Ether and the Derivation of Planck's Constant

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Quantum Mechanics offer science solutions for the discrete energy levels of electrons circling around the nucleus in atoms. The mathematical solutions of QM do not provide a physical explanation why the allowed quantum energy levels of atoms are fixed. In this article we show how the QM-solutions can be explained: QM- and classical physics merge.

1. Introduction

The experiments of Rutherford (1871-1937) lead to the first atomic model, which was named after him. The Rutherford-model, based on the diffraction of α-beams, could not explain the stability and the discrete energy levels of atoms. In order to be able to describe the existence of stable atoms and discrete energy levels, Bohr (1885-1962) introduced his thesis. Bohr, and Heisenberg, Dirac, and Schrödinger in their work, lead to the complete mathematical solution of the atomic model.

The QM-solutions however are, to a certain degree, unsatisfactory because these solutions do not describe the physical processes that lead to, for example, the allowed discrete energy levels of atoms. Knowledge of the physical processes responsible for QM would complement its already undisputable mathematical position.

The principal quantum number n for atoms coincides with fixed energy levels of the atom. The quantization of the energy of the atom can be interpreted as originating from distance quantization. Analyzing this possibility, we encounter strong direct circumstantial evidence pointing to the existence of the ***Quantum Distance***.

2. The Mechanical Free Rotator

The atom is a so-called 'free rotator'. The electrons rotate around the nucleus at discrete energy levels, indefinitely, without losing energy or collapsing.

We consider first the mechanical free rotator. Two masses, M_p and M_e, circle around each other. The masses are mechanically connected through a rigid, mass-less rod of length R (Fig. 1). When both masses M_p and M_e are rotating, and when there is no interaction with any other system, the masses M_p and M_e will rotate stably for infinite time.

Because both masses are connected with the rigid rod, the dynamics can be described by classical kinematics. The rotating point of the system (fig. 1) is determined by the relative masses, according to the following equations:

$$R = R_e + R_p \quad , \quad R_p = (M_e / M_p) R_e$$

Because both masses are rigidly connected to each other, the following equations for velocity, angular velocity, and central force must be valid:

$$V_p = (M_e / M_p) V_e \quad , \quad \omega = V_e / R_e = V_p / R_p \quad ,$$

$$M_e V_e^2 / R_e = M_p V_p^2 / R_p = F_c \quad .$$

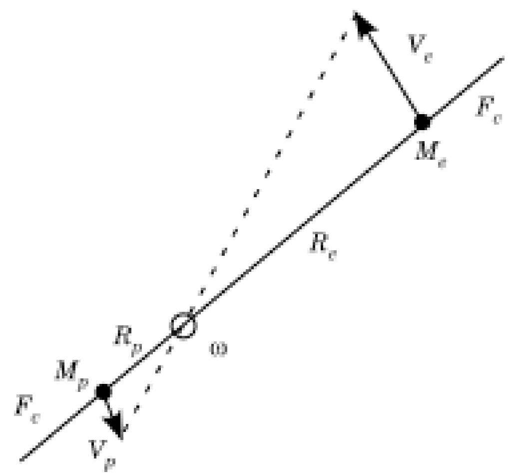

Figure 1. The mechanical free rotator. F_c is centrifugal force putting tension on the rod.

3. The EM-Rotator

When both masses are not connected through a rigid massless rod, and are charged masses, like the electron (M_e) and proton (M_p) in the Hydrogen atom, the above properties of the mechanical free rotator must also be valid in stable situations.

To obtain a free EM-rotator with stable orbits, the function of the mass-less rod must be taken over by forces working on electrons and nucleus in the atom. All forces must be neutralized/equalized during the rotation of the electron around the proton at any time.

In a stable situation, the following mechanical conditions for proton (M_p) and electron (M_e) in the Hydrogen atom must be valid:

$$R = R_p + R_e \quad , \quad R_p = (M_e / M_p) R_e \quad ,$$

$$V_p = (M_e / M_p) V_e \quad , \quad \omega = V_e / R_e = V_p / R_p \quad ,$$

$$M_e V_e^2 / R_e = M_p V_p^2 / R_p = F_c \quad ,$$

where now the centrifugal force F_c, working equally on proton and electron, has to be compensated a force internal to the system: the electrostatic force F_e.

We consider the EM-free rotator where the centrifugal force (F_c) is compensated at ***all times*** by the electrostatic force (F_e). This assumption implies that the electron is in a steady orbit around the proton. The additional mechanical requirements for the steady EM-rotator are:

$$F_e = e^2 / 4\pi\varepsilon_0 R^2 \equiv F_c = MeVe^2 / R_e$$

and
$$F_e = e^2 / 4\pi\varepsilon_0 R^2 \equiv F_c = M_p V_p^2 / R_p$$

The equilibrium relationship for the free and stable EM-rotator is:

$$R_e = e^2 \Big/ \left[4\pi\varepsilon_0 (1 + M_e / M_p)^2 M_e V_e^2 \right] \quad (1)$$

where R_e is the distance of the electron to the rotation point of the system (Fig. 1), M_e the mass of the electron, M_p the mass of the proton, V_e the rotation speed of the electron, e the elementary charge of the electron and ε_0 the dielectric constant in vacuum.

This equation describes the radius R_e of the orbiting electron as a function of the rotation speed V_e in the situation where the system is stable ($dE / dt = 0$) and the orbiting speed is constant ($dV_e / dt = 0$). Analyzing this equation we observe that for any speed of the electron V_e, there is a possible solution R_e.

The situation sketched in Fig. 1 is also the situation where the electron and proton are both in a steady orbit around O. The electrostatic force F_e now compensates the centrifugal force F_c.

