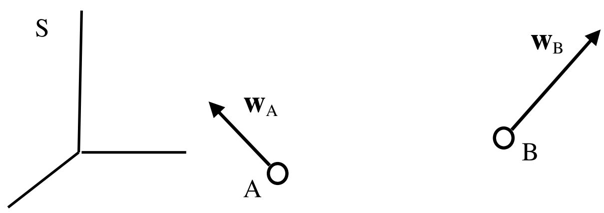
Annex A

In the first part of this Annex an expression will be obtained for the aetherinical force suffered at the epoch T by an elementary particle B due to the presence of another elementary particle A. No restrictions will be imposed here on the movement of A. Therefore the expression obtained will be more general than the one deduced in Section 5 (in which the body causing the force was at all times at rest in the description reference frame). The expression obtained will be used, in the second part of this Annex, to deduce an expression of the aetherinical force suffered at a given epoch T by a particle B describing a circular orbit due to the action of B *itself*. This force that will be called "Autoforce" is the result of the impulses of those aetherinos that having "emerged" from B in the past, arrive again to the moving B at the epoch T. Notice that in a rectilinear reference frame these aetherinos travel from one point of the orbit to another following straight lines.

Let S be the rectilinear reference frame used for the description. As has been said, for the Ideal observer IO, all the aetherinos move at constant velocities in the rectilinear frames.



Fig[A-1]

Consider 1st the aetherinos that emerging from A at a given epoch t_E arrive at B at the observation epoch T :
Let $\mathbf{v}$ be the velocity in S of these aetherinos that emerging from A at a given epoch t_E arrive to B at the (later) epoch T.
Let $\mathbf{w}_A$ be the velocity of A in S at the epoch t_E .
Let $\mathbf{v}_E$ be the velocity of the selected aetherinos "relative to A" , or more precisely, relative to the rectilinear reference frame associated with A at the epoch t_E of their emergence (because at an earlier or at a later epoch, the particle A may have another velocity). Therefore:

[A-1] $\mathbf{v}_E = \mathbf{v} - \mathbf{w}_A$ or more explicitly $\mathbf{v}_E = \mathbf{v} - \mathbf{w}_A[t_E]$

The aetherinical force exerted on B (at the epoch T) by these aetherinos will be calculated (like in preceding sections) from the knowledge of their number density in the vicinity of B at this epoch T.

This density may on its turn be deduced from the knowledge of how many aetherinos of the pertinent type emerge from A at the epoch t_E and from the calculus of their "spread" at the epoch T when they pass by the position of B. This spread depends on its turn on the *distance* δ *travelled by the aetherinos relative to* A, or more precisely, on the distance travelled (between t_E and T) in the rectilinear frame *associated with* A at the epoch t_E of their emergence, being

[A-4] $\delta = v_E \cdot (T - t_E)$

To calculate such density of the pertinent aetherinos in the vicinity of B at the epoch T , it will be assumed that the redistribution r[vE] that emerges from A is *independent* of the movement of A relative to its local aether. (This "principle of relativity" can be seen to be approximately valid only for absolute speeds of a the redistributing particle not much bigger than a few times the speed of light c). Furthermore in this first example of deduction of the force it will also be supposed that the redistribution of A is *isotropic* relative to A (i.e. in the reference frame of A emerges in all directions the same redistribution of aetherinos). An expression of the wanted force could also be deduced supposing that from A emerges a redistribution of aetherinos that is not isotropic but such complication is here out of context and would only distract from the present purpose of explaining the general features of this model of the aether.

