THE HYDROGEN ATOM. (v 5.3 May 2024)
(Revision of Bohr's model)

As proposed in other papers of the model, a positive electric charge is characterized by switching the n-type aetherinos, that collide with it, into p-type aetherinos. It thus creates a deficit of n-type aetherinos of some specific speed distribution. It is said that it creates a *redistribution* of the n-type aetherinos (and also of the p-type aetherinos). The n-type aetherinos produce "impulsions" (and hence small velocity changes) on the material particles of negative electric charge with which they collide.
A negative electric charge in presence of a positive one suffers a force "towards" this positive charge because the negative charge receives less n-types aetherinos from the "side" of the positive charge than from the other directions (from which it receives the n-type aetherinos of its local aether).
The redistribution of aetherinos created by a proton is supposed to be anisotropic (due to some internal anisotropy of the proton). More precisely it is assumed that the proton has a Particle Redistribution Axis (PRA) that creates a redistribution of aetherinos with axial symmetry.
(The electron is also assumed to have an inner structure that gives rise to a redistribution of aetherinos with axial symmetry).

It will now be explained how (1) assuming that the proton creates a specific redistribution of aetherinos and (2) assuming that the proton performs a constant rotation of its inner structure (and hence of its PRA), leads to the prediction of a discrete set of circular orbits in which the force exerted by the proton on an electron does not oscillate in time. Only in these stable orbits around the proton would an electron be able to remain without being kicked out by the oscillating forces suffered in other non stable orbits.
This mechanism is somewhat similar to the creation of standing waves by the interaction of two waves of the same frequency.

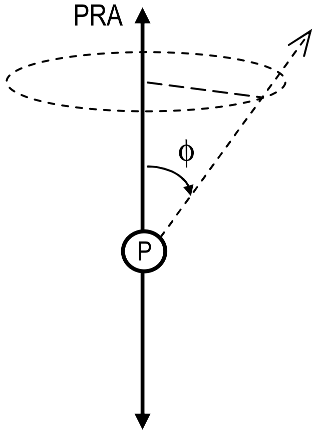
Just for the purpose of making the explanation simpler, suppose by the moment that the proton only creates a redistribution in the number of aetherinos *of two* given speeds v_1 and v_2 relative to the nucleus (i.e. the proton).
Suppose that both these redistributions have the same angular dependence like for example:

[10-1]

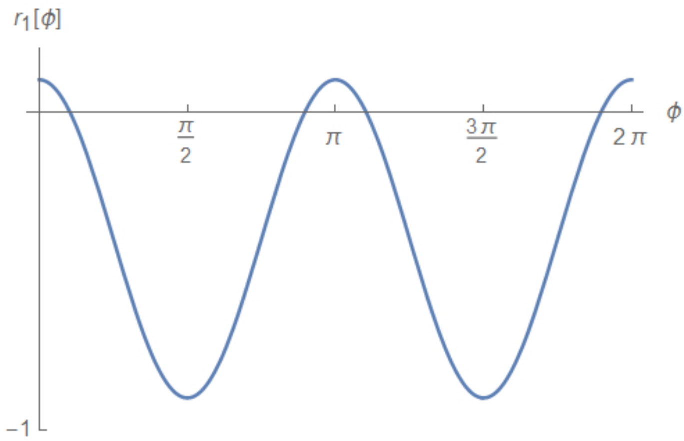
$$r_1[\phi] = -a_1 (k_0 + \mathrm{Sin}[\phi]^2)$$

$$r_2[\phi] = -a_2 (k_0 + \mathrm{Sin}[\phi]^2)$$

where
$r_1[\phi]$ is the deficit (or excess if $r_1[\phi] > 0$) *of n-type aetherinos of speed* v_1 emerging the proton by unit time and by unit solid angle in a direction that makes an angle ϕ with its PRA. (See Fig[10-1]).
k_0 is a constant (that might be needed to fit other phenomena like the strong force) such that $|k_0| << 1$
a_1 and a_2 are positive constants and thus (even if $k_0 < 0$ but still $|k_0| << 1$), when averaging over all directions ϕ, the proton will create a global *deficit* of n-type aetherinos of those speeds v_1 and v_2 (since in most directions ϕ it will be $(k_0 + \mathrm{Sin}[\phi]^2) > 0$



Fig[10-1]



Fig[10-2]

Plot of the $r_1[\phi]$ of Eq[10-1] with a_1=1, $k_0 = -0.1$

Fig[10-2] is an example (corresponding to $k_0 = -0.1$) of what could be the directional redistribution of aetherinos created by a proton. (In this case it would correspond to the redistribution of n-type aetherinos. The redistribution of p-type aetherinos would be the same function but with opposite sign). Along the two semi directions of its PRA (ϕ=0 and $\phi=\pi$) emerge from the proton an *excess* (relatively small) of n-type aetherinos. Along the equatorial directions ($\phi=\pi/2$ and $\phi=3\pi/2$) of the proton's PRA emerge a big *deficit* of n-type aetherinos. On the average a proton with its PRA randomly oriented produces a deficit of n-type aetherinos that attract the electron.

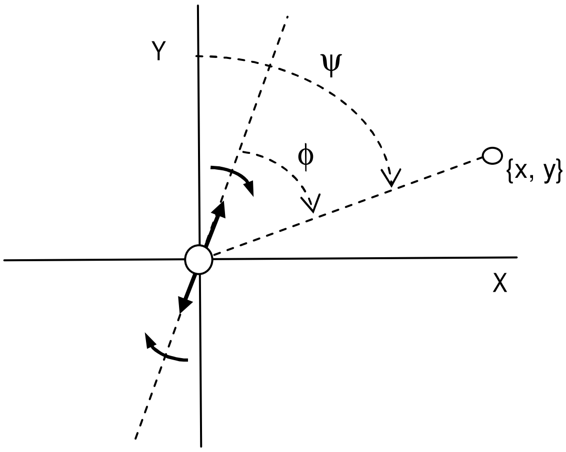
An excess of n-type aetherinos (like the one corresponding to (ϕ=0 and $\phi=\pi$) of Fig[10-2]) implies a *deficit* of p-type aetherinos (those that are able to impulse the particles of positive charge). Therefore two protons close to one another with their PRA pointing each other would attract themselves. This is how the model aims to explain the *strong force* exerted between nucleons. An alternative supposition (see below) would be to assume $k_0 = 0$ (and in this case two protons would never attract each other but only suffer a null force when oriented with their PRA facing each other. The redistribution of aetherinos due to the neutron would then be the main responsible of the strong force and of the confinement of the nucleons in the nuclei).

Suppose that the PRA of the proton of the Hydrogen atom is always performing an intrinsic rotation with an angular frequency ω_P and with a rotation vector perpendicular to such PRA.

<u>Note</u>: instead of supposing that the proton performs an intrinsic rotation that allows, as explained below, that the distribution of aetherinos emerging from the proton is seen to oscillate (when seen from external locations located mainly in a plane) *a more plausible hypothesis* leading to the same results is to suppose that the distribution emerging from the proton oscillates in time at a constant frequency ω_P and in unison in all directions of its equatorial plane, due to some *internal vibration of the proton* of that same frequency. But in what follows only the (less plausible) “proton’s PRA rotation hypothesis” will be developed.

Note: in the case of nuclei composed of many nucleons (protons and neutrons) it may be supposed that the nucleus as a whole also has a global aetherinical redistribution with axial symmetry (i.e. a global PRA) which is the vector sum of the individual PRA of all its nucleons. The global PRA of the composite nucleus must also rotate in space at a constant rate to allow for stable orbits of the atomic electrons.

Let the proton be in the position {x=0, y=0, z=0} and let its redistribution axis (PRA) rotate with its rotation defined by a vector, orthogonal to the PRA, aligned along the axis -Z. Therefore the PRA will lie at all epochs in the XY plane. (See Fig[10-3])



Fig[10-3]

Let {x, y, 0} be the generic position of the electron where the force exerted by the proton will be observed. Let the axis Y be the origin reference of the angles concerning the proton's PRA. Suppose that at the epoch t=0 its PRA is aligned along the axis Y. Therefore at an epoch t_E the proton's PRA will make an angle $\omega_P \cdot t_E$ with the axis Y.

The angle ψ that the position vector {x, y, 0} (of the observation point) makes with the axis Y is ψ = ArcTan[x/y].
Therefore, at an epoch t_E, the angle ϕ relative to the PRA by which emerge from the proton the aetherinos that have the adequate direction to reach the observation point {x, y} is:

[10-2] $\phi = \psi - \omega_P\ t_E = \text{ArcTan}[x/y] - \omega_P\ t_E$

At the epoch t arrive to {x, y, 0} aetherinos of speed v_1 emerged from the proton at an epoch $t_{E1} = t - d/v_1$ together with aetherinos of speed v_2 emerged from the proton at the epoch $t_{E2} = t - d/v_2$ where $d = (x^2 + y^2)^{1/2}$ is the distance between the proton and the observation point {x, y, 0}. Therefore:

[10-3]

$$t_{E1} = t - (x^2 + y^2)^{1/2} / v_1$$

$$t_{E2} = t - (x^2 + y^2)^{1/2} / v_2$$

At these epochs t_{E1} and t_{E2}, the angle relative to the proton's PRA by which emerged from the proton the corresponding aetherinos is (see [10-2]):

[10-4]

$$\phi_1 = \text{ArcTan}[x/y] - \omega_P\ t_{E1} = = \text{ArcTan}[x/y] - \omega_P\ (t - (x^2 + y^2)^{1/2} / v_1)$$

$$\phi_2 = \text{ArcTan}[x/y] - \omega_P\ t_{E2} = = \text{ArcTan}[x/y] - \omega_P\ (t - (x^2 + y^2)^{1/2} / v_2)$$

At the epoch t, the number of aetherinos of speed v_1 reaching, by unit time, a unit area orthogonal-surface located at the observation point is (see 10-1 and 10-4):

[10-5] $n_1[t] = r_1[\phi_1] / d^2 = -a_1 (k_0 + \mathrm{Sin}[\mathrm{ArcTan}[x/y] - \omega_P (t - (x^2 + y^2)^{1/2} / v_1)]^2) / (x^2 + y^2)$

and similarly for the aetherinos of speed v_2 :

[10-5b] $n_2[t] = r_2[\phi_2] / d^2 = -a_2 (k_0 + \mathrm{Sin}[\mathrm{ArcTan}[x/y] - \omega_P (t - (x^2 + y^2)^{1/2} / v_2)]^2) / (x^2 + y^2)$

Two approximations will now be made to simplify this introductory "sketch explanation" (of the existence of a discrete set of orbits in which the force suffered by an electron is stable, i.e. does not oscillate).

(***1***) Suppose that the orbital speed w of an electron in an atom is much smaller than the speeds of the aetherinos responsible of the force, i.e. assume here that

[10-6] $v_2 > v_1 >> w$

(***2***) Suppose that the cross section of the electron to aetherino collisions of relative speed v_1 has approximately the same value than the cross section of the electron to aetherino collisions of relative speed v_2, i.e.

[10-7] $\sigma[v_1] \cong \sigma[v_2]$

It can be shown, according to the model, that the force exerted by a flux n_1 of aetherinos of speed v_1 on an electron that (since $v_1 >> w$) can in this calculus be considered "at rest" is proportional to such flux, to the cross section σ of the electron and to the speed v_1 of those aetherinos, hence:

[10-8] $f_1[t] = k\, \sigma\, v_1\, n_1[t]$ and similarly $f_2[t] = k\, \sigma\, v_2\, n_2[t]$

NOTE:
More generally (see for example the Annex A) the model shows that the force exerted by a flux density n[v] of aetherinos of velocity **v** incident on a particle of velocity **w** is

[10-8b] $f[v] = k\, \sigma[v_R]\, v_R^2\, n[v]/v$

where v_R is the modulus of the velocity $\mathbf{v_R}$ of the aetherinos *relative to the target particle* (i.e. $v_R = |\mathbf{v}-\mathbf{w}|$) and $\sigma[v_R]$ is the cross section of the particle to collisions with aetherinos of relative speed v_R. But if the speed v of the aetherinos is much bigger than the speed w of the target particle (i.e. v>>w) then $v_R \cong v$ and

[10-8c] $f[v] \cong k\, \sigma[v]\, v^2\, n[v]/v = k\, \sigma[v]\, v\, n[v]$ is a good approximation of the force exerted by those aetherinos of speed v.