As there is for any speed of the electron V_e also an orbit distance R_e where all forces are in equilibrium, there are infinite solutions and so there are no theoretical solutions based on this model that resemble the reality of fixed energy levels.

The proton and electron have, besides mass, also a charge. The moving electron and proton would each present an electric current. The magnetic fields induced by electron and nucleus would induce a magnetic force F_m between proton and electron equal to:

$$F_m = \mu_0 e^2 Ve^2 \Big/ \left[4\pi R_e^{\,2} (1 + M_e / M_p)^2 \right] \times M_e / M_p$$

This magnetic force F_m, when relevant, would be negligible compared to the electrostatic force F_e. The nuclear forces are negligible at the molecular distance.

A moving charge presents dynamic energy in the form of magnetic energy. The Rutherford-model was considered not stable because the circling electrons around the nucleus would loose energy by emitting radiation; so a stable EM-rotator like the Rutherford-model was considered impossible. A moving charge can emit radiation and loose energy, but it is not true that a moving charge in all circumstances has to loose energy. We refer to the article "The Equivalence of magnetic and Kinetic Energy" where it is proven that both energy forms are identical. A moving mass can circle indefinitely without loosing energy, and so can a charge.

4. The Energy Level of the Hydrogen EM-free Rotator Atom

Although it has in the past been impossible to obtain a mathematical solution for a EM-free rotator that resembles the Hydrogen atom with it's clear energy levels, we continue the search.

When the electron circles around the proton at a smaller distance ($R_2 < R_1$) the electrostatic energy (W_e) of the system is decreased according to:

$$\Delta W_e = -e^2 / 4\pi\varepsilon_0 R_2 + e^2 / 4\pi\varepsilon_0 R_1 \quad (2)$$

The kinetic energy of the Hydrogen atom, when considering the atom is an EM-rotator, would increase because the electron is now circling around with higher speed.

$$W_k = 1/2 M_e V_e^2 + 1/2 M_p V_p^2 = \tfrac{1}{2} \times \left[M_e V_e^2 (1 + M_e / M_p) \right] \quad (3)$$

Considering Eq. (1):

$$R_e = e^2 \Big/ \left[4\pi\varepsilon_0 (1 + M_e / M_p)^2 MeVe^2 \right]$$

we can express the dynamic/kinetic energy of the system W_k (3) with:

$$W_k = 1/2 M_e V_e^2 + 1/2 M_p V_p^2 = e^2 \Big/ 8\pi\varepsilon_0 (1 + M_e / M_p) R_e \quad (4)$$

Eq. (2) shows the difference in electrostatic energy levels between the orbit radius R_2 and R_1. The electrostatic energy level of the atom, when $R_1 = \infty$ and $R_2 = R_e$, is:

$$W_e = -e^2 \Big/ \left[4\pi\varepsilon_0 R_e (1 + M_e / M_p) \right] \quad (2a)$$

We observe that the kinetic energy of the system W_k (4) is ***at all times*** half of the released potential energy W_e of the electrostatic field (2a). Eqs. (2a) and (4) give

so
$$W = W_e + W_k = -e^2 \Big/ \left[8\pi\varepsilon_0 R_e (1 + Me / Mp) \right] \quad (5)$$

When the atom emits a photon in our EM-rotator, due to the descent of the electron to a lower orbit, the energy of the photon is half the decreased potential energy. Because of the energy conservation law the energy of the emitted photon must be:

$$hv = e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 R_{e_1} \right] - e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 R_{e_2} \right]$$

$$hv = e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 \times (R_{e_2} - R_{e_1}) / R_{e_2} R_{e_1} \right]$$

These are the photons emitted by the EM-rotator when the orbiting distance R_e determines the energy level.

The energy level of the Hydrogen atom, according to the Bohr-atomic model (W_B), is:

$$W_B = (-e^4 M_e / 8\varepsilon_0{}^2 h^2) \times 1 / n^2 \quad (6)$$

where n is the principal quantum number.

The Bohr-atomic model describes the observed energy levels of the atom very well for $n = 1, 2, 3$ ... In Eq. (6) the only variable is n . The energy level of the EM-rotator (5) is completely determined by the distance of the electron to the nucleus.

In classical EM-physics the energy level of the atom is completely determined by the distance between nucleus and electron (5). The QM-solution (6) shows a quantified formula where the orbiting distance is no longer presented. Bohr's Correspondence Principle tells us that both worlds (QM and EM) have to obey the same physic laws. However the quantum rules are of no significance in the macro-world.

At the quantum level physics have to obey the quantum-physics laws and the macrophysics laws. The Correspondence Principle of Bohr tells us that at the quantum level there are no additional rules, only that in the macro-world the quantum rules are no longer significant. The same principle tells us that the macrophysics laws also have to be valid at the quantum level.

Although the Eqs. (5) and (6) are different, Bohr's Correspondence Principle tells us they could be the same; (5) describing the rules of the macro-world and (6) the rules of the micro-world where the laws of both worlds are relevant.

Neglecting the M_e / M_p factor in Eq. (5) we get:

$$W = -e^2 / 8\pi\varepsilon_0 R_n \text{ (***)} \quad (5a)$$

where R_n is the orbiting distance of the electron. [Asterisks mark formulas where the theoretical and experimental values deviate factor 1.003458. The deviation factor appears to be systematic. The deviation implies a difficult mathematical problem that by far exceeds my capabilities.]