Let $r[v_E]\, dv_E$ = redistribution of aetherinos created by the particle "source" of the force (in this case A) = excess (or deficit) of aetherinos with speeds relative to A in the interval $\{v_E, v_E + dv_E\}$ that "emerge" from A in unit time and by unit solid angle. (Note: since the new version of the model asserts that there are two "types" of aetherinos in the aether (p-type and n-type), it must here be understood the redistribution $r[v_E]$ refers only to the type of aetherinos that are able to impulse the target particle B). (See the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf for an analysis of the redistributions of aetherinos proposed by the model)

Remember in what follows that the speeds v_E and the travelled distances δ are referred to the "rectilinear" reference frame defined by A at the epoch t_E.
The calculus of the force suffered at the epoch T by the particle B will be done adding the contributions of the pertinent aetherinos emerged from A at all epochs t_E earlier than T. To find the contribution (to the force) of the aetherinos emerged from A during a time interval $\{ t_E, t_E + dt_E \}$ it will first be deduced the number-density of those aetherinos at the position of B at the epoch T.
Imagine for simplicity that all the aetherinos emerged from A during the infinitesimal time interval $\{ t_E, t_E + dt_E \}$ do actually depart A instantly at the beginning of such interval.
At the epoch T, those aetherinos (emerged from A during the time interval $\{t_E, t_E + dt_E\}$) that have crossed *a sphere* of radius δ centred at the position of A (at t_E) are

[A-5] $$N_\delta = 4\pi\, dt_E \int_{\frac{\delta}{T-t_E}}^{\infty} r[v_E]\, dv_E$$

Those that have crossed a sphere of radius $\delta+\Delta\delta$ centred at the position of A (at t_E) are

[A-6] $$N_{\delta+\Delta\delta} = 4\pi\, dt_E \int_{\frac{\delta+\Delta\delta}{T-t_E}}^{\infty} r[v_E]\, dv_E$$

Therefore those that at the epoch T, of observation of the force, are *between* the 2 spheres are:

[A-7] $$N = N_\delta - N_{\delta+\Delta\delta} = 4\pi\, dt_E \int_{\delta/(T-t_E)}^{(\delta+\Delta\delta)/(T-t_E)} r[v_E]\, dv_E$$

Considering that the region of interest (for the calculus of the density of the pertinent aetherinos and of the "instantaneous" force $\mathbf{F}_{AB}$) is an infinitesimal volume swept by B at the epoch T then it can be assumed that $\Delta\delta << \delta$, and, since a typical redistribution $r[v_E]$ is expected to vary smoothly with v_E, the integral [A-7] can be approximated by:

[A-8] $$N \cong 4\pi\, dt_E\, r[v_{E\ min}]\,(v_{E\ Max} - v_{E\ min}) \equiv 4\pi\, dt_E\, r[\delta/(T-t_E)]\left(\frac{\delta+\Delta\delta}{T-t_E} - \frac{\delta}{T-t_E}\right) =$$
$$= 4\pi\, dt_E\, r[\delta/(T-t_E)]\,\frac{\Delta\delta}{T-t_E}$$

The volume between both spheres is:

[A-10] $\mathrm{Vol} = 4\pi/3\,((\delta+\Delta\delta)^3 - \delta^3)$

that for $\Delta\delta << \delta$, neglecting the terms on $\Delta\delta^3$ and on $\Delta\delta^2$, can be approximated by

[A-11] $\mathrm{Vol} \cong 4\pi\, \delta^2\, \Delta\delta$

Finally the density (number per unit volume) of the pertinent aetherinos (those that emerged A during $\{t_E, t_E + dt_E\}$ and are at the epoch T in the vicinity of B) is:

[A-12] $$d\rho = \frac{N}{\mathrm{Vol}} = \frac{r\left[\dfrac{\delta}{T-t_E}\right]}{\delta^2\,(T-t_E)}\, dt_E$$

that using [A-4] can be written as:

[A-12b] $$d\rho = \frac{N}{\mathrm{Vol}} = \frac{r[v_E]}{v_E^{\,2}\,(T-t_E)^3}\, dt_E$$

When later integrating for all epochs t_E to find the force suffered by B at the epoch T, the speed v_E (of the pertinent aetherinos relative to A) will have to be expressed as a function of t_E and T. For example if the law of movement of A in the reference frame S is given by some known function $\mathbf{p}_A(t_E)$ (where the letter **p** stands for "position vector") then, see Eq[A-1]:

[A-14] $$v_E = |\mathbf{v} - \mathbf{w}_A| = \left|\frac{\mathbf{p}_B[T] - \mathbf{p}_A[t_E]}{T-t_E} - \left[\frac{\partial\,\mathbf{p}_A[t]}{\partial t}\right]_{t_E}\right|$$

Let $\mathbf{w_B}$ be the velocity of B in the reference frame S at the epoch T.
Let $\mathbf{v_R}$ be the velocity of the pertinent aetherinos *relative to the target B* at the epoch of observation T.

Recalling that $\mathbf{v}$ is the name given above to the velocity in S of the aetherinos that emerging from A at a given epoch t_E arrive to B at the (later) epoch T, then

[A-15] $\mathbf{v_R} = \mathbf{v} - \mathbf{w_B}$ or more explicitly $\mathbf{v_R} = \mathbf{v} - \mathbf{w_B}[T]$

The contribution of the presence of A during $\{t_E, t_E + dt_E\}$ to the aetherinical *force* acting on B at the epoch T can then be calculated as follows:

Let σ_B be the cross section to impulsion collisions with aetherinos of the particle B.

Since the pertinent aetherinos have a speed v_R relative to B and since their density in the vicinity of B is the $d\rho$ (of [A-12]), then the number of pertinent aetherino collisions suffered by B in unit time is

[A-16] $dn = \sigma_B \, v_R \, d\rho$

Each of these collisions contributes by definition (according to the model) with an "aetherinical impulse":

[A-17] $\mathbf{i_1} = h_1 \, \mathbf{v_R}$

The aetherinical force (net aetherinical impulse in unit time) due to these collisions being considered is:

[A-18] $d\mathbf{F} = \mathbf{i_1} \, dn = h_1 \, \mathbf{v_R} \, \sigma_B \, v_R \, d\rho$

The total aetherinical force suffered by B at the epoch T due to the aetherinos emerging from A in "all" passed epochs (and whose speed is such that they reach B at the epoch T) is:

[A-19] $$\mathbf{F}[\tau] = \int_{t_E = -\infty}^{t_E = T} d\mathbf{F} = h_1 \int_{-\infty}^{T} \sigma_B \, v_R \, \mathbf{v_R} \, d\rho$$

The cross section σ_B (to aetherino collisions) of the target particle B has been placed *inside* the integral because such cross sections normally depend on the speed v_R of the colliding aetherinos relative to the particle (see for example the Annex to Section 11 of this work). On its turn, the speed v_R of the *pertinent* aetherinos relative to the particle B (i.e. those emerged from the source at the epoch t_E) depends on t_E and T.

Making explicit the time dependencies:

[A-20] $$\mathbf{F}[T] = h_1 \int_{-\infty}^{T} \frac{\sigma_B \; v_R[t_E,T] \; \mathbf{v}_R[t_E,T] \; r[v_E[t_E,T]]}{v_E^{\,2}[t_E,T] \; (T - t_E)^3} \, dt_E$$

where in terms of their position vector time-functions:

[A-21] $$\mathbf{v_R} = \mathbf{v} - \mathbf{w}_B[T] = \frac{\mathbf{p}_B[T] - \mathbf{p}_A[t_E]}{T - t_E} - \left[\frac{\partial\,\mathbf{p}_A[t]}{\partial\,t}\right]_{t_E}$$

