the general science journal

QUANTUM MECHANICS' FOUNDATION, HOW STRONG IS IT?

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The Summary

The basic constants of the quantum mechanics such as the Planck's constant, the fine structure constant, and the Rydberg constant are directly connected with dynamic parameters of the molecule and not of the atom of hydrogen. In particular the Planck's constant is the ratio of the kinetic energy of hydrogen molecule electron to the frequency of its rotation about the nucleus, the fine structure constant is the ratio of the circular velocity of rotation of this molecule's electron to the speed of light in vacuum, and the Rydberg constant is the ratio of the rotation frequency of this molecule's electron to the speed of light in vacuum. In the same way are associated with these parameters all those constants that are derivative from the said basic ones, such as the inverted fine structure constant, or the reduced Planck's constant .
These facts evince that empirical data regarding the light frequencies emitted by heated hydrogen could not and cannot serve as a basement for constructing a hydrogen atom model, and that the hydrogen atom model proposed by Bohr in 1913 and laid in the foundation of the quantum mechanics is not correct. Therefore this foundation and all the theoretical structures made thereon need radical revising.

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Although the beginning of the quantum mechanics, as well as of the whole modern physics is related to the discoveries of Max Planck that gave the first evidence of radiated energy quantization, as its real birth and that of its entire incomprehensibilities one would better mean the hydrogen atom model proposed by Niels Bohr in 1913.

The said model is known en.wikipedia.org/wiki/Rydberg_equation to have been invented on the basis of the firstly proposed in 1885 by Johann Jakob Balmer and later improved by Rydberg formula, arranging wavelengths of light radiated by hydrogen heated in a gas discharge tube in relation to combinations of integers n_1 and n_2. According to a modern redaction the formula looks as follows:

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \qquad (1), \text{ where}$$

λ is wavelength of light radiated in vacuum that is in the above tube, R_H is the Rydberg constant for hydrogen, and n_1 and n_2 are said integers from which $n_1 < n_2$. The both parts of the formula multiplied by the light velocity in vacuum c , it can be converted to somewhat different form, in which ν would stand for the radiated light frequency.

$$\nu = cR_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \qquad (2),$$

The product cR_H with a dimension s^{-1} would stand for a certain frequency.

Although the Balmer-Rydberg formula, depending on number n_1 value, denotes several series of frequencies, those of visible light keep themselves within the Balmer serie with $n_1 = 2$, and just these frequencies were initially analyzed by Balmer and later by Bohr. The last as well as his followers took the view that the creation of photons radiated by hydrogen takes place in its atoms, and that the Balmer formula as exclusively related to monatomic hydrogen had to contain information helpful for creation the model of just this kind of atom. In modern literature on quantum mechanics [1] one even may find allegations that the gas discharge tube which had served as source of the explored radiation had been filled

with monatomic gas, although in earlier sources such reports were unnoticeable. On the other hand, it is known that under ordinary conditions on Earth, elemental hydrogen exists as the diatomic gas H_2 en.wikipedia.org/wiki/Hydrogen and that the most elements aside from the noble gases form diatomic molecules when heated, but high temperatures - sometimes thousands of degrees - are often required en.wikipedia.org/.../Diatomic molecule.

From the exposed above one can conclude that:

- The Balmer-Rydberg formula used by Bohr as a foundation for creation the hydrogen atom model as relating not to the hydrogen atom H but to its molecule H_2 cannot serve as a foundation for the hydrogen atom model construction;
- Photons being formed in hydrogen molecules, the above formula can serve to construct a model of such kind of molecules.

The concept of photons' formation in the hydrogen molecule will be exposed soon in one of my next articles. As regards the molecule itself, it seems to me as composed similarly to the solar planetary system with a nucleus having two protons and two electrons orbiting the nucleus in the same plane and at equal distances there from. I see no reason why these distances could differ, as well as I see no reason why the electrons could orbit the nucleus with different angular or linear velocities. On the other hand, with regard to the necessary stability of the molecule I presume the electrons' orbiting directions to be opposite. I also believe that the orbiting frequency of the electrons has to be stable and I suppose this frequency to equal the said productcR_H.