When Eqs. (5a) and (6) are equally valid we can express the orbiting distance R_e with the principal quantum number n . The energy of Eq. (6) must be equal to Eq. (5a) and therefore:

$$(e^4 M_e / 8\varepsilon_0{}^2 h^2) \times 1 / n^2 = e^2 / 8\pi\varepsilon_0 R_n \quad (5c)$$

where
$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M_e \quad (7)$$

For the ground level of the Bohr-Hydrogen atom ($n = 1$) the calculated distance, of course, coincides with the Bohr radius of the Hydrogen atom $R_B = 5.29177 \times 10^{-11}$ meter; the orbiting distance of the electron being in ground state.

Similar calculations with the Rydberg constant ($R_\infty = 1 / R_r = e^4 M_e / 8\varepsilon_0{}^2 h^3 c$) and Eq. (5c) gives:

$$n_\infty{}^2 = 8\pi h c \varepsilon_0 / e^2 = 1722.045 \quad (8)$$

The Rydberg principal quantum number is calculated at $n_\infty = 41.4975$.

The above calculations of the Bohr-radius of the Hydrogen atom ($n = 1$) and the Rydberg quantum number n_∞ are completely consistent with QM-calculations. Assuming that equation (5a) is identical to (6) doesn't imply any discrepancy.

Summarizing we deduced that the EM-free rotator for the Hydrogen atom has infinite solutions. With the assumption that the hydrogen atom is an EM-rotator there is at any distance or speed a possible equilibrium. The discrete energy levels of the electrons in the atom, the quantisation of energy, can completely be explained by a quantum restriction that the electron can only have stable orbits around the nucleus at the discrete distances; $R_{\text{Bohr}} \times n^2$.

5. The Quantization of Distance

Bohr's Correspondence Principle suggests that Eqs. (5a) and (6) are the same, and they appear to be so. Because the energy levels of atoms are discrete, quantized, one can presume that the distance is quantized in some way because the specific energy quantization of the atom must coincide with certain discrete leaps in orbiting distance. Despite the energy quantization with n by QM, classical EM-physics still determines that the increasing quantum level n **has to** coincide with corresponding increase of orbit distances according to the conservation law of energy.

The equations for the energy level of the atom according to Bohr's model (6) and the EM equation (5a) can be seen as identical. We can express the quantum energy levels of the Hydrogen atom adequately with:

$$W_n = (-e^2 / 8\pi\varepsilon_0 R_{\text{Bohr}}) \times 1 / n^2 \quad (9)$$

where the radius R_{Bohr} is the radius of the Hydrogen atom according to Bohr ($n = 1$) and n the principal quantum number.

The distance $R_n = R_{\text{Bohr}} \times n^2$ of the electron to the nucleus is the macro-world factor that determines the energy level of the atom and also determines the energy level of Bohr's atomic model. The quantum number n indicates that for the quantum distances $R_{\text{Bohr}} \times n^2$, for $n = 1, 2, 3 \ldots$ the stable ionization energy levels are observed.

Because Eq. (6) is identical to Eq. (5a) when $R_n = R_{\text{Bohr}} \times n^2$ we derive equation:

$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M_e \quad (10)$$

R_n is the orbit distance of the electron in the Bohr-Hydrogen atom. The classical Compton-radius R_c of the electron is calculated according to the equation:

$$M_e = \mu_0 e^2 / 4\pi R_c$$

Exactly the same radius for the electron is derived in the Chapter "The Electron" in **From Paradox to Paradigm** [10] where the rest mass/energy of the electron is calculated:

$$M_e c^2 = e^2 / 8\pi\varepsilon_0 R_c + \mu_0 c^2 e^2 / 8\pi R_c$$

where the first part of the equation is the electrostatic energy and the second part the dynamic spin-energy of the electron.

Substitution of M_e in (10) and considering $c^2 = 1/\mu_0\varepsilon_0$ we find:

$$R_n / R_c = 4\varepsilon_0{}^2 h^2 n^2 c^2 / e^4 \tag{10a}$$

for $n = 1$ the radius of orbit is the Bohr-radius of the Hydrogen atom. We calculate the ratio:

$$R_{\text{Bohr}} / R_c = 10.867397 \times 12^3$$

The distance ratio between the last energy trap in the atom, the Rydberg distance, and the first, the Bohr-distance, is expressed with ratio (the quantum number n_∞):

$$(R_\infty)^{-1} / R_{\text{Bohr}} = (n_\infty)^2 = 8\pi hc\varepsilon_0 / e^2 = 1722.045$$
$$= 12^3 / 1.003458 \approx 12^3 = (N_\infty)^3 \quad (11) \; ***$$

With Eq. (8) we calculated that the Rydberg principal quantum number is $n_\infty = 41.4975$. The principal quantum number can also be expressed generally with the ratio: $n^2 = R_n / R_{\text{Bohr}}$

The difference between (11) and (8) is that the quantum number N is calculated differently. We will show that the ***Rydberg distance is*** $R_\infty{}^{-1} = 12^3 R_{\text{Bohr}} = N_\infty^3 R_{Bohr}$ and that there are therefore $N_\infty = 12$ ionization levels, and that $R_n / R_{\text{Bohr}} = n^2 = N^3$

6. The Planck-Radius

The energy quantification of the atoms at molecular distance are possibly the result of the quantization of distance.