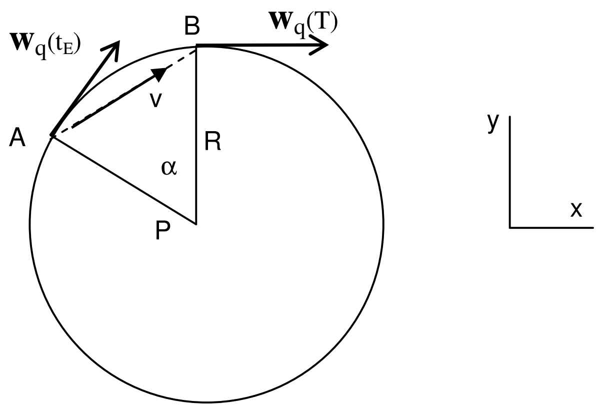
[A-22] $$v_R = \left|\mathbf{v} - \mathbf{w}_B[T]\right| = \left|\frac{\mathbf{p}_B[T] - \mathbf{p}_A[t_E]}{T - t_E} - \left[\frac{\partial\,\mathbf{p}_A[t]}{\partial\,t}\right]_{t_E}\right|$$

Autoforce.

It can be defined as the aetherinical force suffered at a given epoch by a body *q* due to the action of those aetherinos emerged in the past (i.e. in all earlier epochs in which *q* has existed) from *q* itself. This will happen in limited cases (see below) and it will not happen if the body *q* is at rest or moving with a constant velocity.

Note: From the material body *q* emerges at all epochs a specific distribution of aetherinos that is different from that of the surrounding aether (because the material particles redistribute the aetherinos that collide with them) and therefore is able to produce aetherinical forces on other bodies including, in some cases, the body *q* itself. In fact, if, in a rectilinear frame, *q* describes a curved or a zigzag trajectory, it will continuously receive impacts of aetherinos that emerged from *q* itself when it was passing through earlier positions. (The aetherinos travel in the rectilinear frames with constant velocities that can have any value).
Consider the case in which the body *q* is following a circular orbit of radius R and centred at P. (The orbit is circular in the rectilinear reference frame associated to P).
Let w_q be the speed of *q* in its orbit. Suppose that this orbiting speed w_q remains constant at all epochs.

Suppose that at the epoch T at which the Autoforce is going to be evaluated the particle *q* is in the position B (Fig A-26).



Fig[A-26]

Fig [A-26] represents the positions and velocities needed to calculate the contribution to the autoforce of those aetherinos that emerged from *q* itself at an earlier epoch t_E when *q* was passing by position A. The equation [A-20] is valid for this calculus having in mind that the role of A used to obtain [A-20] is now played by *q* itself at the earlier epochs t_E.
At the epoch t_E the angle α subtended by APB is given by:

[A-28] $$\alpha[t_E] = \frac{s[t_E]}{R}$$

where $s[\tau_E]$ is the arc travelled by *q* between the epochs t_E and T.
Therefore from [A-24,25]

[A-29] $$s[t_E] = w_q\ (T - t_E)$$

The Autoforce will be analysed in two components x and y that are taken respectively tangent and perpendicular to the orbit at its point B.
The velocity **v** appearing in [A-20] (see also [A-21,22]) was defined at the beginning of this Annex as the velocity (in the reference frame S) of those aetherinos that emerging at a given epoch τ_E from the particle "source" of the force, arrive to the target particle (*q* itself in this case) at the (later) epoch T. Therefore (see Fig[A-26]) :

[A-30] $$\mathbf{v} = \frac{AB}{T - t_E}$$

has the components:

[A-31] $$v_X = \frac{R \operatorname{Sin} \alpha}{T - t_E} \qquad\qquad v_Y = \frac{R\,(1 - \operatorname{Cos}\alpha)}{T - t_E}$$

The components of $\mathbf{w_q}\,[t_E]$ are:

[A-32] $$\begin{aligned} w_{qX}\,[t_E] &= w_q \ \operatorname{Cos} \alpha \\ w_{qY}\,[t_E] &= w_q \ \operatorname{Sin} \alpha \end{aligned}$$

The components of $\mathbf{w_q}\,[T]$, considering that the X and Y axes are respectively the tangent and the perpendicular (to the orbit) at **this** epoch T of observation, are

