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Mechanics of Atom

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Abstract: The electron-proton system (sep) is the most elementary structure of atom and of matter. The Coulombian interaction of its components allows to describe and to calculate the frequencies of electromagnetic radiations, the lowest density of the space of universe, the Bohr's quantified orbits of the atom, the source of the Cosmic Microwave Background radiation. It also explains that the force of inertia and the gravitational force are not generated by a continuous phenomenon but by quanta!

Keywords: Fundamental physics, Relativity, Bohr's atom, Fine Structure constant, Space's density, Gravitational force, Inertia.

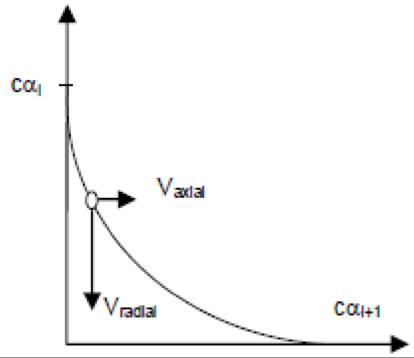
Introduction

We shall consider the simplest of atomic structures that made of an electron and a proton. We shall admit hereafter that it is an electron-proton system and, for simplification sake we will design it in short by: ***sep***. We shall also admit that the electron and the proton are not electrically charged particles but electric charges, drops of a certain substance which has, for us, electrical effects. We have also to admit that electron and proton are made of two kind of electricity. So, the sep will appears to be the simplest and most elementary structure of matter.

In the sep, the electron encircles the proton like the flesh surrounds the pit of a fruit. In fact, electron looks like the pellicle of a soap bulb. These two particles have a movement of rotation around a same axis. That is almost what physicist's name: ***spin.***

Mechanics of the Sep.

When both particles have same rotation speed they are at rest relative to one another. In this configuration they will interact in conformity with the Coulombian attractive law. The electron will be spherically attracted toward the proton, its radius will contract. Its angular speed will increase. Then the two particles will not have the same angular speed. A momentum of force of rotation, a torque, will appear. Radial contraction movement will progressively decrease as torque increases (fig. 1). This axial interaction will tend to equalize the angular velocity of the two particles. When both particles will again have the same speed of rotation, the Coulombian attractive force will act and a new contraction of the radius of the electron will happen (fig. 2).



When radial speed increases, axial speed decreases so as the sum of their squares remains constant.

Fig. 1 – Lorsque la vitesse radiale augmente, la vitesse axiale diminue de telle façon que la somme des carrés de ces vitesses soit toujours constante.

Fig. 2 we represent the successive radius of the electron r_i, r_{i+1}, r_{i+2}..., These radius where the electron keeps a steady value are the orbits of the sep. We admit here that the phase where the radius is constant has the same duration as the phase during which electron contracts but these two phases may have different duration.

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We see that the stationary orbits are natural and that we don't need, as Bohr did, to introduce the sequence of integers to calculate their characteristics.
The variation of the radius of the electron from one orbit of rank i to an inner orbit of rank i+1 could be worked out by study of the spectral characteristics of the radiations of each atomic elements as we will see further on. Here we have admitted:

$$\zeta = \frac{r_i}{r_{i+1}} \qquad \text{with } \zeta = 2 \qquad (1)$$

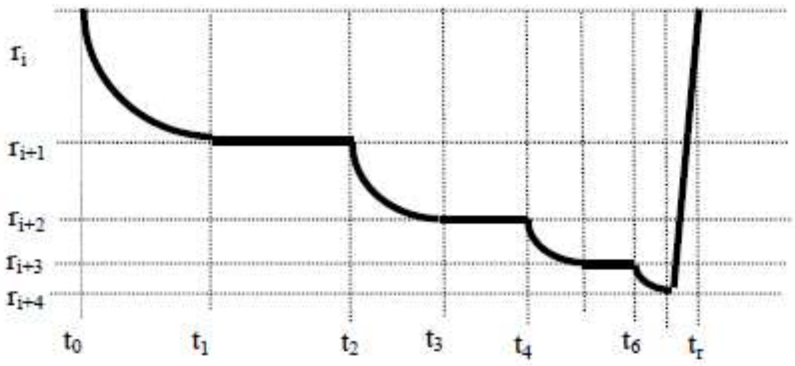

Fig. 2 – Evolution of the radius of the sep in regard to time when it contracts. We just show here few orbits but it's obvious that they can be much more when the sep pulses in low pressure environment.

