulates.
14. The **STDE** is the *most important* of the *quantum wave postulates* because its *physical dysfunctionality* forced the apparition of the remaining ones. Let the STDE be replaced with the DTDE. Question: What then happens with the seven *accessory postulates*? Answer: They are immediately recognized as *logical fallacies* of the type classified by logicians as *red herrings*. See [3] Chap. 3, §8, p. 136.
15. The vicissitudes of Quantism demonstrate the consequences of *misjudging* as *physically correct* the *wrong mathematical equation* (in itself mathematically plausible as one more in the long list of partial differential equations).

16. The *fallacies* have been terribly *effective*. Instead of promoting an unanimous effort in search of a correct replacement for the STDE they *diverted* the *attention* of many scientists towards *irrelevant* and *physically useless* speculations. Historical *examples* of fallacies are Stahl *phlogiston* theory, Lamarck *inheritance of acquired traits* and the Aristotelian doctrine of *motive force*.
17. Mistakenly assuming that the fallacies were demonstration of an ongoing scientific revolution capable of disclosing unimaginable wonders of the microworld, many *talented minds* dedicated their precious *time* and *energy* to explore, discuss, elaborate, dispute and extend the *quantum postulates*. In the near future quantum fallacies may provide the best textbook examples of science gone wrong.
18. A pressing question is whom to make *responsible* for the blunder. And how to *compensate* the misdirected efforts exerted by thousands of well intended persons including educated citizens, students, journalists, physicists, mathematicians, philosophers, scientists and even theologians that have fallen *victim* to the quantum fallacies.

References

- [1] Cabello, A. *Bibliographic guide to the foundations of quantum mechanics and quantum information*. Latest arXiv version 2004.
- [2] Crespin, D. *Deconstruction of Quantum Wave Mechanics*, 2021.
- [3] Hurley, P. J. *A Concise Introduction to Logic. 12th ed.*, 2014. Cengage Learning.

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