In the "*The photon and the constant of Planck*" in [10], the Planck-radius is calculated at:

$$R_{\text{Planck}} = e^4 / 32\pi^2 M_e \varepsilon_0{}^2 hc^3 = 1.636393 \times 10^{-18} \text{meter} \tag{12}$$

The classical radius or Compton–radius of the electron is:

$$R_c = \mu_0 e^2 / 4\pi M_e = 2.81794 \times 10^{-15} \text{meter} \tag{13}$$

We observe that the ratio between the Compton-radius and the Planck-distance is:

$$R_c / R_{\text{Planck}} = 8\pi hc\varepsilon_0 / e^2 = 1722.0436 = 12^3 / 1.003458$$

which is exactly the same factor as between the Rydberg radius and the Bohr radius (11). ***

We will show that this equality is not just a coincidence, but the result of the existence of the quantum distance (QD). The Planck-distance, the Compton radius, the Bohr-radius and the Rydberg constant are directly and integer related by the quantum number 12^3.

The derivation of the Planck-distance is based on the assumption that space is not absolutely empty, but that space is filled with so called point-volumes with a radius of the Planck-distance. Although a not empty space is formally not consistent with the assumption of science that space is absolutely empty, science already admits inherently that space is not empty by the general acceptation of the field theory. The field theory assumes that in 'empty' space, vacuum, there can be fields such as electrostatic fields, magnetic fields, and gravity fields.

How can there exist fields in vacuum when this vacuum is assumed to be absolutely empty?

Philosophically this is not considered possible. Science already implicitly accepts that vacuum is not absolute empty, only science doesn't yet admit it officially or formally!

There are more very strong indications that vacuum is not just empty space. The phenomenon of stellar aberration for example indicates strongly that there is 'ether'. [4] So when we assume space is not empty, but filled with so-called point-volumes, this is scientifically not unacceptable. The remarkable thing that happens is that when we fill space with point-volumes, a completely QM-consistent explanation for the 12 atomic ionization levels is found and at the same time calculations of the correct distance/energy level of the nucleus at the ionization levels are obtained. Although mainstream science rejects ether, the scientific explanations are too compelling to ignore.

When we imagine that space is filled up with bulb shaped point-volumes with radius $QD = R_{\text{Planck}}$ then space cannot be homogeneous everywhere (Fig. 2).

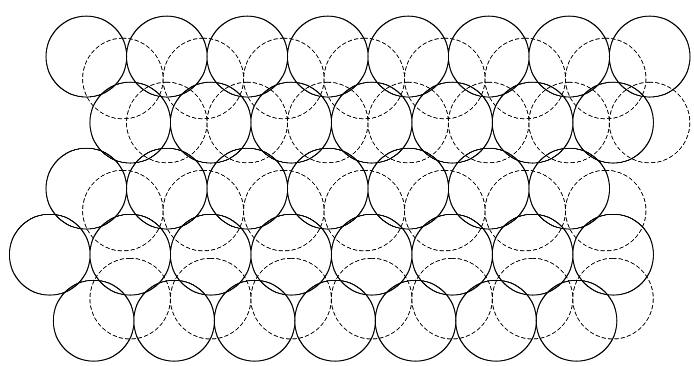

Figure 2. An impression of space filed with point-volumes.

7. The Orientation of Point-Volumes Surrounding a Charge

When there is a charge in space the shown non-orientation in Fig. 2 of the point-volumes will be influenced. Vacuum is able to contain fields (field-theory) like the electrostatic field presented in vacuum by the dielectric constant ε_0. The charge in vacuum will initiate dielectric displacement in the point-volumes. The electric field will influence the orientation of the point-volumes.

In Fig. 3 we demonstrate that the energy of the charge influences the point-volumes.

The point-volumes are responsible for transport of the electric field according to the laws of physics. Dielectric displacement is achieved in the point-volumes and distributed over space. One can imagine that at the QD level space is not homogeneous and quantification is inevitable.

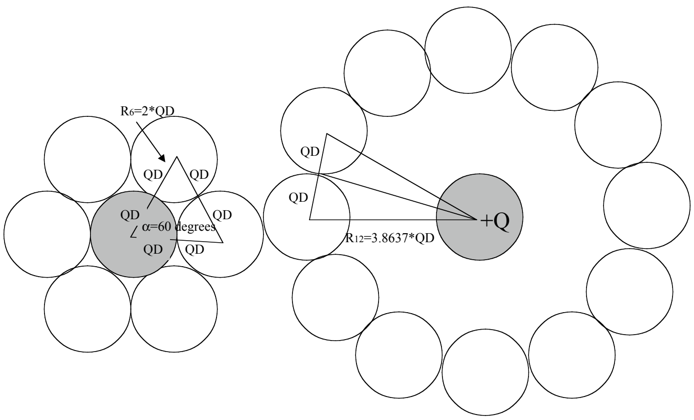

Figure 3. The orientation of point-volumes around a charge

The orientation of the point-volumes around the charge will minimize the energy level according to physics laws. The non-orientation of Fig. 2 has disappeared.

The reader can see that the space around charge $+Q$ can no longer be filled homogeneously with point-volumes. The orientation of the 6 point-volumes around the charge sketched in Fig. 3 is still comparable with field free point-volumes in Fig. 2, but the circle of 12 point-volumes around $+Q$ cannot be found in the field/energy free vacuum of Fig. 2.

The tension of the electric field draws the point-volumes towards $+Q$ and at the same time orientates the point-volumes or 'ether' as far as possible into a bulb shape orientation.

7. The Quantum Distance and the Second Quantum Dimension (Compton-radius)

The Planck-radius is the smallest known distance so we assume that the quantum distance is: $QD = R_{\text{Planck}}$

$$R_{\text{Planck}} = e^4 / 32\pi^2 M_e \varepsilon_0{}^2 hc^3 = 1.636393 \times 10^{-18}\,\text{meter} \qquad (12)$$

We have seen that the ratio between the classical radius of the electron, the Compton radius (R_c), and QD is the same as the ratio between the Rydberg-distance R_r and the Bohr-distance. Is this a coincidence or not?