If it is now supposed that the redistribution of the proton is such that the constants a_1 and a_2 (see [10-5] and [10-5b]) and the speeds v_1 and v_2 are related by

[10-9] $a_1/a_2 = v_2/v_1$

it should be evident that the two forces $f_1[t]$ and $f_2[t]$ (see 10-8, 10-5 and 10-5b) oscillate with *the same amplitude* whatever the position of the electron. (Note: the oscillation amplitudes of those forces decrease of course as the distance to the proton increases but they remain the same to one another).

For example if the constant a_1 of $n_1[t]$ has the value $a_1=1$ then the constant a_2 of $n_2[t]$ should have the value $a_2 = a_1 v_1/v_2 = v_1/v_2$ and the two forces $f_1[t]$ and $f_2[t]$ would be:

[10-10]

$$f_1[t] = (k\,\sigma\,v_1)\;(k_0 + \mathrm{Sin}[\mathrm{ArcTan}[x/y] - \omega_P\,(t - (x^2 + y^2)^{1/2}/v_1)]^2)\;/\;(x^2 + y^2)$$

$$f_2[t] = (k\,\sigma\,v_2)\;(v_1/v_2)\;(k_0 + \mathrm{Sin}[\mathrm{ArcTan}[x/y] - \omega_P\,(t - (x^2 + y^2)^{1/2}/v_2)]^2)\;/\;(x^2 + y^2)$$

NOTES:

If it is assumed that a proton's redistribution affects a continuum of speeds, including aetherino speeds smaller than a typical orbital speed w of the electron, then the above approximation (*1*) could be revised to assume now that (***1***) "the orbital speed w of an electron in an atom is much smaller than the speeds of the aetherinos responsible of the *significant part* of the force." This would not be an unreasonable approximation considering that an aetherino colliding a particle contributes with an impulse proportional to its speed relative to the particle and therefore the contribution of the slow aetherinos is not very significant.

On the other hand the above approximation (***2***) $\sigma[v_1] \cong \sigma[v_2]$, was introduced to simplify the explanation. But in a more rigorous description this supposition should be omitted. To predict an equality of oscillation amplitudes of the forces f_1 and f_2 it should instead be supposed that the constants a_1 and a_2 of their redistributions are related with their speeds v_1, v_2 and electron cross sections $\sigma[v_1]$, $\sigma[v_2]$ by

[10-9b] $$a_1/a_2 = (\sigma[v_2]\,v_2)/(\sigma[v_1]\,v_1)$$

instead of by [10-9]

Radii at which the two "force waves" arrive in opposite phase.

Since the angular frequency of rotation of the proton's PRA has been called ω_P, its rotation period is $T_P = 2\pi/\omega_P$ (in this case T_P is the time interval between *two* consecutive events in which a given "pole" of the PRA points in a given direction). But since the PRA has axial symmetry, it is actually with a periodicity $T_P/2 = \pi/\omega_P$ that the proton repeats its aetherino's emission features in any given direction (of the plane XY).
Note: To facilitate the visualization of what is next explained, suppose that from the proton emerge an *excess* (instead of a deficit) of speed_v_1 aetherinos and also an *excess* (instead of a deficit) of speed_v_2 aetherinos. Suppose also that $v_2 > v_1$.
If a *maximum* of speed_v_1 aetherinos is emitted along a given direction at the epoch t_{E1}, a *minimum* will emerge the proton in that direction at the epoch $t_{E1} + T_P/4$. And according to the expressions [10-1] (in which both group of aetherinos (v_1 and v_2) emerge the proton at a rate that has the same angular dependence), then at the epoch $t_{E1} + T_P/4$ will also emerge the proton a *minimum* of the speed_v_2 aetherinos.
Since the proton's PRA is, in this simplified model, always rotating at a constant angular speed and since its redistribution (of the aetherinos of its local aether) is always active, then consecutive *maxima* of v_1 aetherinos will depart the proton along the direction of the observer at the epochs
t_{E1}, $t_{E1} + T_P/2$, $t_{E1} + 2\,T_P/2$, ... , $t_{E1} + n\,T_P/2$, ... (n is an integer)

Similarly consecutive *minima* of speed_v_2 aetherinos will depart the proton along the direction of the observer at the epochs
$t_{E1} + T_P/4$, $t_{E1} + 3\,T_P/4$, $t_{E1} + 5\,T_P/4$, ... , $t_{E1} + (2n-1)\,T_P/4$, ... (n is an integer)

There will be a discrete set of distances from the proton (i.e. atomic radii) at which a maximum of speed_v_1 aetherinos arrive at the same time than a minimum of speed_v_2 aetherinos emerged from the proton a time $(2n-1)\;T_P/4$ later. I.e. at these radii the v_2 aetherinos will arrive with an opposite "abundance phase" (and therefore an opposite “force phase”) to that of the v_1 aetherinos. More generally, it will happen at these radii that, whatever the abundance phase of the v_1 aetherinos that are arriving, a v_2 group of aetherinos will be simultaneously arriving with an opposite abundance phase.

Let R[n] be the radius at which arrive at the same time a group of v_1 aetherinos and a group of v_2 aetherinos emerged from the proton a time (2n-1) $T_P/4$ later. Calling t_{E1} the epoch of emission of the v_1 aetherinos and calling t the epoch at which they arrive at the distance R[n], it can be written:

[10-12] $R[n] = v_1 (t - t_{E1})$

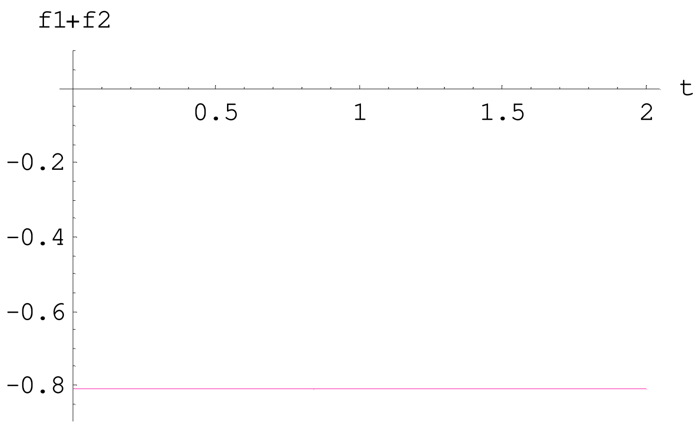
and for the v_2 aetherinos emerged a time (2n-1) $T_P/4$ later it can be written:

[10-14] $R[n] = v_2 (t - (t_{E1} + (2n-1) T_P/4))$

From these two equations (eliminating $t-t_{E1}$) it follows:

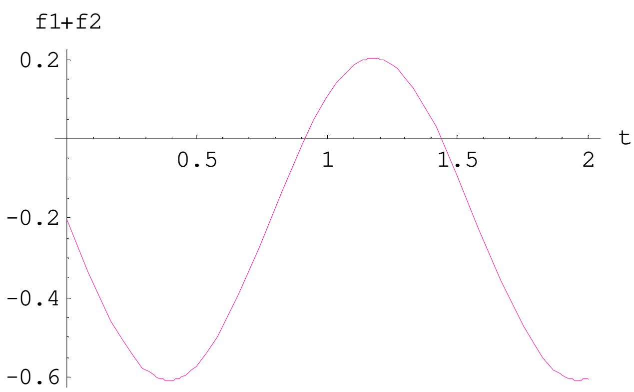
[10-15] $$R[n] = \frac{(2n-1)\, v_1\, v_2\, T_P}{4\,(v_2 - v_1)} = (2n-1)\frac{\pi\, v_1\, v_2}{2\,\omega_P\,(v_2 - v_1)}$$ with n = 1,2,3…

Example:
Suppose that (in arbitrary units) it is $v_1 = 0.5$, $v_2 = 1$, and $\omega_P = 2$. Then the first radius R[1] (corresponding to n=1) at which the two aetherinical forces $f_1[t]$ and $f_2[t]$ (shown in [10-10]) act at all epochs with opposite phase and produce therefore at all epochs a net non-oscillating force will be R[1] = 0.7854
The following figure is a time plot of the global force $f_1[t] + f_2[t]$ suffered by an electron at the position x=0.7854, y=0
(it has been supposed that, in arbitrary units, k=1, σ=1).



Fig[10-4]

while for example at an intermediate distance between R[1]=0.785 and R[2]=2.356 like for example at the position x=1.57, y=0 the total force strongly oscillates in time:



Fig[10-5]

If instead of supposing, as done above in Eq[10-1], that both the v_1 and v_2 aetherino beams emerge with a maximum intensity along the same angle (relative to the proton's PRA) it is supposed that it is the *minimum* of the v_2 beam that emerges along the same PRA angle than the *maximum* of the v_1 beam then the redistribution expressions [10-1] should be replaced for example by:

[10-1b]
$$r_1[\phi] = -a_1 (k_0 + \mathrm{Sin}[\phi]^2)$$
$$r_2[\phi] = -a_2 (k_0 + \mathrm{Sin}[\phi + \pi/2]^2)$$

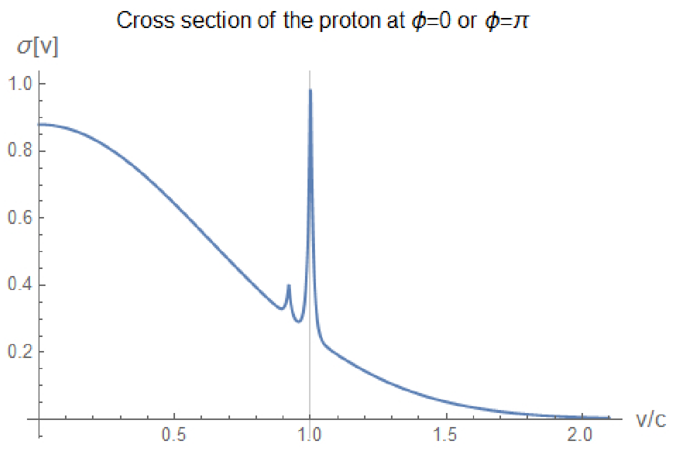
and then the discrete set of stable orbits (that correspond to those radii at which a maximum of speed v_1 aetherinos arrives at the same time than a minimum of speed v_2 aetherinos emerged later from the proton) must be deduced acknowledging that the emission delay between a v_1 maximum and a v_2 minimum (or vice versa) is now given by $n\, T_P/2$ (instead of $(2n-1)\, T_P/4$ as above). In this case the radii of the stable orbits will be given by

[10-15b]
$$R[n] = \frac{2n\, v_1\, v_2\, T_P}{4\,(v_2 - v_1)} = n\, \frac{\pi\, v_1\, v_2}{\omega_P\,(v_2 - v_1)} \qquad \text{with } n = 1,2,3\ldots$$

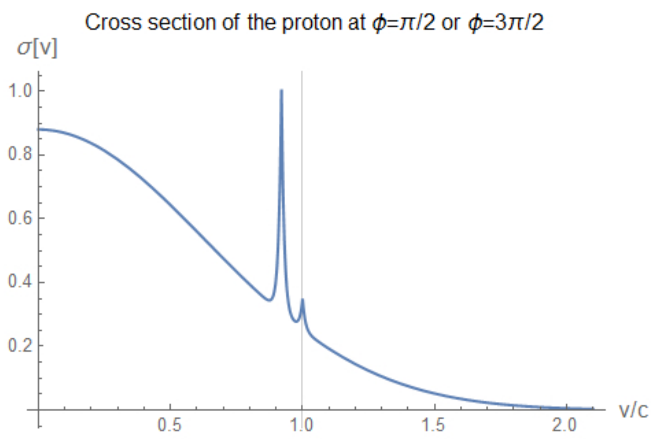
It can be seen (with test evaluations of the aetherinical force suffered by an electron due to a proton) that the flows of aetherinos emerging the proton *do not* necessarily have to be two "highly narrow" speed intervals centered respectively in v_1 and v_2 but can instead be two aetherino flows consisting in some "not so narrow" speed intervals including each a continuum of speeds. Furthermore the goal of predicting a discrete set of distances R[n] in which the force suffered by the electron does not oscillate (in spite of the oscillating intensity of the beams emerging the rotating proton) can also be achieved supposing that from the proton emerge not only two aetherino flows of "narrow" speed intervals but also an underlying, less intense, flow of aetherinos spanning a wide continuum of speeds like is shown for example in the figures [10-8] or [10-b] below.