Each time the sep contracts, it's obvious that the conditions of the interaction between the electron and the proton are modified. More the radius of the sep is small, more the interaction is strong. This makes that the electron has to increase the angular speed of the proton. **This work is inertia!** The sep cumulates this inertia at each contraction. So we have to define a mode of calculation of the inertia of the sep in regard to the degree of contraction it reaches.

Fine structure constant

In Rutherford-Bohr's atom, the speed of the electron is expressed: v = c α/n where c is the celerity of light; α, the *fine structure constant* and n, the rank of the orbit. The value of α is determined by:

$$\alpha = \frac{e^2}{2\varepsilon_0 hc} \approx \frac{1}{137} \qquad (2)$$

We will not discuss the legitimacy of this method of calculation of α. We will just propose another means of calculation and explain its signification in the context of atom.

In respect to Rutherford-Bohr's proposition we can write that the speed of the electron in atom is: v = c α. But we will write it:

$$v_i = c\alpha_i \qquad (3)$$

In this expression α has the same index as that of the rank of the orbit. Si it's no more a constant but a coefficient.

The bigger orbit the sep can have would be indexed 1. So, we have to find a mode of calculation of the coefficients α_i which matches with today's experience. To keep a homogeneous way of calculation for all the orbits, we can write:

$$\alpha_1 = \frac{1}{\sqrt{1^2}}$$

$$\alpha_2 = \frac{1}{\sqrt{1^2 + 2^2}}$$

$$\alpha_3 = \frac{1}{\sqrt{1^2 + 2^2 + 3^2}}$$

$$\alpha_3 = \frac{1}{\sqrt{1^2 + 2^2 + 3^2 + \cdots n^2}} \qquad (4)$$

And so, the Bohr fundamental orbit will have the rank 38 in our system because:

$$\alpha_{38} = \sqrt{\sum_1^{38} n_i^{-2}} = 1/137 \qquad (5)$$

Space's density

We can immediately verify the coherence of this mode of calculation of α. If the sep contracts et each jump in conformity with (1) above with the value of $\zeta = 2$ the radius of the sep on orbit 2 will be:

$r_2 = r_{38}\zeta^{38-2}$

With the value of Bohr's radius: 5.29 x 10^{-11} m for the orbit rank 38, we obtain: r_2 = 3.63 m. This radius leads to a molecule which volume is equal to 201 m^3 and then the density of space equals 1.66x10^{-29} kg/m^3.

This value is coherent with General Relativity which estimation is: $\rho = \frac{1}{R(t)^3} = \frac{3x10^{-31}g}{cm^3} = (\frac{3x10^{-28}kg}{m^3})$ Wikipedia gives: 9.24×10^{-27} kg/m^3. The sep can't exist on orbit of rank 1, because the speed of its electron would be equal to the speed of light and it will vanish. Molecules on rank 2 leads to the lowest density space could have. But the real space containing matter and gases must have a higher density. **So, it looks like the method of calculation we propose makes of coefficient α a direct link between the microcosm and the infinity! This result, by itself, can be sufficient to valid the present proposition**.

In addition we show that each atom of the molecule of hydrogen has a maximum extension while the other atom has a no significant volume. We also show that there is no empty space between molecules.