We assume the ratio has the integer value of:

$$(R_\infty)^{-1} / R_{\text{Bohr}} = Rc / QD = (N_\infty)^3 = 8\pi hc\varepsilon_0 / e^2 = 12^3$$

In Fig. 3 the quantum numbers 6 and 12 already give some symmetry. First we will concentrate on the quantum number 12^3 and show that with this number we can create "homogeneous" space.

In Fig. 4 schematically the Compton-radius is the radius of the drawn circle.

$$R_c = 12^3 \times QD$$

$$\tan(\alpha) = 2 * QD / Rc = 2QD / 12^3 QD = 1 / 864$$

$$\alpha = 360 \times 60 / 864 = 25'$$

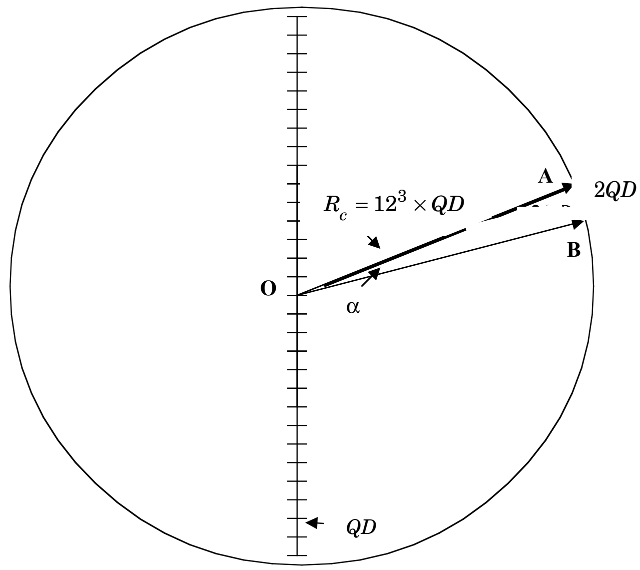

Figure 4. The quantum distance transformation.

Calculation gives 25 minutes for the angle α (= Fine Structure Constant = $2\pi/864$***) in Fig. 4. In 360 degrees there are ***exactly*** 864 angles of 25 minutes. The perimeter of the 'circle' in Fig. 4, the sum of all 864 straight lines $AB = 2 \times QD$, is:

$$864 \times 2 \times QD = 12^3 \times QD = Rc\,.$$

The perimeter of the created circle is R_c (864 angles α of 25′ = 360 degrees) while the perimeter of a circle in the macro-world is $2\pi R_c$!

This result is remarkable. How can R_c be $2\pi R_c$ at the same time?

When we want to compare the quantum perimeter with the macro-world perimeter the correction factor is 2π .

The straight line AB, the basis of triangle OAB, is $2 \times QD$. The surface of one triangle OAB is:

$$O_{OAB} = R_c \times QD = 12^3 QD^2 \quad .$$

The total surface of one side with 864 triangles is: $O_c = 12^6 QD^2 / 2$.

The surface of both sides of the created 'circle' has 12^3 triangles with a total surface $O_c = 12^6 QD^2 = R_C{}^2$.

The 'macro-world' surface of two circles with radius R_c is $O_c = 2\pi R_c^2$, so with the surface there is also a 'translation' factor of 2π for the transformation from the QD to R_c level.

At the Compton-level R_c, $12^3/2$ point-volumes create a 'perfect' circle for observers in O (Fig. 4). The observer in O can observe no more than two, right angled "perfect" circles, at the same time at distance R_c. Because there is no restriction for the angle of observation of the two 'perfect' circles, one should be able to observe the circles in 'any' direction, but not at the same time (the point-volumes create at R_c the two-dimensional quantum space).

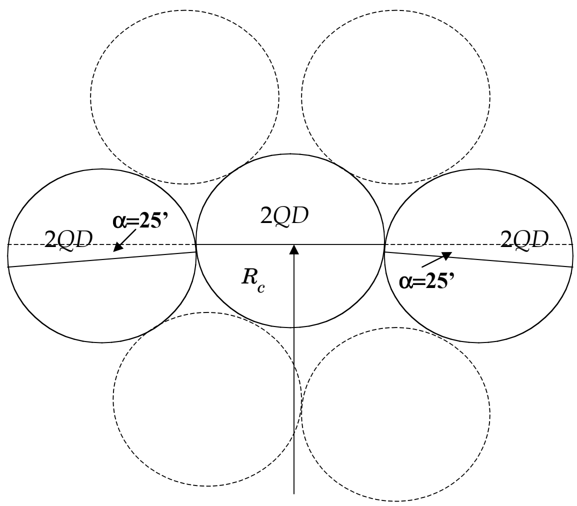

Figure 5. Illustration of the imperfect Quantum Space at the Compton-distance.

The quantum bulbs at R_c (Fig. 5) touch each other in such a way that they can form with $12^3/2$ QD-bulbs a 'perfect' circle around O; all QD-bulbs of circle R_c are 'in touch'. One can observe that the QD-bulbs up and down R_c (Fig. 5) do not have closed perimeters because 'curved' three-dimensional space around a charge cannot be filled continuously with bulbs. Inhomogeneity is unavoidable.

8. The Transformation to the Third Quantum Dimension (Bohr-distance)

We demonstrated that with $12^3/2$ point-volumes we can create a perfect 'circle' with 864 triangles OAB. Point O (Fig. 4) is the center of the created Compton quantum circle (R_c). Between O and R_c the quantum space is imperfect. The 'bulbs' with radius QD cannot fill up spherical space homogeneously. The 'perfect' geometry is created at R_c. For the observer in O it is not possible to observe perfect circles all around (no perfect bulb possible when space is filled with point-volumes). The orientation of the two possible circles R_c is not fixed.