[A-33] $$\begin{aligned} w_{qX}[T] &= w_q[T] = w_q \\ w_{qY}[T] &= 0 \end{aligned}$$

The two components of the **Autoforce**, see [A-20] are

[A-34] $$F_X[T] = h_1 \int_{-\infty}^{\tau} \frac{\sigma_q\, v_R[t_E,T]\ v_{RX}[t_E,T]\ \ r[v_E[t_E,T]]}{v_R{}^2[t_E,T]\ (T - t_E)^3}\, dt_E$$

[A-35] $$F_Y[T] = h_1 \int_{-\infty}^{\tau} \frac{\sigma_q\, v_R[t_E,T]\;\; v_{RY}[t_E,T]\;\; r[v_E[t_E,T]]}{v_R^{\,2}[t_E,T]\;\;(T-t_E)^3}\, dt_E$$

where, using above equations and remembering that the role of the source particle (particle A in [A-21,22]) is now played by *q* itself:

[A-36] $$v_{RX} = v_X - w_{qX}[T] = \frac{R\,\mathrm{Sin}\,\alpha}{T-t_E} - w_q$$

[A-37] $$v_{RY} = v_Y - w_{qY}[T] = \frac{R\,(1-\mathrm{Cos}\,\alpha)}{T-t_E}$$

[A-38] $$v_R = (\, v_{RX}^{\,2} + v_{RY}^{\,2})^{\,1/2}$$

[A-39] $$v_E^{\,2}[t_E,\, T] = v_{EX}^{\,2} + v_{EY}^{\,2} = (v_X - w_{qX}[t_E])^2 + (v_Y - w_{qY}[t_E])^2 =$$

$$= (\frac{R\,\mathrm{Sin}\,\alpha}{T-t_E} - w_q\;\mathrm{Cos}\,\alpha)^2 + (\frac{R\,(1-\mathrm{Cos}\,\alpha)}{T-t_E} - w_q\;\mathrm{Sin}\,\alpha)^2$$

and where the α dependency on time (that must be accounted for in the integration) is:

[A-40] $$\alpha \equiv \alpha[t_E] = \frac{s[t_E]}{R} = \frac{(T-t_E)\,w_q}{R}$$

For example, in the case of an electron orbiting a proton, the net force acting on the electron at a given epoch T, is the vector sum of the electron "Autoforce", whose components are given in [A-34,35], and the centripetal force of the proton, whose components may be deduced from [A-20..] . Care must be taken in the use of the redistribution $r[v_E]$ appearing in the above equations since this $r[v_E]$ is not the same for the electron and the proton. The simplest plausible choice is (see Section 1) to take both residual distributions as equal but of opposite sign, i.e. $r_P[u] = - r_q[u]$.

Notes: It can be seen in the evaluations http://www.eterinica.net/EVAANA/AOE.nb that only the very recent past of the electron (i.e. 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. the x-component in the above calculus) acts in opposition to the velocity of the orbiting electron.

- The radial component of the Autoforce (i.e. the y-component in the above calculus) acts in opposition to the centripetal force exerted by the nucleus.

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

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

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

Equations for a central force in 3D.

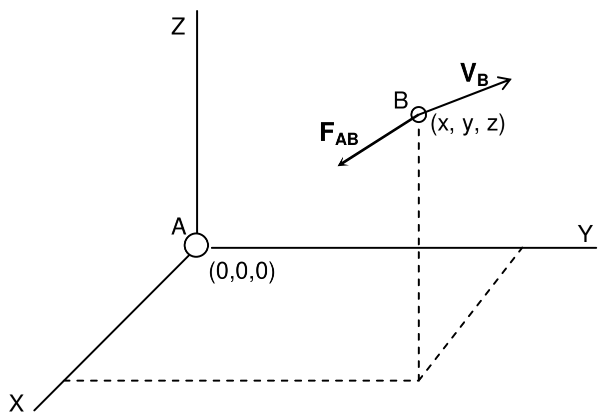


Fig [A-70]

Consider a system made of two charged particles A and B. Let A be much more massive than B (e.g. A is a proton and B is an electron). Let the reference frame of description be associated with the body A. It will be assumed that this reference frame is a “rectilinear reference frame” (in which the aetherinos travel in straight lines at constant speeds). This assumption is a reasonable approximation considering that the body A (due to its much greater mass) will suffer, due to the force F_{BA}, negligible accelerations compared to those suffered by the body B due to the force F_{AB}. (Note: a more strict but more complicated assumption would be to consider the centre of mass system to be the rectilinear reference frame).