The existence of two dominant flows of aetherinos centered respectively at two speeds v_1 and v_2 travelling from the proton to the electron can be implemented by the model in several ways:

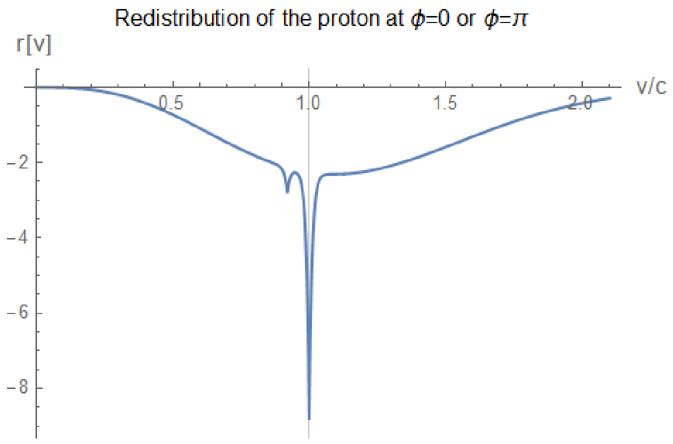
<u>Option</u> A
It could be supposed that the proton has two sharp resonances in its interaction with the aetherinos of respective speeds v_1 and v_2. The interaction cross section of the proton with the aetherinos would be of the types shown in Figs[10-6] & [10-7] corresponding to two given directions (relative to the internal structure of the proton) giving rise to the redistributions (of n-type aetherinos) shown in Figs[10-8] & [10-9].
In these examples it has been supposed $v_1 = 0.95c$, $v_2 = c$.



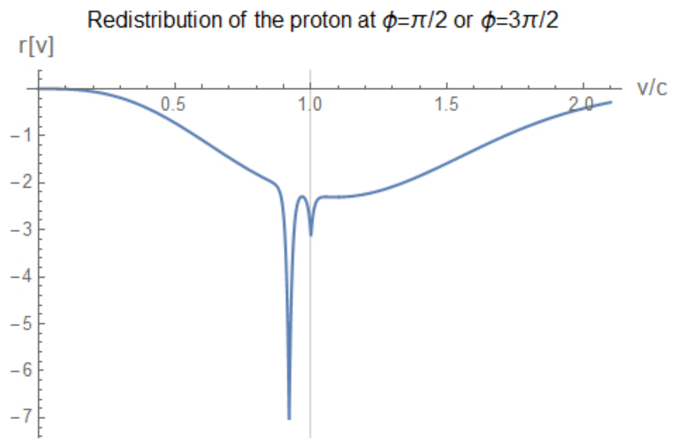
Fig[10-6]



Fig[10-7]



Fig[10-8]



Fig[10-9]

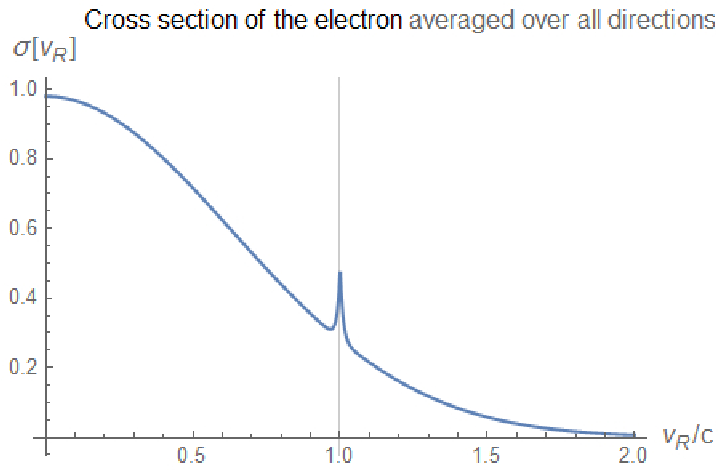
Option B

It has been postulated in other papers of the model that the interaction cross section of the electron (to aetherino collisions) has itself a sharp and strong resonance centered at a speed equal to c (relative to the electron) and one can make use of this fact to justify the arrival of two aetherino flows of respective speeds v_1 and v_2 (in opposition of "abundance phase" at a discrete set of distances from the proton) invoking only one resonance in the cross section of the proton and only one resonance in the cross section of the electron. This approach seems more reasonable than invoking two resonances for the proton and none for the electron.
As an example of this option consider the following:
The average (over all directions relative to the internal structure of the electron) *cross section of the electron* is (plausibly, according to the model) of the type:

[10-16] $$\sigma_E[v_R] = a_{1E}\,\mathrm{Exp}[-b_{1E}\ v_R^2] + a_{2E}\,\mathrm{Exp}[-b_{2E}\ |v_R-c|]$$

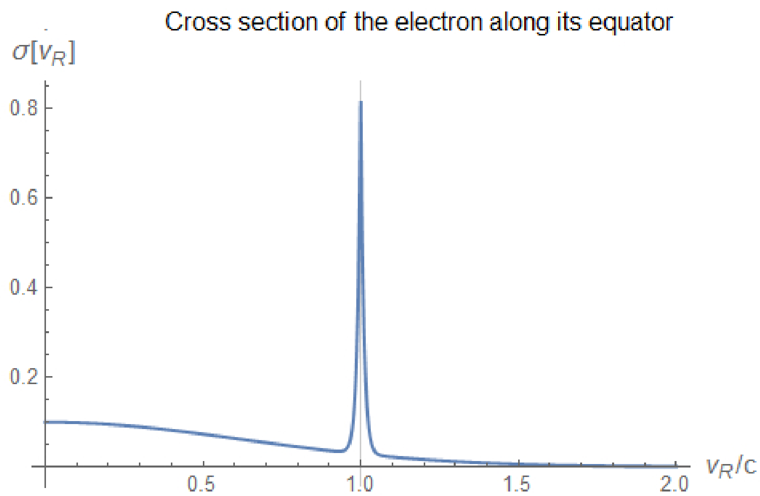
where
v_R is the speed of the aetherino relative to the electron
a_{1E} and a_{2E} are numerical constants
b_{1E} is a constant whose value is plausibly $1.255/c^2$
b_{2E} is a constant whose value is still open to the model

Fig[10-16] is a plot of the average (over all directions) cross section of the electron (Eq[10-16]) taking $a_{1E}=0.98$, $a_{2E}=0.2$, $b_{1E}=1.255/c^2$, $b_{2E}=100/c$



Fig[10-16]

In an atom, an orbiting electron does not radiate because its PRA keeps aligned perpendicularly to the orbital plane. That means that the electron's equatorial plane keeps facing the proton and therefore the aetherinos (or their deficit of the n-type) coming from the proton reach the electron along its equatorial directions.
But the cross section of the electron to aetherinos whose directions make small angles with the equatorial plane of the electron is supposed to be of the type shown in Fig[10-17] which is a plot of Eq[10-16] taking now
$a_{1E} = 0.1$, $a_{2E} = 0.8$ (and again $b_{1E} = 1.255/c^2$, $b_{2E} = 100/c$)

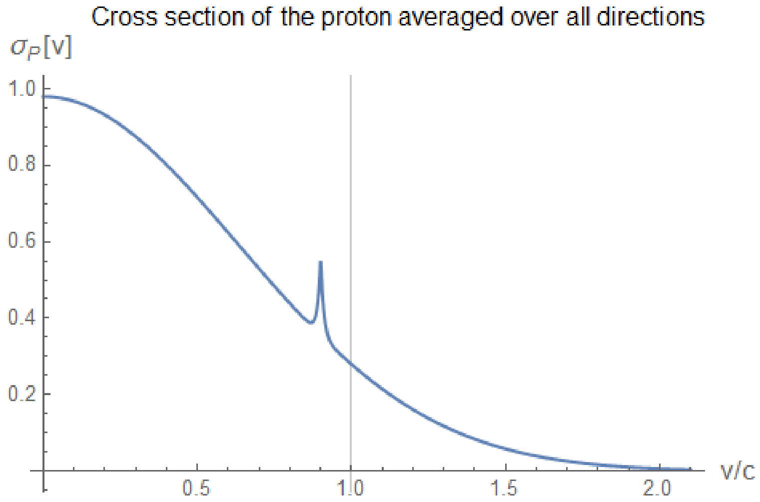


Fig[10-17]

Suppose now that the resonance in the cross section of the *proton* to aetherino collisions occurs at some speed c_P (relative to the proton itself) different from c. (The value that should be expected for c_P and its consequences have not yet been studied).
For the purpose of visualizing the present model of stable orbits, suppose <u>for example</u> that $c_P = 0.9$ c The cross section of the proton to switch collisions with n-type aetherinos would have a form similar to that of the electron (Eq[10-16]) but now with its resonance centered at $v_R = c_P$
(Note: *remember* that in the *switch collisions* a proton transforms the n-type aetherinos into p-type aetherinos creating therefore a deficit of n-type aetherinos)

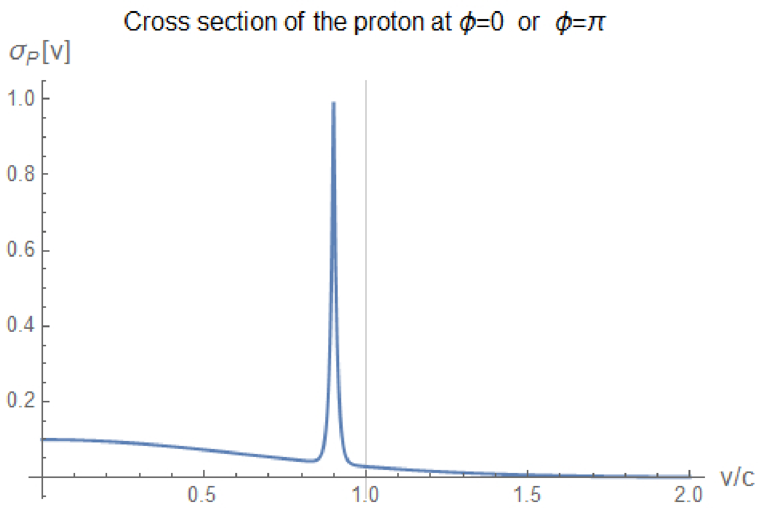
[10-18] $\sigma_P[v_R] = a_{1P}\ \mathrm{Exp}[-b_{1P}\ v_R^2] + a_{2P}\ \mathrm{Exp}[-b_{2P}\ |v_R - c_P|]$

The following Fig[10-18] is a plot of the plausible *average* (over all directions) cross section of the *proton* (Eq[10-18]) taking
$a_{1P} = 0.98$, $a_{2P} = 0.2$, $b_{1P} = 1.255/c^2$, $b_{2P} = 100/c$, $c_P = 0.9$ c



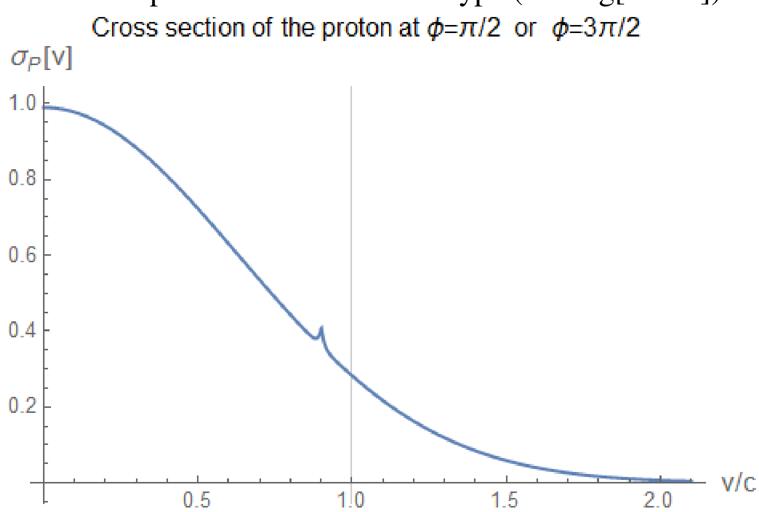
Fig[10-18]