With the 'perfect' two-dimensional circle R_c we are able to create a perfect bulb shell tunnel with diameter R_c at the distance $12^3 \times R_c$; the Bohr-distance.

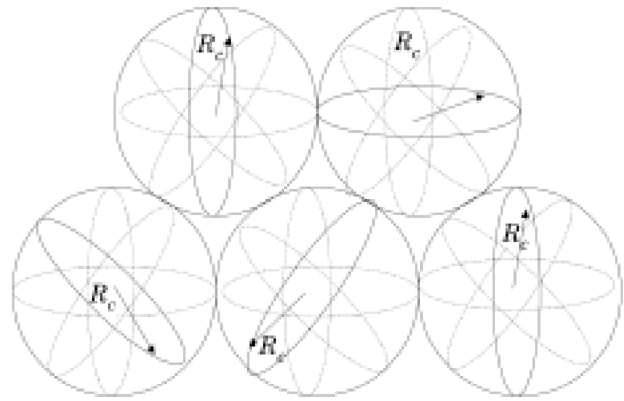

Figure 6. Compton circles creating the third quantum dimension.

With $12^3/2$ circles R_c (two circles each) we are able, in conjunction with the creation of the Compton-circle, to create two 'perfect' bulb shell tunnels with radius R_c at the Bohr-distance; the beginning of the third quantum dimension. The ratio between the distances R_B and R_c should be 12^3.

We have observed that the ratio between the Bohr-radius and the Compton-radius is:

$$R_{\text{Bohr}} / R_C = 4\varepsilon_0 h^2 / \mu_0 e^4 = 10.8674 \times 12^3 \qquad (14)$$

The Bohr/Compton distance ratio appears to be 10.8674 times larger than the ratio R_c / QD or the Rydberg/Bohr ratio.

The volume of a bulb with radius R_B is in the macro-world is $V_B = \frac{4}{3}\pi R_B^3$ (where $R_{\text{Bohr}} = R_B$). The surface of the created Compton-circle is πR_c^2 including the correction from 1-QD to the 2-QD level. The 'volume' of the circle (R_c) at the 2-QD level with 'thickness' QD is $V_C = \pi \times R_c^2 \times QD$ and for $QD = R_c / 12^3$ we get: $V_C = \pi \times {R_C}^3 / 12^3$; the volume of the Compton circle-plate.

When we calculate the ratio V_{Bohr} / V_C we observe that the ratio $V_{\text{Bohr}} / V_C = \frac{4}{3} R_B^3 / R_C^3 = 8.8297 \times 10^{12}$

$$R_B^3 / R_C^3 = 10.8674^3 \times 12^9 \quad , \quad R_B / R_C = 10.8674 \times 12^3$$

So when we compare the volume of the Bohr-bulb and the Compton-plate the ratio R_B / R_c =10.8674 ×12^3 is confirmed.

We must however not forget that the situation at 2-QD is not the same as the 1-QD level or the 3-QD level. We have seen that a mathematical correction from 1-QD to 2-QD with the factor 2π was necessary. We now compare the third dimension of the

Bohr-bulb with second dimension of the Compton plate. A mathematical correction is necessary.

The factor 10.8674 is the correction factor from the 2-QD to the 3-QD. From the first to the second QD the correction factor is 2π. This transformation explains the origin of the mathematical natural constant π. Is it a coincidence that the other mathematical natural constant e can be found in 10.8674, because $4\times e = 10.8731$ and the difference is therefore only 0.05%? **

(** When we correct for neglecting the factor $(1+M_e/M_p)$=1.0005446, when Eq. 5a was derived from 5, the deviation factor with 4*e is less than 2.10^-5)

So both mathematical natural constants may well originate from the dimension transfer from the point-volume to three-dimensional space.

After the dimension correction we have also the ratio $R_B/R_c = 12^3$.

The total mathematical correction from the point-volume (first dimension) to our third dimension is: $2^3 \times e \times \pi = 68.318$.

9. The 12 Ionization Levels of the Atom

At the end of Section 5, we stated that we would show that the Rydberg distance is exactly $12^3 \times R_B$ and that there are 12 ionization levels.

Calculating the principal quantum number n for the Rydberg distance we found in accordance with QM that $n_\infty = 41.4975$. This means that according to QM there are over 40 ionization levels from the Bohr distance to the Rydberg distance. The principal quantum number is calculated with the help of Eq. (7):

$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M e$$

Substitution of the Compton radius [Eq. (13)] gives

$$R_n / R_c = 4{\varepsilon_0}^2 h^2 n^2 c^2 / e^4 \qquad (7a)$$

It is relevant to observe that with Eq. (7a, and therefore also with Eq. (7), we are calculating the ratio between R_n and R_c; we are comparing third QD R_n with second QD R_c.

With Eq. (6) $W_B = (-e^4 Me / 8\pi{\varepsilon_0}^2 h^2)\times 1/n^2$ we are with M_e (and therefore R_c) in the second QD. Eq. (6) therefore has to be translated to the third QD. The energy value of (6) is independent of the quantum dimension and therefore correct, but the calculated principal quantum number is not. We can achieve the correct transformation of Eq. (6) from 2-QD to 3-QD with (5c):

$$W_B = (-e^4 Me / 8{\varepsilon_0}^2 h^2)\times 1/n^2 = -e^2 / 8\pi\varepsilon_0 R_n$$

For $n=1$ we calculate the Bohr distance. We define $R_n = R_{\text{Bohr}} \times N^3$ instead of $R_n = R_{\text{Bohr}} \times n^2$ in Eq. (9):

$$W_B = (-e^4 Me / 8{\varepsilon_0}^2 h^2)\times 1/n^2 = (-e^2 / 8\pi\varepsilon_0 R_{\text{Bohr}})\times 1/N^3$$

The two equations are still identical for $n^2 = N^3$.