The first goal of the present calculus is to deduce the force $\mathbf{F}_{AB}$ suffered by B as a function of its velocity $\mathbf{V_B}$ and its position in the reference frame of description.
By the moment it will also be supposed that (1) A is at rest in the aether, and (2) the aetherinical redistribution of A is the same in all directions (the particle A has no preferential axis of redistribution). With those suppositions, due to symmetry, the force $\mathbf{F}_{AB}$ should only depend on the distance AB and on the velocity of B *relative to* A. Nevertheless the system of coordinates chosen for the description will be the standard 3D Cartesian system due to its simplicity (in spite that a more natural choice in this case would be a polar coordinate system). The body A is supposed to be located at all epochs at the origin of coordinates (0,0,0) while the body B (at the epoch of determination of the force $\mathbf{F}_{AB}$) is supposed to be passing the generic position (x,y,z) with the generic velocity (V_{BX}, V_{BY}, V_{BZ}).

Since in this example the aetherinical redistribution that originates the force does not change with time, it is simpler to integrate for all the pertinent aetherinos in consideration of their *speed* instead of their emission epoch.

In the vicinity of B, the *density* of aetherinos with speeds in the interval {v, v+dv} that have been redistributed by A is:

[A-71] $$d\rho[v] = \frac{r_A[v]}{v\,D^2}\,dv$$

where:
$d\rho[v]$ is the number of *such* speed {v, v+dv} aetherinos in unit volume at the vicinity of B.
$r_A[v]$ is the redistribution caused by A, i.e. the excess/deficit number of speed v aetherinos "emerging" from A by unit time, by unit speed interval and by unit solid angle.

In the reference frame chosen for the description (associated with A), *the direction* of all the *velocities* of the aetherinos that, coming from A, collide with B at any given epoch is equal to the direction AB of the vector joining A and B at that given epoch.
The expression [A-71] of the density of aetherinos should be evident considering that, according to the definition of $r_A[v]dv$ as a flux *by unit solid angle*, $r_A[v]dv/D^2$ is the number of aetherinos (of speeds in {v, v+dv}) crossing in unit time (at all epochs) a unit area surface oriented perpendicular to their velocity and located at a distance D from A. The number of aetherinos of speed (approximately) v having crossed such unit surface in a unit time interval can therefore be found in an imaginary cylinder of base 1 and length v whose volume 1*v has therefore a magnitude equal to that of the speed v.

When an aetherino proceeding along the semi direction AB collides with B it gives to this particle an *aetherinical impulse* $h_1\,\mathbf{v_R}$ where $\mathbf{v_R} = \mathbf{v} - \mathbf{V_B}$ is the velocity of the aetherino *relative to B*. Therefore for an aetherino of speed v, the Cartesian components of this elementary aetherinical impulse are (see Fig[A-70]):

[A-72] $$\begin{aligned} i_X &= h_1\,(\mathbf{v} - \mathbf{V_B})_X = h_1\,(v_X - V_{BX}) = h_1\,(v\,x/D - V_{BX}) \\ i_Y &= h_1\,(\mathbf{v} - \mathbf{V_B})_Y = h_1\,(v_Y - V_{BY}) = h_1\,(v\,y/D - V_{BY}) \\ i_Z &= h_1\,(\mathbf{v} - \mathbf{V_B})_Z = h_1\,(v_Z - V_{BZ}) = h_1\,(v\,z/D - V_{BZ}) \end{aligned}$$

where it has been acknowledged that when the particle B is at the position (x,y,z) the components of the velocity $\mathbf{v}$ of an aetherino traveling along AB are:

$$[A\text{-}73] \quad \begin{aligned} v_X &= v\,x/D \\ v_Y &= v\,y/D \\ v_Z &= v\,z/D \end{aligned}$$