The cross section of the proton to aetherinos whose directions make small angles with the proton's PRA would be of the type (see Fig[10-19]):



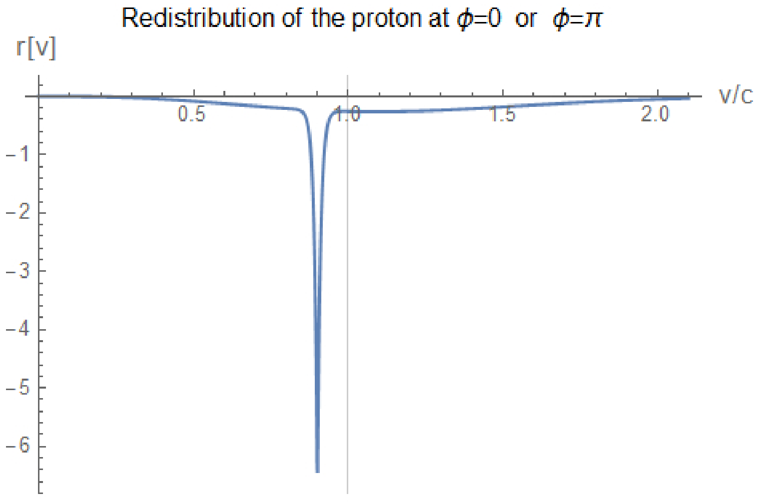
Fig[10-19]

while the cross section of the proton to aetherinos whose directions make small angles with the equatorial plane of the proton would be of the type (see Fig[10-20]):



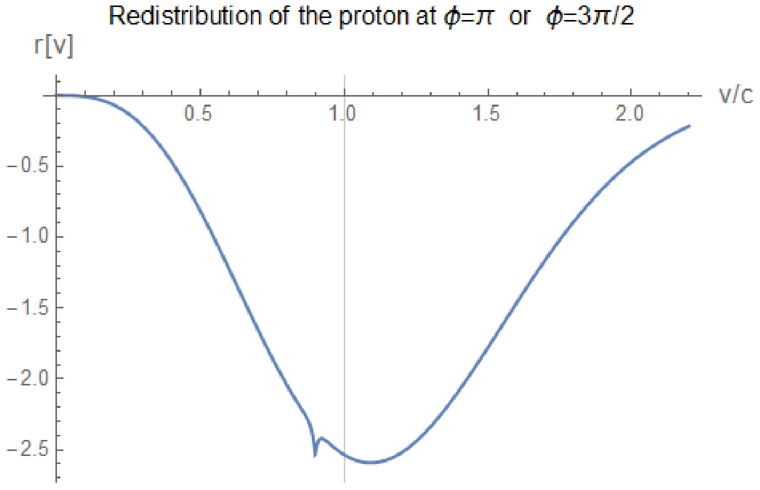
Fig[10-20]

The cross section of the proton to aetherinos whose directions make small angles with its PRA (see Fig[10-19]) would create a deficit *redistribution* of n-type aetherinos emerging along those directions of the type (see Fig[10-19b]):



Fig[10-19b]

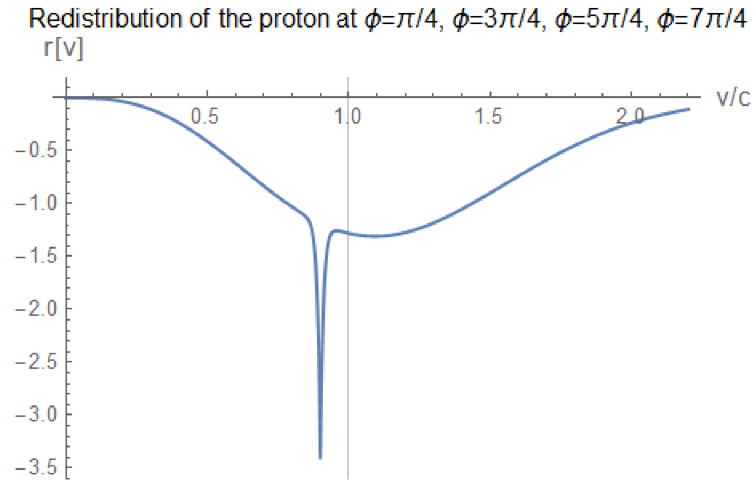
while the cross section of the proton to aetherinos whose directions make small angles with its equatorial plane (see Fig[10-20]) would create a *redistribution* of n-type aetherinos emerging along those directions of the type (see Fig[10-20b]):



Fig[10-20b]

(notice that the "minimum" of the redistribution [10-20b] is significantly less intense than the "minimum" of the redistribution [10-19b] due to the peak of the latter).

Since the proton of the Hydrogen atom has been postulated to be rotating (at a constant angular speed ω_P), the orbital electron would "see" a redistribution deficit of n-type aetherinos emerging from the proton (in the direction of the electron) that would oscillate between that of Fig[10-19b] and that of Fig[10-20b].
The evolution between those redistributions would of course be gradual, as the proton's PRA rotates. In this respect, an intermediate redistribution emerging along the directions (relative to the proton)
$\phi = \pi/4$, $\phi = 3\pi/4$, $\phi = 5\pi/4$ and $\phi = 7\pi/4$ would be of the type (see Fig[10-21]):



Fig[10-21]

Two dominant oscillating pulses of aetherinos (of their deficit number) travelling from the proton to the orbiting electron can then be distinguished:

- A pulse carried mainly by aetherinos of speed $v_1 = c_P$ (relative to the proton) would be due to a redistribution of the type of Fig[10-19b] emerging the proton, with a periodicity $T_P/2 = \pi/\omega_P$, in the direction of the electron. This pulse produces an intense oscillating force on the electron due to the big (deficit) number of aetherinos (of speed close to c_P) in the pulse in spite of the fact that the interaction cross section of the *electron* to the aetherinos of relative speed c_P =0.9c is small (as can be seen in Fig[10-17])
- A pulse carried mainly by aetherinos of speed $v_2 = c$ (relative to the electron and also of speed approximately c relative to the proton since the orbital speeds w of the electron are supposed to always be w<<c) would be due to a redistribution of the type of Fig[10-20b] emerging the proton, with again a periodicity $T_P/2 = \pi/\omega_P$, in the direction of the electron. This deficit pulse produces an intense oscillating force on the electron due to the big interaction cross section of the electron to the aetherinos of relative speed c (see the resonance at that speed in Fig[10-17]) in spite of the fact that the (deficit) number of aetherinos of speed close to c in the "emerging" the proton is now comparatively small.

The redistribution of (n-type) aetherinos emerging the proton at an angle ϕ with its PRA, can be approximated by

[10-22] $$r[\phi,v] = -r_1\,(k_0 + \mathrm{Sin}[\phi]^2)\, v^3/c^3\, \mathrm{Exp}[-b_1\, v^2/c^2] - r_2\,(k_0 + \mathrm{Sin}[\phi + \pi/2]^2)\, \mathrm{Exp}[-b_2\, |v-c_P|/c]$$

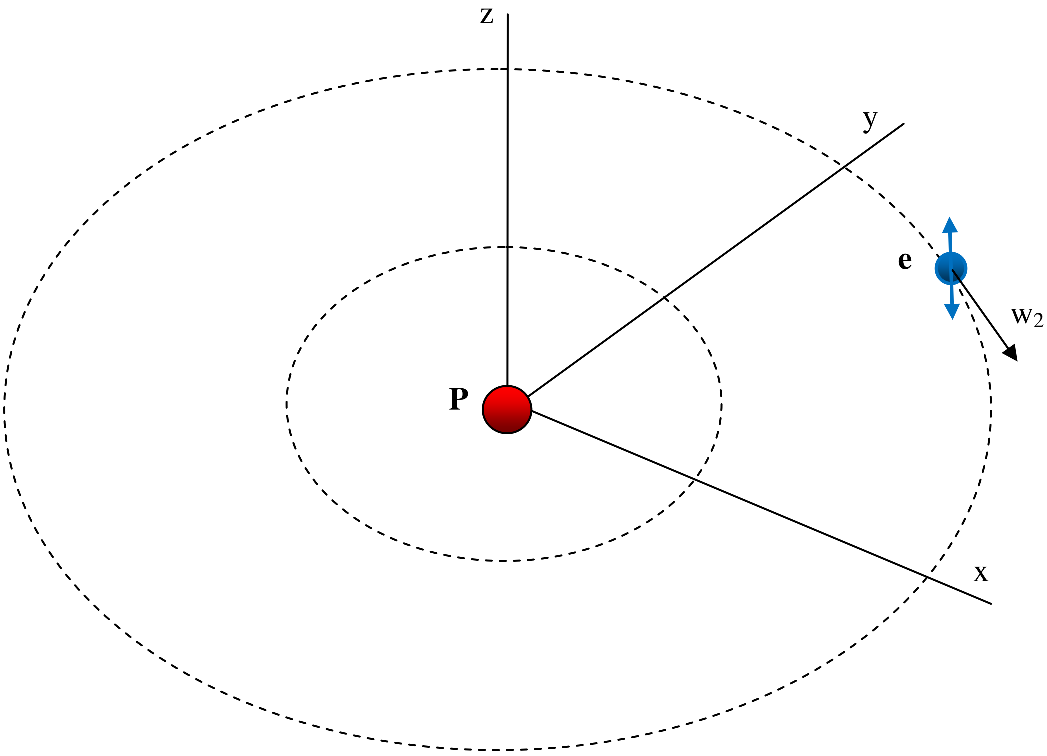
where, as the proton rotates with an angular speed ω_P , the angle ϕ relative to the proton's PRA by which emerges the redistribution r[ϕ,v] in a given direction is given (see Eq[10-2]) by $\phi = \psi - \omega_P\, t_E$
and where

* r_1, r_2, b_1, b_2 are positive constants
* $-1 << k_0 \leq 0$
* the function $v^3/c^3\, \mathrm{Exp}[-b_1\, v^2/c^2]$ is an approximation of a typical redistribution of aetherinos due to an elementary particle with charge (as shown in the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf). The fit with the more precise expression of the redistribution deduced by the model is achieved taking the constant $b_1 = 1.3$ (approximately).
* the function $\mathrm{Exp}[-b_2\, |v-c_P|/c]$ implements the sharp resonance (for speeds v close to c_P) in the redistribution of the proton.