Actually nothing has changed. The only difference is that N^3 indicates that N is determined by the third quantum dimension and not by the second QD. All that changes is that N is not integer for all integer values of n. This is of no importance because the quantization of distance has not changed. The ratio R_n/R_B is still integer related according to $n^2 = N^3$. The dimension correction only changed the number of ionization levels in the range from the Bohr radius to the Rydberg distance from 41.5 to 12; the actual observed number of ionization levels.

At the Bohr distance point-volumes in space around a charge $+Q$ creates two 'perfect' bulb shell tunnels with radius R_c (beginning of the third quantum dimension). Outside the tunnels at the Bohr radius space is not yet 'perfectly' three-dimensional for the electron.

For distances from $+Q$ further than the Rydberg constant (N>12) there is no ionization level anymore because the fourth quantum dimension has started where space is everywhere 'perfectly' three-dimensional for the electron.

10. Planck's Constant

The above analyses give the unique possibility to eliminate Planck's constant h as an independent natural constant.

The formula for the Planck distance is:

$$R_{\text{Planck}} = e^4 / 32\pi^2 Me\varepsilon_0^2 hc^3 \qquad (12)$$

The classical radius or Compton–radius of the electron is:

$$R_c = \mu_0 e^2 / 4\pi M_e \qquad (13)$$

We showed that the ratio between the Planck radius and the classical radius of the electron is 12^3.

$$R_c / R_{\text{Planck}} = 12^3 = 8\pi\varepsilon_0 hc / e^2$$
$$h = Rc / R_{\text{Planck}} \times e^2 / 8\pi\varepsilon_0 c = 12^3 e^2 / 8\pi\varepsilon_0 c \qquad (14)$$

The theoretical value for Planck's (14) constant is $h = 6.648982\times 10^{-34}$ [Js] while the empirical measured value is $h = 6.626069 \times 10^{-34}$ [Js].

The theoretical derived constant of Planck is a factor 1.003458 times the empirical value. The discrepancy is just 0.35%. Scientists claim that this formula for Planck's constant is merely a numerical approximation, not exact and therefore the formula is false!

11. The Deviation Between the Theoretical and the Empirical Values of *h*

Theoretical Physics endorsed the drag coefficient of Fresnel when the empirical 'confirmation' by Fizeau showed a deviation of 10%!

Is the derived formula for Planck's constant false when the deviation is just 0.35%?

Statistically it is impossible to obtain by coincidence a formula for Planck's constant with just a deviation of 0.35%. Scientists should acknowledge that, and let the scientific debate determine whether the theory behind the derivation is acceptable or not. It is the task of the scientific community (not just editors and referees) to determine that.

Although this paper reveals more than enough arguments and evidence to justify publication without explaining the cited deviation of 0.35% I will indicate how the deviation can be explained.

The empirical value of h is obtained with the formula that describes the relation between the energy and the frequency of the photon; $E = h\nu$. The derivation of theoretical formula for the Planck distance (12) is based on this equation. Other formulas refer to particles with mass.

The photon propagates through space and does not distort tension-free ether. Masses, however, distort the surrounding ether. A nucleus, a charged mass, affects the stress free cubical orientated ether and shapes the surrounding space into a stresed spherical orientation. The stress free cubical orientated space contains more point-volumes or ether per volume than spherical-orientated ether surrounding the nucleus of an atom. The packing density of point-volumes in the spherical orientated space/ether around a nucleus therefore differs from the cubical tension-free ether packing density. (Figs, 2, 3 & 5).

When a nucleus polarizes the surrounding ether/space (electric field), the point-volumes are forced to orient into a spherical shape. The point-volumes surrounding a charged nucleus occupy more space. The experimentally determined constant of Planck and the formula for the Planck distance refer to physics of tension-free cubical-oriented ether. While deriving Planck's constant the difference between stress and stress-free ether is not mathematically addressed. The packing difference possibly explains the systematic deviation factor of 1.003458.

12. The Quantization of Physics by Means of the Quantum Distance

The above calculations and explanations are confusing. The link between QM and classical physics was buried deeply. We will tell the story again in words so all doubts may disappear.

Ref [4] proves without doubt that ether is scientifically much more likely than an absolutely empty space. The widely accepted field theories implicitly assume a vacuum that is ***not*** absolutely empty. So the assumption that vacuum is space filled with point-volumes is not scientifically impossible. The point-volumes supply the physical means to transfer the electromagnetic fields in vacuum according to natural constants ε_0 and μ_0.

When space is filled with point-volumes and there is no electric field; vacuum is 'stress-free'. A charge placed in vacuum polarizes the point-volumes and draws them to the charge Q. Space, vacuum, is not 'stress-free' anymore. The point-volumes obligatory orientate around $+Q$ into a bulb configuration because of the electrostatic force. The dimension of the point-volume determines the sequence of the distances at which perfect symmetric figures can be created.

At R_c two 'perfect' circles are created that defines the dimensions of the electron. The electron can orbit around the nucleus "resistant free" in the third Quantum Dimension at the Bohr radius in two tunnels and in the tunnels at the other 11 ionization levels until the Rydberg istance. Between the ionization levels the electron has to be deformed according to the imperfect dimensions of space in between. The deformation of the electron needs force/energy and therefore creates the energy traps at the ionization levels.