So far as according to NIST physics.nist.gov/cuu/Constants/index.html R_H =10 973 731.568 527 m^{-1} and c=299 792 458 m s^{-1}, cR_H=3.289842·10^{15} s^{-1}, which means that in a second these electrons make more than 3289 million of millions revolutions.

The proposed planetary model of the hydrogen molecule has much in common with the model of atom proposed by Rutherford and at that time considered inoperative, for the reason that charged electrons turning around a nucleus and meeting no resistance at all would continuously accelerate, whereas all accelerated charges according to the classic theory of electromagnetism emit electromagnetic energy, in this case at the expenses of the kinetic energy of their own, whose losses would very soon enforce the electrons to fall on the nucleus [1].

With no intention to dispute with the Rutherford model critics I would only state that according to the first postulate of Bohr electron of the hydrogen atom turns on a circular orbit around the nucleus under the influence of the coulomb attraction between electron and the nucleus according to laws of the classic mechanics i.e. in the same way as in the Rutherford model.

With regard to all the other Bohr's postulates I would by the way remark that without founding on any known physical laws or hypothesizes they seem to be subdued to attempt in a pure mathematical way to satisfy the already known mathematical regularity.

Let us examine now only few perspectives opening with use of the proposed model of hydrogen molecule.

Let us begin with analyzing the balance of forces applied to one of its electrons and for more simplicity let us assume that the protons of the nucleus are so close to each other that one could imagine them both in a point, as well as electrons turning around this point on circular orbits. The left part of the balance equation can be represented as a Coulomb force determined according to modern scientific views as

$$F_c = k_e \frac{q_1 q_2}{r^2},$$

where k_e stands for the coefficient of proportionality, q_1 and q_2 are the interacting electric charges and r – the distance between them. As we know from Wikipedia en.wikipedia.org/wiki/Coulomb's_law

k_e =8.9875517873681764·10^9 N m C^{-2}. The molecular nucleus having two unitary charges and electron – only one, the Coulomb force attracting electron to the nucleus will be equal to

$$F_c = k_e \frac{2q^2}{r^2},$$

where q – is a unitary electric charge. According to NIST physics.nist.gov/cuu/Constants/index.html the unitary charge of electron and therefore of proton equals 1.602 176 487(40) x 10^{-19} C.

The right part of the balance equation would be in form of eccentric force

$$F_{cf} = m_e r\omega^2, \text{ where}$$

m_e – is mass of electron, which equals 9.109 382 15(45) x 10^{-31} kg physics.nist.gov/cuu/Constants/index.html and ω – is its angular velocity.

According to the above presumption concerning the frequency of the electron's orbiting, $\omega = 2\pi c R_H$ and the balance equation will have the following form

$$F_c = k_e \frac{2q^2}{r^2} = F_{cf} = m_e r(2\pi c R_H)^2.$$

From there one can find out the radius of the electron's orbit:

$$r = \sqrt[3]{\frac{k_e q^2}{2\pi^2 m_e c^2 R_H^2}}.$$

Using the above numeric data we can obtain r= 1.058354·10^{-10} m.

Circular velocity of the electron's rotation will equal

$$v_e = \omega r = 2\pi c R_H r = 2.1876904 \cdot 10^6 \text{ m s}^{-1}.$$

The relation of this value to the speed of light in vacuum makes $\frac{v_e}{c} = 2\pi R_H r = 7.2973497 \cdot 10^{-3}$, which virtually coincides with the value of the fine structure constant α=7.297 352 5376(50) x 10^{-3} shown on the site of NIST physics.nist.gov/cuu/Constants/index.html , while an inverted value makes 1/ α=137.036.
Just about the last value the creator of the Quantum electrodynamics Richard Feinman allowed himself the following statement: "It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it. Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil." We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly!" [2].