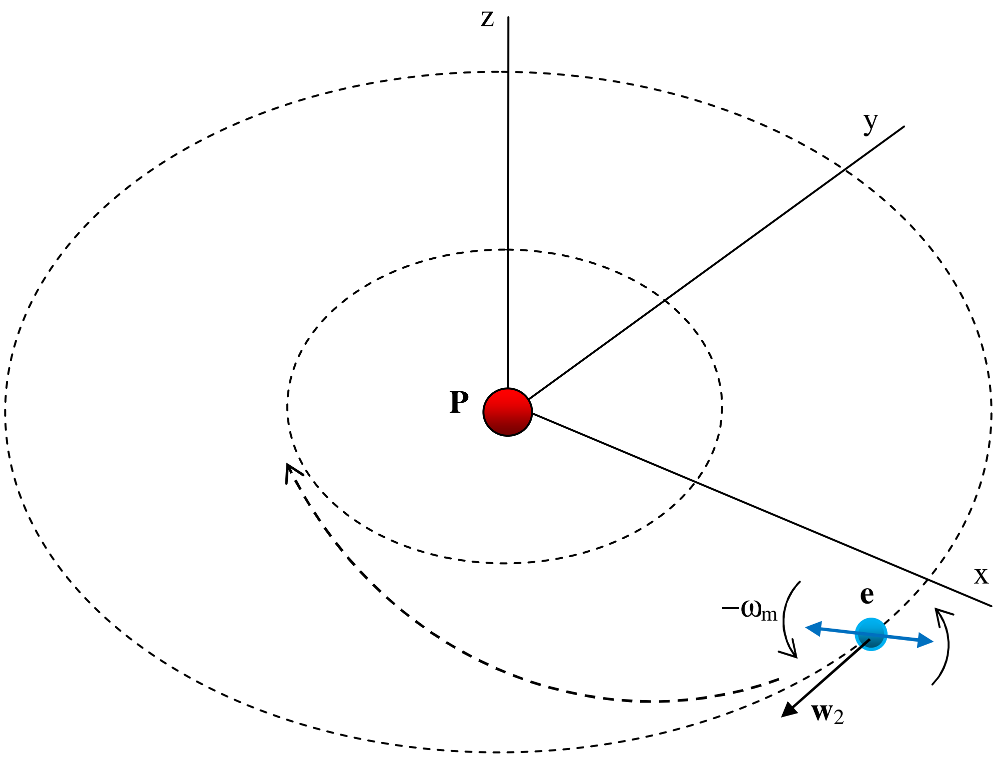
Evaluations that have been made show that, assuming a specific cross section of the orbiting electron of the type shown in Fig[10-17], the constants r_1 and r_2 can be adjusted so that at a discrete set of distances R[n] given in Eq[10-23] (in similitude with [10-15b] making $v_1=c_P$, $v_2=c$) the net force suffered by the electron does not oscillate in time:

[10-23] $$R[n] = n\,\frac{\pi\, c_P\, c}{\omega_P\,(c - c_P)} \qquad \text{for } n = 1,2,3\ldots$$

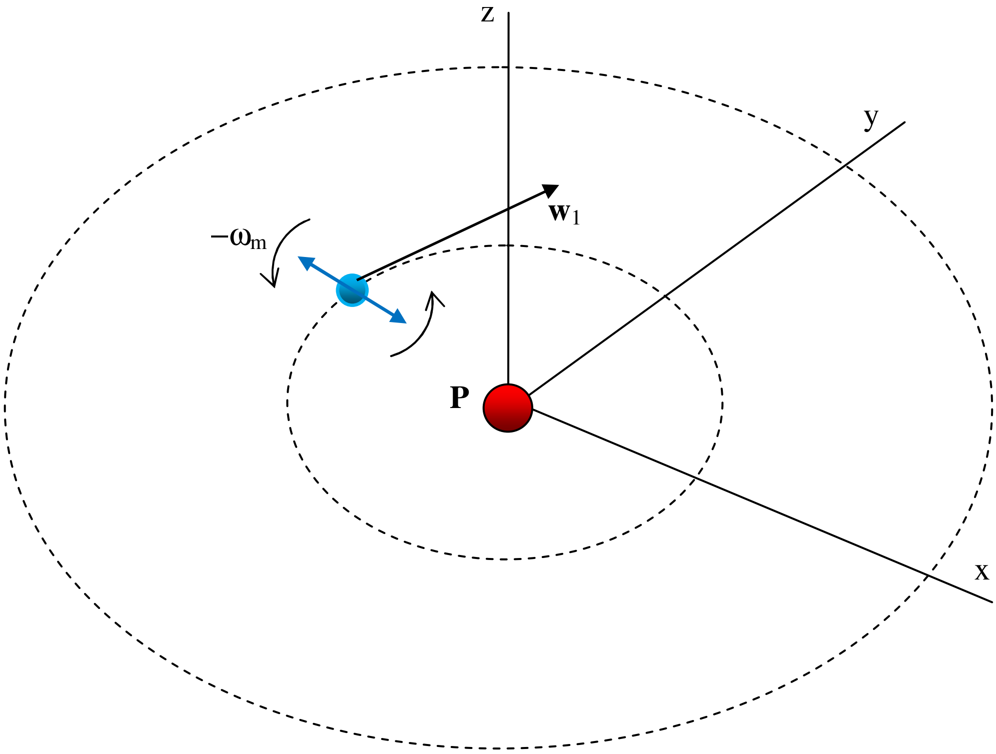
Spectral lines.



Fig[10-24]



Fig[10-25]



Fig[10-26]

Bohr, in his model of the Hydrogen atom, does not analyze the detailed behavior of the electron during its transition from one stationary state *m* to a lower one *n* and does not try to explain *how* the atom emits during such process a radiation of the frequency ν_{mn} given by the Rydberg formula (Eq[10-24]).
Quantum wave mechanics on its turn considers that the description that it makes of the electron and the proton, based in mathematical entities (wave functions) and in a set of rules and postulates, is a sufficient explanation since it makes successful predictions of the experimental facts about the atom (including the frequencies that it is able to radiate).
But the present model considers that the emission of radiation by the atoms can and must be explained with more detail than just asserting that $\nu_{mn} = (E_m-E_n)/h$
The Rydberg formula for Hydrogen (Z=1) written as:

[10-24] $$\nu_{mn} = c\,R\left(\frac{1}{n^2} - \frac{1}{m^2}\right) = \frac{c\,R}{n^2} - \frac{c\,R}{m^2} = \nu_n - \nu_m$$

suggests that the frequency ν_{mn} emitted by a Hydrogen atom when its electron jumps from the state *m* to the state *n* is the subtraction of two frequencies related with their respective states. But the only obvious frequency associated with a given stationary state of the Hydrogen atom is the orbital frequency of the electron in such state. Then, within the paradigms of the model, a sketch of a *possible process* through which the atom emits a radiation of frequency ν_{mn} (related with the orbital frequency ν_m of the initial orbit and the orbital frequency ν_n of the final orbit) could be as follows:

- As explained in other papers of this model, the electron, when stabilized in a stable orbit around the nucleus, does not radiate because the electron aligns its PRA (Preferred Redistribution Axis) perpendicularly to the plane of its orbit (see Fig[10-24]).
- When the electron suffers an external disturbance (e.g. due to a fluctuation of the aether in the case of spontaneous emission) its PRA is tilted and ceases to be perpendicular to the orbit. But if the

electron's PRA lies in the orbital plane (or makes a small angle with it) the conservation of angular momentum, which is the sum of the orbital angular momentum and the electron's intrinsic angular momentum, is supposed to provoke a rotation of the electron's PRA of the same angular speed but opposite sign to that of its orbital angular speed. During this disturbance event the electron loses energy and immediately decays to a lower stable orbit (see Fig[10-25]).

- In its new orbit the electron immediately acquires the orbital speed to keep in orbit and during a short time is supposed to maintain the intrinsic rotation of its PRA of angular speed $-\omega_m$ acquired in its previous orbit (see Fig[10-26]). It is during this short time that the electron radiates with an angular frequency $\omega_{mn} = \omega_n - \omega_m$ because a distant observer will see the electron's PRA pointing to him with that frequency ω_{mn}
- Gradually the electron orients its PRA in its most stable angle (perpendicular to its new orbit) and therefore ceases to radiate.

The interpretation of the Rydberg formula [10-24] as the difference between the orbital frequencies of the electron in two stable orbits (the n^{th} and the m^{th}) implies that the frequencies ν_n of revolution of the electron around the proton must decrease proportionally to $1/n^2$ as the orbital index n (the orbital quantum number) increases.
The orbital frequency ν of a circular orbit of radius r traveled at speed w is:

[10-25] $\nu = w/(2\pi r)$

According to Bohr's model of the Hydrogen atom (and to classical Physics) the orbital speed w of the electron is related with the radius r of the orbit by
(equating the electric centripetal force with the centrifugal force):

[10-26] $k_C \frac{e^2}{r^2} = m_e \frac{w^2}{r}$ =>

[10-27] $w = \sqrt{\frac{k_C}{m_e}\frac{e^2}{r}}$

and therefore replacing w in [10-25] the orbital frequency ν decreases with the radius as:

[10-28] $\nu \propto 1/r^{3/2}$

But according to the model of stable orbits proposed above (see for example Eq[10-15b]), the radii of the stable orbits are given by $r = r_1 n$ (with n=1,2,3…) and therefore the orbital frequencies of those stable orbits would be given by

[10-29] $\nu_n \propto 1/n^{3/2}$

which are not of the type $1/n^2$ that would allow to interpret the radiated frequencies ν_{mn} (see [10-24]) as the difference of the final and initial orbital frequencies.

But some simulations have been done showing that when the rate number N_F of aetherinos implementing the force exerted by a material particle P on another particle E is relatively high compared with the rate number N_A of the rest of aetherinos (from the local aether) colliding with the target particle E, Newton's 2nd law ($a = F/m$) must be revised since now the target particle suffers an acceleration that increases as N_F/N_A increases. But N_F/N_A increases as the distance r between the source particle P and the target particle E decreases. The guess (supported by the simulations) is that *the acceleration* suffered by the target particle E when suffering an intense electric force due to the presence of the particle P located at the small distance r can be approximated by:

[10-30] $a = \frac{F_{PE}}{m_e} \frac{1}{1 - e^{-r/r_k}}$

For very short distances ($r << r_k$) the factor 1-Exp[-r/r_k] tends to r/r_k and therefore the acceleration suffered by an electron very close to the nucleus (like in the Hydrogen atom) due to the force F_{PE} exerted by the proton can be approximated by

[10-30b] $a = \frac{F_{PE}}{m_e} \frac{r_k}{r}$ for $r << r_k$

For big distances ($r >> r_k$) the factor 1-Exp[-r/r_k] tends to 1 and therefore the acceleration suffered by the target particle satisfies again Newton's 2nd law.

For small distances of the orbiting electron to the nucleus (e.g. in the Hydrogen atom) the dynamic equilibrium must therefore satisfy the following equality of accelerations:

centripetal acceleration of the electron = centrifugal acceleration of the electron

=>

[10-31] $\frac{F_{PE}}{m_e} \frac{r_k}{r} = \frac{w^2}{r}$ for $r << r_k$

where
F_{PE} is the Coulomb force $F_{PE} = k_C e^2 / r^2$
w is the orbital speed of the electron
r_k is a constant of yet unknown value

therefore

[10-31b] $\frac{k_C e^2 r_k}{m_e r^3} = \frac{w^2}{r}$ =>

[10-31c] $\sqrt{\frac{k_C e^2 r_k}{m_e}} \frac{1}{r} = w$ for $r << r_k$

Note: since according to this model, the radii of the stable orbits are quantized (see Eq[10-23]) as r[n] = r[1] n then the orbital speeds of the stable orbits will be quantized (see Eq[10-31c]) as w[n] = w[1]/n

And the orbital frequency ν of a circular orbit of radius r traveled at speed w takes now, as a function of r, the form

[10-32] $\nu = \frac{w}{2 \pi r} = \frac{1}{2 \pi} \sqrt{\frac{k_C e^2 r_k}{m_e}} \frac{1}{r^2}$

But since, according to this model, the radii of the stable orbits are quantized (see Eq[10-23]) as *r[n] = r[1] n* then the orbital frequencies will be quantized (see Eq[10-32]) according to:

[10-33] $\nu[n] = \nu[1] / n^2$ for n = 1,2,3…

which is now of the type $1/n^2$ that allows to interpret the radiated frequencies ν_{mn} (see Eq[10-24]) as the difference of the final and initial orbital frequencies.

Notice also that since according to this model the radii of the stable orbits are quantized as r[n]= r[1] n and the orbital speeds as w[n]=w[1]/n then the *angular momentum of the electron* in those orbits *is constant* (i.e.

does not depend on the radius of its orbit). In fact, replacing the orbital speed w of the electron by its value given in Eq[10-31c], the orbital angular momentum of the electron takes the form:

[10-34] $$m_e\, \mathrm{w}\, r = m_e \sqrt{\frac{k_C\, e^2\, r_k}{m_e}}\, \frac{1}{r}\; r = \sqrt{k_C\, m_e\, e^2}$$

This result although it contradicts the mainstream description of atomic physics does not, a priori, represent a problem for the model that does not consider that the photon is a real particle. (The Bohr model of the atom induced mainstream physics to assign an angular momentum (integer multiple of h/2π) to the "photons" emitted in the atomic transitions).