Frequencies of Pulsation of the Sep

When the sep contracts from an orbit of rank i to an orbit of rank i+1 it travels over a space:

$s = \pi(r_i - r_{i+1})$ Or with Bohr's value:

$$s_i = \pi r_{38}(\zeta^{38-i} - \zeta^{37-i}) \quad (6)$$

Because it's still spinning. With the speed given above (3) it will take a time:

$$t_i = \frac{s_i}{v_i} = \frac{\pi r_{38}(\zeta^{38-i} - \zeta^{37-i})}{c\alpha_i} \quad (7)$$

On fig. 2, we had admit that the time during which the proton gets the same angular speed as the electron has the same duration as the time electron needs to contract. It might be different, but it will not change in an important way the results we expose here.

So, each jump from an orbit to the first inner orbit will take 2 t_i.

If the sep pulses from an outside orbit of rank ***p*** to an inner orbit of rank ***k***, it will take a time:

$$t_{pk} = \sum_k^p 2t_i \quad (8)$$

We have chosen the index ***p*** to design the outer orbit and the index ***k*** for the inner orbit as it is done at the present time. But it's clear that we don't design the same orbits as those in Bohr's atoms. On a very inner orbit, when the electron gets a dimension compatible with the dimension of the proton of the other atom of the molecule, these two particles will interact. The contraction will stop and the electron of one of the atom will be free and reach the outside where it will interact with the other proton. Then the process of contraction will start again.

At the time given by (8) we so have to add the return time:

$$t_r = \frac{\pi(r_p - r_k)}{c} = \frac{\pi r_{38}(\zeta^{38-p} - \zeta^{38-k})}{c} \quad (9)$$

And so a complete period takes a time:

$$T_{pk} = t_{pk} + t_r \quad (10)$$

$$T_{pk} = \sum_k^p 2t_i + t_r$$

$$T_{pk} = \frac{\pi r_{38}(\zeta^{38-p} - \zeta^{38-k})}{c} + \sum_k^p (i) 2 \frac{\pi r_i(\zeta^{(38-i)} - \zeta^{(37-i)})}{c\alpha_i}$$

For the calculation of these periods it is convenient to use a table where, for each orbit, we give the value of:

$$\beta_i = \zeta^{38-1} + \pi \sum_1^i \zeta^{38-i} \alpha_i^{-1} \quad (11)$$

The period T_{pk} and the wavelength λ_{pk} will be:

$$T_{pk} = r_{38}c^{-1}(\beta_p - \beta_k), \quad \lambda_{pk} = r_{38}(\beta_p - \beta_k) \quad (12)$$

1	2.27494+12	**17**	6.08520+8	**33**	23567.4	**49**	0.63629
2	1.77445	**18**	3.29117	**34**	12298.7	**50**	0.32762
3	1.25734	**19**	1.77310	**35**	6410.49	**51**	0.16859
4	8.36273+11	**20**	9.51889+7	**36**	3337.62	**52**	8.67074-2
5	5.32066	**21**	5.09383	**37**	1735.89	**53**	4.45666
6	3.27637	**22**	2.71787	**38**	901.920	**54**	2.28917
7	1.96774	**23**	1.44626	**39**	468.165	**55**	1.17491
8	1.15874	**24**	7.67689+6	**40**	242.792	**56**	6.02395-3
9	6.71576+10	**25**	4.06567	**41**	125.803	**57**	3.08368
10	3.84156	**26**	22.14861	**42**	65.1316	**58**	1.57437
11	2.17343	**27**	1.13326	**43**	33.6936	**59**	7.99952-4
12	1.21823	**28**	5.96629+5	**44**	17.4171	**60**	4.02778
13	6.77361+9	**29**	3.13570	**45**	8.99682	**61**	1.99167
14	3.74006	**30**	1.64539	**46**	4.64411	**62**	9.48282-5
15	2.05247	**31**	8.62089+4	**47**	2.39567	**63**	4.13819
16	1.12027	**32**	4.51046	**48**	1.23502	**64**	1.40152