Interesting in connection to the just found based on the proposed model relation are several other statements borrowed from the site en.wikipedia.org/wiki/Fine-structure_constant. Here the Wikipedia writes that:

"The **fine-structure constant** (usually denoted α) is a fundamental physical constant, namely the coupling constant characterizing the strength of the electromagnetic interaction."

"Arnold Sommerfeld introduced the fine-structure constant in 1916, as part of his theory of the relativistic deviations of atomic spectral lines from the predictions of the Bohr model. The first physical interpretation

of the fine-structure constant α was as the ratio of the velocity of the electron in the first circular orbit of the relativistic Bohr atom to the speed of light in the vacuum. Equivalently, it was the quotient between the maximum angular momentum allowed by relativity for a closed orbit, and the minimum angular momentum allowed for it by quantum mechanics. It appears naturally in Sommerfeld's analysis, and determines the size of the splitting or fine-structure of the hydrogenic spectral lines."

"The fine structure constant so intrigued the physicist Wolfgang Pauli that he even collaborated with the psychologist Carl Jung in an extraordinary quest to understand its significance."

Returning now to the main stream of the article it is convenient to note that the kinetic energy of the electron would be equal

$$E = \frac{1}{2} m_e v_e^2 = \frac{1}{2} m_e (2\pi c R_H r)^2,$$

which after the necessary numerical calculations gives:

$$E = 2{,}179870 \times 10^{-18} \text{ J}.$$

The ratio of this value to the frequency of electron's rotation equals

$$h = \frac{E}{cR_H} = 6{,}6260636 \times 10^{-34} \text{ J s},$$

which virtually coincides with the Planck's constant value $h = 6.626\ 068\ 96(33) \times 10^{-34}$ J s published on the same site physics.nist.gov/cuu/Constants/index.html . The last allows determining the Planck's constant as the relation of the kinetic energy of electron in the hydrogen molecule to the frequency of its orbiting the nucleus.

In this context it would be opportune to note that the constant of Planck had entered the science long before the appearance of the Bohr's hydrogen atom model and is not linked with it directly. As Wikipedia says en.wikipedia.org/wiki/Planck_constant, the Planck constant (denoted *h*), also called Planck's constant is a physical constant used to describe the sizes of quanta in quantum mechanics. The Planck constant is the proportionality constant between energy (*E*) of a photon and the frequency of its associated electromagnetic wave (*v*).

According to modern scientific views en.wikipedia.org/wiki/Rydberg_constant **"**the Rydberg constant is a physical constant relating to atomic spectra in the science of spectroscopy. Rydberg initially determined its value empirically from spectroscopy, but it was later found that its value could be calculated from more fundamental constants by using quantum mechanics."

"The Rydberg constant represents the limiting value of the highest wavenumber (the inverse wavelength) of any photon that can be emitted from the hydrogen atom, or, alternatively, the wavenumber of the lowest-energy photon capable of ionizing the hydrogen atom from its ground state. The spectrum of hydrogen can be expressed simply in terms of the Rydberg constant, using the Rydberg formula."

The cited data evidence that at the beginning the determination of the Rydberg constant was made empirically without basing on any photon creation model and only later was linked to an accepted model of atom.

Resulting from all exposed above the fundamental constants of the quantum mechanics, i.e. the Planck's constant, the fine structure constant, and Rydberg constant are directly linked with parameters of motion of electron in the molecule of hydrogen. Similarly have to be linked with these parameters all the other constants derived from the above fundamental ones, for instance the inverted fine structure constant, or reduced Planck's constant.

As to connection of these constants with the atom of hydrogen, the direct evidence of such a connection is not perceptible.

Obviously the theoretical foundation of the quantum mechanics is laid incorrectly and all the theoretical structures built on this foundation need a radical revising.

Bibliography:

1) Robert Eisberg and Robert Resnick, Quantum Physics, John Wiley & Sons, Second Edition, ISBN 0-471-87373-X, p.96
2) Feynman, Richard, QED: the strange theory of light and matter. Princeton University Press. (2006). ISBN 0-691-12575-9

See also the web-site www.physicsofether.kiev.ua