The *energy* of the stable orbits is quantized in the model proposed in the same way as in the Bohr model, i.e. as

[10-35] $E[n] = E[1]/n^2$

which seems the reasonable conclusion from the facts that
(1) the kinetic energy of the electron is 1/2 m_e w^2 but the orbital speed w is quantized (as said above) according to w[n]=w[1]/n which implies that the kinetic energy should be quantized as $K[n]=K[1]/n^2$
and
(2) the "force" exerted by the proton on an electron, "very close" to the proton, *can be interpreted* according to Eq [10-31b] and *just for the present purpose*, to decay *quantitatively* with the distance r in proportion to $1/r^3$ which corresponds to the gradient of a potential V that decays with the distance in proportion to $-1/r^2$ and therefore (considering that the radii are quantized as r[n] = r[1] n) the potential energy of the electron in the n_{th} stable orbit would be quantized as $V[n] = V[1]/n^2$

The model is therefore compatible with the fact that the radiation frequency ν_{mn} emitted when the Hydrogen atom jumps from state m to state n is proportional to the energy difference ΔE = E[m]-E[n] between those states.

Fine structure. Spin of the electron.

Mainstream physics "explains" the fine structure of the atomic energy levels assigning to the electron an intrinsic angular momentum: the spin. But such intrinsic angular momentum cannot be ascribed to a very fast rotating charge since that would be inconsistent with other mainstream theories (e.g. with Special Relativity). On the other hand, the QFT description of the electron spin is considered (by the author and others) an abstract, positivistic explanation of low prediction power. That is why an explanation of the fine structure based on the hypothesis of an internal structure of the electron (or more precisely on a non isotropic distribution of its charge) should at least be attempted. This section only pretends to suggest the features of such type of description.

The force suffered by an electron due to the redistribution of aetherinos emerging from the positive nucleus of its atom depends not only on the distance between the nucleus and the electron but also depends, according to the model, on the velocity of the electron relative to the nucleus. The strength of such (electric) force is conditioned by the cross section of the electron to the n-type aetherinos (those able to impulse a negative charge particle).
It is expected that such cross section of the electron is not the same along all its directions due to an internal non-isotropic structure of the electron (as it has already been mentioned in relation with a preferred redistribution axis PRA of the electron).
But suppose now that such interaction (with aetherinos) cross section has two *relative* maxima in two opposite sides (antipodes) of the electron's "equator". Furthermore, suppose that such cross section has a slightly different strength in each of those maxima.

Since a “cross section maximum” of the electron will tend to face (be oriented towards) the nucleus because such orientation implements a maximum of attraction force (which implies a “stable equilibrium” orientation) then it is expected to find the electron with either its cross section maximum #1 or its cross section maximum #2 facing the nucleus. When an electron has its cross section maximum #1 facing the nucleus, mainstream physics would say that the electron has a *spin +1/2* and if the electron has its relative maximum #2 facing the nucleus it would say that the electron has a *spin -1/2*.
Suppose for example that it is the electron’s *relative* maximum #2 the one that is slightly stronger than its maximum #1. This scenario could be described assuming that the electron behaves as if its *electric charge* is slightly bigger when it performs its orbit with its maximum #2 facing the nucleus than when it is its maximum #1 that faces the nucleus.

Consider that an electron, with its maximum #1 facing the nucleus, is able to perform circular orbits of radii $R_1[n]$ where $R_1[n]$ are the set of radii described above (e.g. in Eq[10-23] in which the centripetal force suffered by the orbiting electron does not oscillate and the electron is not kicked out of the orbit). It could seem at first sight that an electron with instead its maximum #2 facing the nucleus would also be able to perform circular orbits of the same set $R_1[n]$ of radii although at higher speeds (so has to have bigger centrifugal forces able to cancel its now stronger centripetal forces) but the radii in which the oscillations of the centripetal force of the model are cancelled have a small dependence on the orbiting speeds of the electron and therefore the radii at which an electron with its maximum #2 facing the nucleus would detect no oscillations in the centripetal force would be a set $R_2[n]$ slightly different from $R_1[n]$. More precisely, see Eq[10-23], the value of the proton-dependant speed c_P would not change when changing the electron’s cross section maximum (#1 or #2) facing the proton but the speed at which travel, in the reference frame of the atom, the aetherinos for which the electron has its sharp resonance (Fig[10-17]) would only be strictly c if the orbiting speed of the electron was zero. For higher orbiting speeds, the speed c in Eq[10-23] (referred to the reference frame of the atom) should be replaced by smaller values since the most effective aetherinos in exerting a force on the electron are those of speed c *relative to the electron* (i.e. at its resonance speed). It can be seen in Eq[10-23] that replacing the speed c by slightly smaller values (although still bigger than c_P) the radii R[n] take slightly bigger values. Therefore it can be expected that an electron with its cross section maximum #2 (the stronger one) facing the proton would perform an orbit with a slightly bigger radius than an electron (of the same energy “order”) with its cross section maximum #1 facing the proton since the former should have a bigger orbiting speed due to its bigger “effective charge” (i.e. stronger directional interaction cross section).

Mainstream description of the atom together with the experimental facts show that a spin +1/2 electron and a spin -1/2 electron (both otherwise with the same principal, orbital angular momentum and magnetic quantum numbers) have very close energies (as the name “fine structure” reminds). This relatively very small difference of energies implies that, in the proposed “two maxima model”, the orbits of a faced #1 electron and that of a faced #2 electron (of the same order n in Eq[10-32]) should be very close in space (i.e. should have very close value radii). But it does not seem plausible (stable) that two electrons can occupy, in the same orbital plane, orbits of very close radii unless the electrons remain, all the time, at opposite sides of the nucleus due to having the same angular speed (although different orbiting speed). This equal angular speed would pose a severe restriction to the values of the electron’s cross sections at its two maxima and it is not clear (it hasn’t yet been calculated) if those two cross section values would allow the same angular speed not only for two close orbits of a given order n but of all orders.

Lifetime broadening of the spectral lines.

It seems reasonable to assume that, in the discrete levels that the electrons can occupy in the atoms, the forces acting “most of the time” on the electron correspond to what may be called a “quasi stable equilibrium” meaning here that (1) for “small” displacements of the electron from the center of that level, the forces suffered by the electron tend to restore it to a more bound position, but (2) if the electron suffers a “big” displacement from the center of the level there is an increasing probability that the atomic forces can no longer restore its position (and energy) to the quantum level from which it was displaced and the electron

begins to radiate loosing energy and decaying to a lower energy level. This scenario reminds of an electron inside a potential well of finite height but, in this case of an atomic level, the electron can exit the "well" not only when it increases its energy beyond some "high energy threshold" *but also when it decreases its energy* beyond some "low energy threshold", both specific of the quantum level.
The model of the aether proposed in this work is suited to make a straightforward description of those events in which an electron occupying a quasi-stable atomic level decays "spontaneously" to another level. Mainstream physics calls "spontaneous" those derails (i.e. decays) of an electron from a quasi-stable level because mainstream physics ignores that the cause of the derail is a fluctuation of the "nominal "force suffered by the electron due to a *natural fluctuation of its local aether* (made of aetherinos and hence of statistical nature).

It is an experimental fact that the natural or *lifetime width* of the spectral lines of the radiation emitted in those "spontaneous" decays is inversely proportional to the lifetime τ of the electron in the quasi-stable level from which it decays.
(The "*width*" of a spectral line is understood as the span (i.e. interval) of emitted *frequencies* at half maximum (of intensity) of the line (i.e. the Full Width at Half Maximum or FWHM).
(The name "*lifetime"* width is to remark that other causes of the broadening of the spectral lines (like the pressure broadening or the Doppler broadening) are not considered here).
The proposed aether model can describe this natural broadening of the spectral lines as follows:
A *short* lifetime τ of an atomic level is the consequence that the probability that the electron is pushed out of the level is *high*. That will be so when the restoring bounding forces acting on the electron in such level are *small* (and they decrease quickly when displacing the electron from its equilibrium, more bound, location) because, in this case, even the small fluctuations of the forces suffered by the electron will have a big probability to push it out of its level.
Note: The forces acting on an electron (in an atom) are the central attraction force exerted by the positive nucleus and the inertial force (that is commonly a centrifugal force). Both forces are dependent on the parameters of the local aether. But the aether of the model is a statistical entity made of aetherinos whose number (by unit volume) and whose distribution of speeds suffer fluctuations.
The small fluctuations of the aether are responsible of small fluctuations of the force suffered by the electron while the big fluctuations of the aether are responsible of big fluctuations of the force.

Let E_0 be the *nominal* energy of the electron in a given atomic level. E_0 will be the energy at which the electron is more tightly bound to the level and hence the most probable energy of the electron in that level

Let ΔE_+ be the energy increment that when *added* to E_0 gives the electron a high probability, of say a 75%, of decaying from the level. This energy ΔE_+ can be called the *plus* "work function" of the level (in analogy with that of the photoelectric effect).

Let ΔE_- be the energy decrement that when *subtracted* from E_0 gives the electron a high probability, of say a 75%, of decaying from the level. This energy ΔE_- can be called the *minus* "work function" of the level.

(In what follows, ΔE_- will be considered a *positive* quantity that will be preceded by a minus sign when describing a removal of energy from the system).

When the electron, lying with higher probability at its nominal energy E_0, suffers a fluctuation that *adds* "instantly" an energy ΔE_F to it, then if ΔE_F is bigger than ΔE_+, the electron will exit the level with an energy $E_0 + \Delta E_F - \Delta E_+$ (where the energy ΔE_+ corresponding to the "work function" has been subtracted since the electron, during its exit journey has to overcome the restoring forces that remove such energy from it). For energy-adding aether fluctuations between a minimum energy $\Delta E_F = 0$ and a maximum energy $\Delta E_F = \Delta E_{FMax}$ the electron will *begin* its decay (to a lower level) with energies in the interval $\{E_0, (E_0 + \Delta E_{FMax} - \Delta E_+)\}$ (i.e. with a minimum E_0 corresponding to the case in which the fluctuation adds an energy just equal to ΔE_+ since for smaller fluctuations there will be no significant number of decays). Similarly:

When the electron suffers a fluctuation that *removes* "instantly" an energy ΔE_F to it (consider ΔE_F a positive quantity to be subtracted), then if ΔE_F is significantly bigger than ΔE_- , the electron will exit the level with an energy $E_0 - \Delta E_F + \Delta E_-$ (where the energy ΔE_- corresponding to the "*minus* work function" has been added since the electron, during its exit journey, has to overcome the restoring forces that tend to add energy to it). For energy-removing aether fluctuations between a minimum removed energy $\Delta E_F = 0$ and a maximum energy-removing fluctuation ΔE_{FMaxR} (that is expected to be nevertheless small compared with $|E_0|$) the electron will *begin* its decay (to a lower level) with energies in the interval $\{E_0, (E_0 - \Delta E_{FMaxR} + \Delta E_-)\}$ (i.e. with a minimum equal to E_0 corresponding to the case in which the fluctuation exactly removes an energy equal to ΔE_- since for smaller energy-removing fluctuations there will be no decay).

When an electron decays from an atomic level of nominal energy E_0 to a lower level of nominal energy E_2 it is well known that a radiation of frequency n is emitted such that $E_0 - E_2 = h\,\nu$ but since the energy of the electron in the upper level (when it starts its decay) will not in general be (as explained above) exactly equal to E_0 but will instead have some value in the interval $\{ (E_0 - \Delta E_{FMaxR} + \Delta E_-),\ (E_0 + \Delta E_{FMax} - \Delta E_+) \}$ that can also be written as:

$$\{ E_0 - (\Delta E_{FMaxR} - \Delta E_-),\ E_0 + (\Delta E_{FMax} - \Delta E_+) \}$$

then the radiations emitted in this type of decay will have frequencies in the interval $\{ ((E_0 - \Delta E_{FMaxR} + \Delta E_-) - E_2)/h,\ ((E_0 + \Delta E_{FMax} - \Delta E_+) - E_2)/h \}$ that can also be written as:

$$\{ ((E_0 - E_2) - (\Delta E_{FMaxR} - \Delta E_-))/h,\ ((E_0 - E_2) + (\Delta E_{FMax} - \Delta E_+))/h \}$$

(valid only if, as expected, it is $\Delta E_{FMaxR} > \Delta E_-$ and $\Delta E_{FMax} > \Delta E_+$ because otherwise there will be no decays from that level)

and since, in any ordinary statistical media, the number of fluctuations above a given value ΔE_F decreases when ΔE_F is increased, then the line will have a maximum of *intensity* at the frequency $\nu = (E_0 - E_2)/h$ since E_0 will be the energy with which the electron starts its decay in a majority of cases (corresponding to small, but sufficient fluctuations).
The values ΔE_{FMaxR} and ΔE_{FMax} (of the bigger fluctuations) are parameters depending only on the local aether.