When an electron circles around a proton at distances greater than the Rydberg distance the electron and proton are moving in each others fourth quantum dimension. The quantum effects have become irrelevant when the radius of the orbiting electron R_e between proton and electron exceeds the Rydberg distance.

The electron must be deformed when it travels between the ionization levels. When the electron reaches a tunnel at an ionization level it will oscillate in the tunnel when it tries to penetrate the imperfect space around the tunnel; the electron will oscillate. When the electron emits a photon while captured, the overflow of kinetic energy is released; the energy of the electron is reduced to the quantified energy needed to perfectly circle the nucleus at that distance. The deformation of the electron requires force/energy and therefore creates the observed energy traps. The imperfection of space increases more and more when the electron approaches the Bohr distance; the first distance where 2 perfect bulb shell tunnels for the electron to orbit the nucleus are created.

The resonances of the perfect Bohr circle at the ionization levels $n = 2, 3, ...$ are 'safe heavens' for the electron in the imperfect space. When the electron is caught in the energy trap of one of the ionization levels, the overflowing kinetic energy is emitted.

Under normal conditions it is impossible for the electron to close in on the nucleus under the Bohr distance. The deformation of the electron is so severe that the required force to deform the electron is not available. The electron cannot close in on the nucleus under 'normal' conditions.

Discussion

We described the Hydrogen atom as an EM free rotator and found complete consistent formulas with QM. Scientists state that Bohr's atom model is invalid for atoms when the charge of the nucleus exceeds the charge of the positron ($Z > 1$) and that therefore the presented EM free rotator for atoms when $Z > 1$ must be invalid to.

The reason why Bohr's atomic model is not adequate to describe atoms when $Z > 1$ is that the formula for the (macroscopic) Coulomb force between two charges ($F = Q_1 Q_2 / 4\pi\varepsilon_0 r^2$) is only valid in describing the electrostatic force between charges in our macro-world. The Coulomb force is an in our macro-world experimental derived formula. The QM rules at subatomic levels are not relevant anymore in our macro world and for that reason the Coulomb-force formula is not valid at QM levels. At the subatomic (ionization) levels there is interference of the electrostatic fields of the positive charges in the nucleus. This interference disappears in the macro-world. The Coulomb force for the EM free rotator and Bohr's model should be:

$$F = Z^2 e^2 / 4\pi\varepsilon_0 R^2 \text{ or } F = \frac{2^3 \pi \exp(1)}{12^3 / 2} \cdot \frac{Z^2 e^2}{\varepsilon_0 (n^2 R_B)^2} \quad (***)$$

Interference occurs at subatomic levels because the electrostatic fields of the protons in the nucleus seek a way out. Not all point-volumes around the nucleus are in touch (inhomogeneous space) so the resistance for electrostatic fields differs around the nucleus. The different fields of the protons in the nucleus follow the same low resistance 'route' in space (=interference).

The electrostatic field around a nucleus is not homogeneous. Interference of electrostatic fields at the subatomic level is expected, while in our three-dimensional world, space/vacuum is homogenous.

In general QM describes mathematically the physics at the molecular level and the sub-atomic level very well. This is so even when one realizes that the use of mathematical correction factors by QM is not uncommon. Despite the significance of the mathematical solutions QM offers, there is a serious flaw: the physics behind the QM math are not understood.

The perspective of science concerning vacuum is an absolutely empty space, although in Theoretical Physics the field theory is widely accepted, and contradicts at least philosophically the assumed absolutely empty space.

I request the reader to answer the following question: What is the chance that by coincidence the Rydberg distance is 12^3 times the Bohr radius, and that the Bohr radius is 12^3 times the Compton radius, and that the Compton radius is 12^3 times the Planck radius, and that at the same time the 12 atomic ionization levels of the atom are identified, Planck's constant eliminated as an independent natural constant, the origin of the mathematical constant e and π is located, and the mysterious aspects of molecular QM are answered?

Is it impossible that science erroneously concluded that vacuum is absolute empty space?

Complete mathematical and physical understanding of QM in the case of Bohr's atomic model can be achieved when we consider space filled with point-volumes with radius QD. The matrix of point-volumes filling up space around the nucleus is imperfect for electrons (R_c) at distances smaller than the Rydberg constant. The resonance of 12^3 QD in the 'matrix of space' from the Planck-distance to the Rydberg distance can be simulated mathematically. This simulation will show the 12-ionization levels of the electron orbiting around the nucleus. Many, many other quantum resonance distances between the QD and the Rydberg distance will be identified.

The reader should realize that the above shown relations between $R_r / R_B = R_B / R_c = R_c / QD = 12^3$ is the consequence of the three-dimensional properties of the electron. The electron circles around the nucleus, and the dimension of the electron determines the distances where space is 'perfect' for the electron. Should the electron have other dimensions than R_c the observed distances R_r and R_B would change accordingly.

The quantization of distance in the presented EM free rotator is completely consistent with the quantization of energy in QM. The solution is even much simpler because in QM every atom has its own energy quantizations while with the EM free rotator and the geometrical energy traps at the ionization levels; **the distance quantization for every atom is the same**.

The radii of nuclei are according to QM approximately 10^{-12} meter. The QM volume of nuclei contain therefore approximately 10^{18} point volumes. Theoretically any QED particle/process can be realized with the presence of 10^{18} point volumes. Dragged ether is consistent with any QM/QED (sub) nuclear process or particle discovered or calculated by Theoretical Physics. But despite the consistency of dragged ether with QM, scientists argue that dragged ether is violating QM/QED, and that the dragged ether theory must therefore be false!

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