T ab. 1 - Values of β_i calculated with (11) for $\zeta = 2$

Periods are indeed obtained when one makes the difference between the times an electron will need to pulse from the orbits p and k to a very inner orbit. The table is so calculated to give, for each orbit the accumulation values of all the inner orbits. For example, when the sep pulses between orbits 32 and 36 and emits on orbit 36, the wave length of its radiation will be:

$\lambda_{32,36} = r_{38}(\beta_{32} - \beta_{36}) = 5.29X10^{-11}X(45104.6 - 3337.62) = 2209.473nm$

If it pulses between orbits 35 and 45, the wave length will be:

$\lambda_{35,45} = r_{38}(\beta_{35} - \beta_{45}) = 5.29X10^{-11}X(6410.45 - 8.996) = 338.19nm$

But, as we already said, it seems that ζ may have different values for different atomic elements depending of the number of peripheral electrons. So, it would be hazardous to attribute it a constant value and wanted to establish tables of all the wave lengths emitted by all atomic elements. Anyhow, we see that this method is suitable to explain why hydrogen which has only one electron can emit so many wave length radiations while Bohr's theory can't do it.

So, the cosmic background radiation of 1 mm wave length can be emitted by hydrogen molecules pulsing between orbits 17 and 18 as calculated with (12):
$\lambda_{pk} = r_{38} (\beta_{17} - \beta_{18}) = 5,29 \times 10^{-11} (6,08 \times 10^8 - 3,29 \times 10^8) \approx 0,001$ m

The molecules of this space have a radius:

$r_{17} = 5,29 \times 10^{-11} \times 2^{38-17} = 1,1 \times 10^{-4}$ m

And the space has a density:

$\rho = 5,84 \times 10^{-16}$ kg/m^3

This density is in agreement with what we know about space at the present time.

Inertia and Gravitational Force

The Coulombian force exerted between two point like particles separated by a distance r is:

$$f_c = \frac{e_0^2}{4\pi\varepsilon_0 r^2} \qquad (13)$$

But here, the particles are concentric and the force exerted in all directions of space is:

$$f = \frac{e_0^2}{\varepsilon_0 r^2} \qquad (14)$$

Expressions in which e_0 is the standard electric charges = $1.602x10^{-19}$ coulomb; ε_0 is the dielectric constant equal to $8.854x10^{-12}$ A^2sec^4/kgm^3 and r, the distance in m.

We saw, above that at each contraction of the sep the radius stay stable and that during this phase the electron dragged the proton at its angular speed. This is a work made by the electron which modifies the inertia of the proton. So, the proton accumulates more inertia at each contraction of the sep. Its electrical properties vanish as its material properties emerge. That's why α is not a constant. This coefficient takes into account the degree of strength that binds the two particles. So, the force becomes:

$$f = \frac{e_0^2 \alpha}{\varepsilon_0 r^2} \qquad (15)$$

And the force at each orbit has to be write:

$$f_i = \frac{e_0^2 \alpha_i}{\varepsilon_0 r_j^2} \qquad (16)$$

When the sep is moving in space, its speed has to be added to the linear speed of the electron. If one imagines a point on the equator of the electron, this point may have a speed greater than $c\alpha_i$ and to avoid that, the electron will contract. So, its angular velocity will increase and it will drag the proton to have the same angular speed as it has. This is a work and that is inertia! That's what Einstein thought but he could never explain: the mass (inertia) increases and the dimensions shrink when the speed of movement increases!

The sep is always interacting with other sep or with matter structures. It's obvious that this interaction is as stronger as it is on an outer orbit. So, the force of interaction with the external world is:

$$f_{ext} = f_i \alpha = \frac{e_0^2 \alpha_i^2}{\varepsilon_0 r_i^2} \qquad (17)$$

And the internal force between electron and proton would be:

$$f_{int} = \frac{e_0^2 \alpha_1 (1-\alpha_i)}{\varepsilon_0 r_i^2} \qquad (18)$$