On the other hand, the values ΔE_+ and ΔE_- are specific of the level from which the electron decays and therefore the bigger they are the bigger are the fluctuations able to trigger their decays and therefore the longer is the lifetime τ of the level. But if ΔE_+ and ΔE_- are big then $(\Delta E_{FMaxR} - \Delta E_-)$ and $(\Delta E_{FMax} - \Delta E_+)$ will be small implying that the width of the spectral line is small (small broadening).

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Analysis of the Hydrogen atom from other points of view.
(What follows was written a long time ago and has not yet been revised and updated).

As said in Annex A, in a more detailed analysis of the force suffered by an electron orbiting a proton, the total force suffered by the electron at a given epoch t, is the vector sum of (1) the "proton force", whose components may be deduced from [A-20..], (2) the electron's "Autoforce", whose components are given in [A-34,35] , and (3) the "aether Drag force" due to the speed of the electron relative to its local aether (see Section 2).

Here are some considerations, according to the model, about those three forces suffered by the orbiting electron:

(1) **The proton force**.

This is the force suffered by the electron due to the aetherinos redistributed by the proton (which is at the "centre" of the atom). The proton creates a deficit of n-type aetherinos at many speeds and therefore the electron receives from the direction of the proton less n-type aetherinos than from the rest of directions of space (Note: ignoring by the moment the corrections introduced by the aether drag force and the Autoforce (see below), the electron receives from those other directions of space an isotropous and balanced number of aetherinos from the local aether).

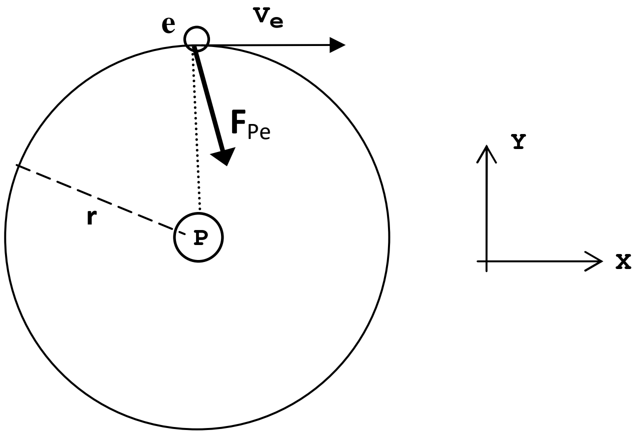


Fig [10-4]

Let S be the reference frame associated with the proton and suppose that the proton is at all epochs at the position {x=0, y=0}. See Fig[10-4].
Suppose for example that, at the epoch t of observation of the force, the electron is passing the position {x=0, y=r}. At this epoch the electron is receiving aetherinos emerged from the proton along the direction +Y. In the reference frame S, the x-component of the velocity of all those aetherinos is zero.
In the reference frame S' of the electron, instead, the velocity of one of those aetherinos has the Cartesian components {-v_e, v} where v_e is the speed of the electron in S and v is the speed of the aetherino (also in S). See Fig[10-5]. Therefore the impulse that an aetherino, emerged from the proton, gives to the electron (when at the position {x=0, y=r}) has a non zero component along the semi direction –X' that opposes the velocity of the electron. (This effect is similar to the so called aberration of star light). But, see below, the impulse that *a missing aetherino*, removed at the proton, gives to the electron (when at the position {x=0, y=r}) has a non zero component along the semi direction +X' that tends to *increase* the speed of the electron.

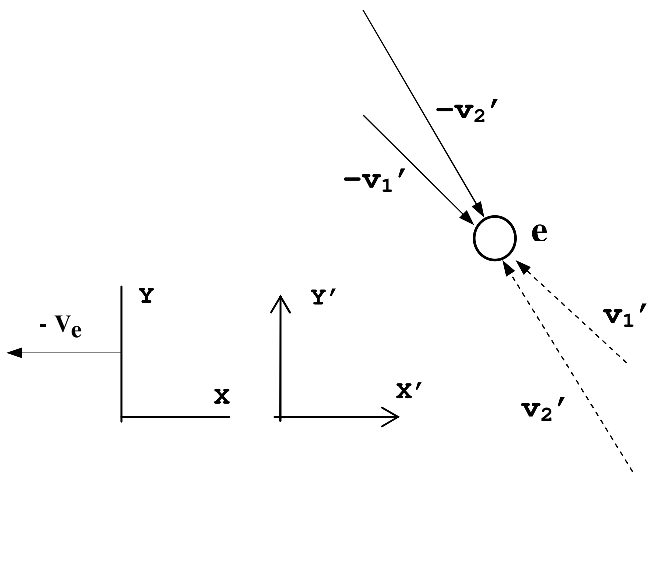


Fig [10-5]

In Fig[10-2] have been represented in dashed lines the velocities v'_1 and v'_2 (relative to the electron) of two aetherinos of different speed coming from the proton and reaching the electron when it is at the position {x=0, y=r}. But from the proton emerges a *deficit* of those aetherinos. The electron in presence of the proton receives therefore a specific *deficit of aetherinos* of many velocities *compared to the number of aetherinos* from the local aether that it would receive if the proton was not there. But in an aether of aetherinos, in which any particle (e.g. the electron) is bathed by its local aether and therefore suffers a *high* rate of collisions, if, say, n aetherinos of those colliding with the particle with relative velocity $\mathbf{v}'_1$ are removed by unit time, the particle behaves in the same way as if an *excess* of n colliding aetherinos of opposite velocity $-\mathbf{v}'_1$ were added by unit time to its previous state.
I.e. since any specific group of aetherinos colliding by unit time with a particle exert on it a given force **F**, the removal of those aetherinos is equivalent to adding to the particle a force **– F**. In other words, the force exerted by a redistribution that takes a negative value (a deficit) can be calculated just changing the sign of the force that would be exerted by an excess (positive value) of the corresponding aetherinos. (In Fig[10-2] have been drawn in solid lines the velocities $-\mathbf{v}'_1$ and $-\mathbf{v}'_2$ of two aetherinos of the local aether whose impulses must now be taken into account to evaluate the "absence" of two specific aetherinos removed from the local aether by the proton and whose velocities in S' have been drawn with dashed lines).

Conclusion:

The force exerted by the proton on an orbiting electron can be decomposed into two non-zero components:

- *A component along the instantaneous direction joining the electron with the proton. This radial component attracts the electron towards the proton and will be called "centripetal force".* The evaluations show that for slow orbital speeds of the electron (i.e. for $v_e << c$), this component does not vary sensibly with the electron's speed.
- *A component along the orbital velocity of the electron that tends to increase the electron's orbital speed (in the reference frame of the nucleus). This tangential component that will be called "forward force" has a strength proportional to the speed* v_e *of the electron.* (Notice however, that in the case of two charges A and B *of equal sign that repel* each other, if the velocity of, say, B is perpendicular to the line AB then the tangential force that A exerts on B acts in the opposite semi-direction of B's velocity).

(2) **The Autoforce** (of the orbiting electron on itself).

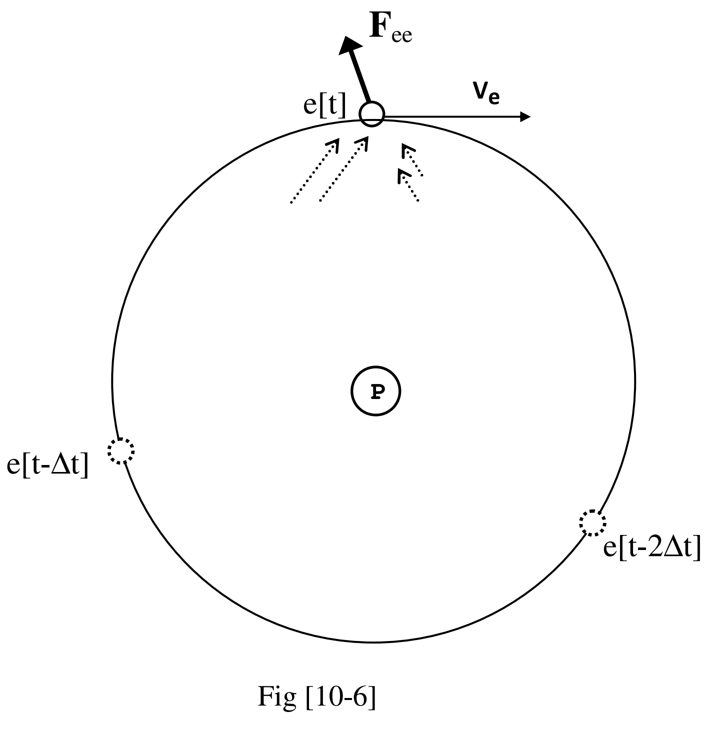


Fig [10-6]

The Autoforce is the aetherinical force suffered at a given epoch by the electron due to the collision of the aetherinos emerged in all earlier epochs from the electron itself.
Suppose that the reference frame S associated to the proton is a “rectilinear reference frame”. (Note: the model assumes the existence of rectilinear reference frames in which all the aetherinos travel in straight lines at constant speeds). In Fig[10-6] has been represented an orbiting electron in three different epochs and positions e[t-2Δt], e[t-2Δt] and e[t]. At the epoch t the electron is in the position e[t] and is receiving aetherinos emitted by the electron itself in all earlier epochs like for example those emitted when the electron was at e[t-Δt] (whose speed in S will be smaller than the orbital speed v_e of the electron since, in the same time interval Δt, those aetherinos have travelled a shorter distance (the chord of the circle instead of the arc of the circle travelled by the electron). The speed of the aetherinos emitted when the electron was at e[t-2Δt], and arriving again at the electron at the epoch, will be even smaller since now the arc travelled by the electron during 2Δt is much longer than the chord travelled by the aetherinos. (Note: In the Annex A of this model can be found the equations for the calculus of the Autoforce).

Evaluations have been done assuming a reasonable (according to the model) cross section and redistribution for the electron. These evaluations show that only the very recent past of the electron (say, the last two or three orbits) contribute significantly to the Autoforce.

It has also been found in those evaluations that, for circular orbits:

- The tangential component of the Autoforce (i.e. along the direction of the actual velocity of the electron) acts in opposition to the velocity of the orbiting electron.

- The radial component of the Autoforce (i.e. along the instantaneous direction that joins the proton with the electron) acts in opposition to the centripetal force exerted by the proton.

- Both the tangential and the radial component of the Autoforce decrease with the orbital radius as $1/r^2$.

- For the orbiting speeds considered plausible in the Hydrogen atom, the Autoforce is many orders of magnitude smaller than the proton force. Therefore *in the following analysis of the electron orbits of the Hydrogen atom the Autoforce will be ignored.*

- The relation $|F_R/F_T|$ (between the radial and the tangential components of the Autoforce) decreases as the orbital speed v_e increases. ($|F_R/F_T|$ is approximately equal to 1 for $v_e = 0.066c$).

- The strength of both components of the Autoforce (and hence of the net Autoforce itself) increases with the orbital speed v_e. At high speeds v_e, the increase becomes very sharp (e.g. for v_e in the interval {0.01c, 0.1c} the Autoforce increases approximately as $k\,v_e^7$).

(3) **The aether Drag-force.**

This is the aetherinical force suffered by a material particle that moves relative to the aether. The evaluations (see Section 2 of this work) show that the force exerted by the aether on a material particle that moves at a velocity **u** relative to the aether as a whole (or more precisely relative to the reference frame in which the local aether can be considered at rest) can be approximated by:

[10-40] $\mathbf{F}_{DRAG} = -K\,\sigma_I\,\mathbf{u}$ for $u \ll$ (average speed of the aetherinos of the aether)

Note: considering that the average speed of the aetherinos of the aether is plausibly several orders of magnitude bigger than the speed of light c, it can be shown that the expression [10-40] is a good approximation for u smaller than, say, a few times c.

K is a constant (independent of the kind of particle or body suffering the drag-force).

σ_I is the average “impulsion cross section” of the particle to collisions with the aetherinos.

If the body suffering the aether drag force is made of many elementary particles then the model shows that the cross section σ_I of [10-40] is given by:

[10-41] $\sigma_I = n_1\,\sigma_{I1} + n_2\,\sigma_{I2} + n_3\,\sigma_{I3} + \ldots$

where the n_i are the number of elementary particles of the type “i" and cross section σ_{Ii} composing the body.

But according to the model, the mainstream concept of *inertial mass* of a body is proportional to its total cross section σ_I. That is so because, according to the model, the acceleration acquired by a material body when it suffers a given aetherinical force is inversely proportional to the number N of Simple Particles ultimately composing the body and, on its turn, this number N is assumed to be proportional to the total average cross section σ_I of the body. Therefore it can be written:

[10-42] $m = k\,\sigma_I$

and

[10-43] $\mathbf{F}_{DRAG} = -K\,\sigma_I\,\mathbf{u} = -K\,m/k\;\mathbf{u}$ (for u not much bigger than c)

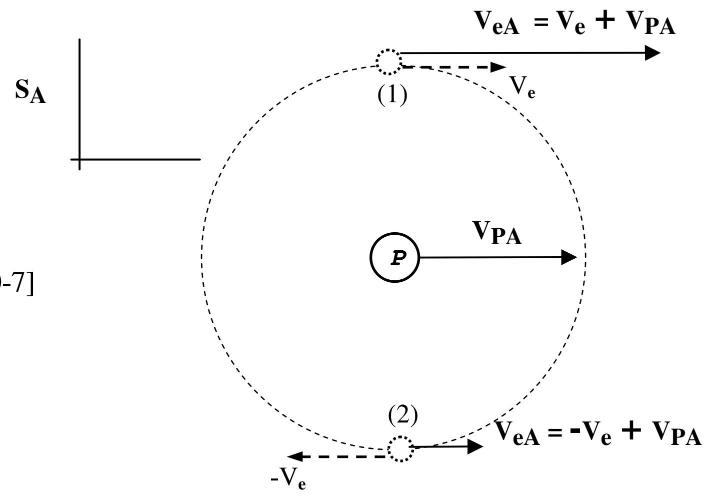
where m is the inertial mass of the body and k is a constant independent of the nature of the body with the following proviso-warning:

NOTE: many elementary particles are believed to have some internal structure due to which their cross section varies with the direction from which it is collided by the aetherinos. There is also the possibility that in some aggregations of elementary particles (e.g. in nuclei) the component particles are so close to one another that they partially screen each other from aetherino collisions. For those reasons the expression [10-41] is not always strictly correct and the inertial mass of a composite particle will be by the moment be considered to be proportional to the average cross section of the particle (averaging now over all directions of space) and taking into account the possible screening of its components.

If the atom of Hydrogen as a whole, or more precisely the proton, is at rest in the aether then it is evident that the electron (whose velocity is $\mathbf{v}_e$) will suffer at all epochs an aether Drag force equal to $\mathbf{F}_{De} = -K\,\mathbf{v_e}$ Therefore in all the positions of the electron along its circular orbit, the modulus of this force will be Kv_e and its semi-direction will be opposite to that of the electron’s velocity.
It has been found in the simulations (see the Annex A) that a fully closed and stable electronic orbit is only possible if the *aether drag force* has a non-zero value that cancels the *forward force* (tangential component of the proton force as explained above). The model predicts the existence of only one strictly closed orbit. But if the orbital speed of the electron is not too fast (e.g. $v_e < 0.005c$) it can be seen that the orbital radius decreases very slowly and therefore at those discrete set of radii (described above) at which the force suffered by an electron does not oscillate it can be said that the orbits are only quasi-stable.

If the atom (or more precisely the proton) is moving relative to the aether then one is tempted to think that the aether Drag force will impede the electron to follow a circular orbit (relative to the proton) since the speed of the electron relative to the aether will be different at different positions of its orbit. See Fig[10-4].

Fig [10-7]



In solid-line vectors the velocities *relative to the aether* of the proton ($\mathbf{v}_P$) and of the electron in two positions, (1) and (2), of its orbit.

But consider the following:
Let S_A be the reference frame in which the local aether can be considered to be at rest.
Let $\mathbf{v}_{PA}$ be the velocity of the proton relative to S_A (i.e. relative to the aether).
Let $\mathbf{v}_{eA}$ be, at some given epoch, the velocity of the electron *relative to* S_A and
Let $\mathbf{v}_e$ be the velocity of the electron *relative to the proton* at that epoch. Therefore:

[10-44] $\mathbf{v}_e = \mathbf{v}_{eA} - \mathbf{v}_{PA}$

Let S be the reference frame associated with the proton.

Due to the aether drag-force (see [10-43]) the proton suffers a force:

[10-45] $\mathbf{F}_{DP} = - K_2 m_P \mathbf{v}_{PA}$

where m_P is the mass of the proton and K_2 is a constant (equal to the K/k of [10-43]).
Similarly, due to the aether drag-force the electron suffers a force:

[10-46] $\mathbf{F}_{De} = - K_2 m_e \mathbf{v}_{eA}$

In the reference frame S_A, the aether drag force "contributes" to the following *acceleration* of the proton:

[10-47] $\mathbf{a}_{DP} = \mathbf{F}_{DP} / m_P = - K_2 \mathbf{v}_{PA}$

Similarly, in the reference frame S_A, the aether drag force "contributes" to the following *acceleration* of the electron:

[10-48] $\mathbf{a}_{De} = \mathbf{F}_{De} / m_e = - K_2 \mathbf{v}_{eA}$

Therefore (remember that in the Galilean relativity adopted in the description of this model, the relative accelerations simply "add") the acceleration of the electron *relative to the proton* contributed (added) by the aether drag force is (see [10-44]):

[10-49] $\mathbf{a}_{De} - \mathbf{a}_{DP} = - K_2 (\mathbf{v}_{eA} - \mathbf{v}_{PA}) = - K_2 \mathbf{v}_e$

which is the same acceleration that would contribute the aether drag force on the electron if the atom (i.e. the proton) was at rest in the reference frame S_A of the aether. In other words (as far as the proton's redistribution (and hence its force on the electron) does not change significantly with the absolute velocity of the atom), the atomic electron behaves in the same way whether the atom is at rest on the aether or moving relative to it at some speed v_P (that must not be much bigger than c so that [10-43] is a good approximation).

NOTE: In the Section 3 of this work, this "principle of relativity" was invoked in a more general way including not only the aether drag force but also the gravitation force as follows:

Floating reference system.

Suppose a neutral body B, with mass, "floating freely in space". This must be understood as meaning that the body B is acted by (1) the gravitation force due to the rest of the bodies of the universe and (2) by the aether drag force due to its speed relative to the reference frame in which the aether can be considered at rest (i.e. due to its absolute speed), but the body B is not acted by any other force (e.g. radiation forces, electric or magnetic forces, cosmic radiation, etc…)

Suppose next a small region R of space that "moves" with B (e.g. having at all epochs the body B at its center). The region R can be considered defined by the space contained within some imaginary walls. Suppose that the mass of B is so small that it has a negligible gravitational influence on any other test body that might be placed inside R or, better still, suppose that the body B, that has only been invoked to define the "floating" of R in space, is removed from R. The floating region R must be small enough so that all its parts suffer approximately the same gravitational influence from the exterior bodies of the universe.

The floating region R will be said to define a "floating reference system" during a given time interval Δt if, during such time interval, the region does not rotate noticeably relative to the *rectilinear* reference frames.

It can then be asserted that any neutral body B', with mass, placed inside R at rest relative to its walls will remain at rest (relative to R).

The reason is that the only forces acting on B' are the gravitational force (from the other bodies of the universe) and the aether drag force (due to its absolute speed through the aether) and both forces are directly proportional to the mass of a body. And therefore any body B' (with mass and initially at rest in R) will suffer the same acceleration **a** (relative to a rectilinear reference frame) suffered by the body B used to define the floating reference frame R.

(Note: according to the model, both the gravitation force and the aether drag force are proportional to the total cross section to aetherino collisions of the body target of the force. Hence, assuming that the Simple particles composing the body do not screen themselves, the gravitation force and the aether drag force are proportional to the number of Simple Particles composing the body target of the force. In a more generic way, it can be said that the mass of a body is directly proportional to its "quantity of matter").

But if a body A, with mass, is placed inside R with an initial velocity $\mathbf{V}_{RA}$ relative to R, the body A will suffer a different aether drag force than a body B at rest in R. (It will be supposed by the moment that the gravitation force suffered by a body due to the attraction of another body with mass (e.g. the gravitation force suffered by A or B due to the other bodies outside R) does not depend on the relative speed of the gravitationally interacting bodies.

Consider what happens from the point of view of the rectilinear reference frame S in which the aether can be considered at rest. Suppose that the velocity, *relative to* S, of the region R is $\mathbf{V}_R$. Therefore the body B (at rest in R) will be suffering an aether drag force $\mathbf{F}_{DB} = - m_B\, k\, \mathbf{V}_R$ (where m_B is the mass of B). The body A will be suffering an aether drag force $\mathbf{F}_{DA} = - m_A\, k\, (\mathbf{V}_R + \mathbf{V}_{RA})$ (where m_A is the mass of A). The gravitation forces (due to the massive bodies outside R) suffered respectively by B and A will be: $\mathbf{F}_{GB} = m_B\, K\, \mathbf{g}$ and

$\mathbf{F}_{GA} = m_A K \mathbf{g}$ where the vector **g** is the same at both bodies and depends on the distribution of masses, relative to R, of the exterior bodies of the universe. Due to those forces, the accelerations (observed in the absolute reference frame S) of the bodies B and A are respectively:

$$\mathbf{a}_B = (\mathbf{F}_{DB} + \mathbf{F}_{GB})/m_B = -k\,\mathbf{V}_R + K\,\mathbf{g}$$

$$\mathbf{a}_A = (\mathbf{F}_{DA} + \mathbf{F}_{GA})/m_A = -k\,(\mathbf{V}_R + \mathbf{V}_{RA}) + K\,\mathbf{g}$$

and (in the "Galilean absolute-time" scenario of the model) the acceleration of the body A relative to B and hence relative to the floating reference frame R is therefore:

$$\mathbf{a}_R = \mathbf{a}_A - \mathbf{a}_B = -k\,\mathbf{V}_{RA}$$

i.e. in other words, a body A with mass, set with an initial velocity **V** in a floating reference frame, behaves in the same way as if it were moving with a velocity **V** relative to the absolute reference frame in which the aether can be considered at rest. The laws of mechanics are therefore the same in any floating reference system and equal to the laws of mechanics valid in the absolute reference frame associated with the aether at rest. This equivalence between the floating reference systems of the model is similar to the equivalence between the *inertial* reference systems of mainstream Physics (or more precisely of General Relativity). But the model predicts that: (1) a body set at an initial velocity **V** relative to a floating reference system does not maintain that speed V but slows down according to an exponential law, independent of its mass, that will be shown below, and (2) a reference system that moves at constant velocity relative to a "floating reference system" is not a floating reference system.

In another section of this work it is shown that, supposing a nucleus at rest in the absolute reference frame, closed orbits of electrons around such nucleus are possible precisely due to the contribution of the aether drag force suffered by the electron (i.e. the electric attraction force exerted by the nucleus on the electron is by itself unable to predict a closed orbit). Now it can be expected that the same stable electronic orbits (and hence the same atoms) will be possible in all "floating reference systems".

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