We saw above that the contraction of the electron is the result of the force of attraction of the proton. So this contraction is an *accelerated movement*. At each contraction a *vacuum* space is generated. This vacuum is a pull to the external world. But this pull is not constant during a phase of contraction. It starts strongly and decreases as the angular momentum increase. By integration in regard to time, with (10) we obtain an impulse ϕ_i

$$\phi_i = \frac{e_0^2 \alpha_i^2}{\varepsilon_0 r_i^2} \frac{\pi r_{38}(\zeta^{38-i} - \zeta^{37-i})}{c\alpha_i} \left(1 - \frac{\pi}{4}\right) \qquad (19)$$

ϕ_i has the dimension of a quantum of movement p. The force the sep exert on the external world when it pulse from orbits p to k would be the sum of all the pulls during a period T given by (10) so:

$$F = \sum_k^p \phi_i / T_0 \qquad (20)$$

With the above equation we obtain the force the sep exert during one complete contraction from orbit p to orbit k. But during 1 second of time the sep pulses billion times and we can be tempted to sum all these pulls but weights do not cumulate with time. A body can stay hours on the pan, the scale will always display the same weight. So, in (20) T = 1.

This force acts in all directions of space but weights are sensitive in only one direction so:

$$P = \frac{F}{4\pi} \qquad (21)$$

As we done for the wave lengths, we can establish a table which gives the values of

$$\Psi = (1 - \frac{\pi}{4}) \frac{e_0^2}{4c\varepsilon_0 r_{38}} \Sigma \frac{\alpha_i(\zeta^{38-i} - \zeta^{37-i})}{(\zeta^{38-i})^2}$$

$$\Psi = 3{,}918 \times 10^{-26} \sum_k^p \frac{\alpha_i \zeta^{38-p} - \zeta^{38-k}}{(\zeta^{38-i})^2} \qquad (22)$$

16	2,71E-34	**29**	8,76E-31	**42**	4,07E-27	**55**	2,21E-23
17	4,93E-34	**30**	1,66E-30	**43**	7,86E-27	**56**	4,31E-23
18	8,99E-34	**31**	3,16E-30	**44**	1,52E-26	**57**	8,39E-23
19	1,65E-33	**32**	6,02E-30	**45**	2,93E-26	**58**	1,63E-22
20	3,05E-33	**33**	1,15E-29	**46**	5,67E-26	**59**	3,18E-22
21	5,64E-33	**34**	2,20E-29	**47**	1,10E-25	**60**	6,21E-22
22	1,05E-32	**35**	4,20E-29	**48**	2,13E-25	**61**	1,21E-21
23	1,96E-32	**36**	8,05E-29	**49**	4,12E-25	**62**	2,36E-21
24	3,67E-32	**37**	1,54E-28	**50**	8,00E-25	**63**	4,61E-21
25	6,88E-32	**38**	2,96E-28	**51**	1,55E-24	**64**	9,01E-21
26	1,30E-31	**39**	5,70E-28	**52**	3,01E-24	**65**	1,76E-20
27	2,44E-31	**40**	1,10E-27	**53**	5,85E-24	**66**	3,44E-20
28	4,62E-31	**41**	2,11E-27	**54**	1,14E-23	**67**	6,72E-20

Tab. 2 - Values of Ψ calculated from orbit 2 with (22). Summation is made since orbit 2 but the first 15 values are not showed.

This table is calculated such way that the weight of a sep pulsing for example from an outer orbit p of rank 30 to an inner orbit k of rank 40 will be obtained by the difference:

$$\Psi_{40} - \Psi_{30} = 1.1 \times 10^{-27} - 1.66 \times 10^{-30} = 1.098 \times 10^{-27}$$

The weight of the UMA will be obtained when the sep pulses from any outer orbit to orbit rank 41.

As all the sep pulse at the same time but that they are never in phase the macroscopic weight of a body is given with a coefficient G which is the gravitational constant of Newton's physics. And we have seen that the inertia and the gravitational force is generated by Coulombian interaction not continuously but by pulses, by quanta!

Reference

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