Notice also that the components of the velocity $\mathbf{v_R}$ of an aetherino relative to B are ($v\,x/D - V_{BX}$, $v\,y/D - V_{BY}$, $v\,z/D - V_{BZ}$) and therefore the modulus v_R of such relative velocity is:

$$[A\text{-}74] \qquad v_R \equiv |\mathbf{v}_R| = ((v\,x/D - V_{BX})^2 + (v\,y/D - V_{BY})^2 + (v\,z/D - V_{BZ})^2)^{1/2}$$

The number of collisions in unit time between B and the pertinent aetherinos (those whose density is given in [A-71]) can again be calculated considering that *in the specific reference frame where these pertinent aetherinos (of velocity* **v***) are at rest* the particle B of cross section σ_B sweeps in unit time a cylindrical volume of length v_R. Hence this rate of collisions is:

$$[A\text{-}75] \qquad dY_v = \sigma_B\, v_R\, d\rho[v] = \sigma_B\, v_R \frac{r_A[v]}{v\,D^2}\, dv$$

The aetherinical impulse given to B by all these collisions occurring *in unit time* has therefore the components:

$$[A\text{-}76] \qquad \begin{aligned} dF_X(v) &= i_X\, dY_v = h_1 (v\frac{x}{D} - V_{BX})\, \sigma_B\, v_R \frac{r_A[v]}{v\,D^2}\, dv \\ dF_Y(v) &= i_Y\, dY_v = h_1 (v\frac{y}{D} - V_{BY})\, \sigma_B\, v_R \frac{r_A[v]}{v\,D^2}\, dv \\ dF_Z(v) &= i_Z\, dY_v = h_1 (v\frac{z}{D} - V_{BZ})\, \sigma_B\, v_R \frac{r_A[v]}{v\,D^2}\, dv \end{aligned}$$

where v_R is given in [A-74] and the distance D is equal to:

$$[A\text{-}77] \qquad D = (x^2 + y^2 + z^2)^{1/2}$$

The components of the aetherinical force $\mathbf{F_{AB}}$ are finally obtained adding for the *pertinent* aetherinos of *all* speeds.

For example if it is supposed that the above expression of the elementary aetherinical $\mathbf{i}_1 = h_1\, \mathbf{v_R}$ is true whatever the relative speed v_R of the aetherino, then the Cartesian components of the force $\mathbf{F_{AB}}$ would be:

$$[A\text{-}78] \qquad \begin{aligned} F_X &= \int_{v=0}^{v=\infty} dF_X(v) = \frac{h_1}{D^2}\int_0^\infty (v\frac{x}{D} - V_{BX})\, \sigma_B\, v_R \frac{r_A[v]}{v}\, dv \\ F_Y &= \int_{v=0}^{v=\infty} dF_Y(v) = \frac{h_1}{D^2}\int_0^\infty (v\frac{y}{D} - V_{BY})\, \sigma_B\, v_R \frac{r_A[v]}{v}\, dv \\ F_Z &= \int_{v=0}^{v=\infty} dF_Z(v) = \frac{h_1}{D^2}\int_0^\infty (v\frac{z}{D} - V_{BZ})\, \sigma_B\, v_R \frac{r_A[v]}{v}\, dv \end{aligned}$$

where the integration limits include the aetherinos of all speeds.

In the later versions of this model it is supposed that the cross section of an elementary particle of unit electric charge (e.g. an electron or a proton) to aetherino collisions depends on the speed of the aetherinos relative to the particle. Therefore the cross section σ_B appearing in the above equations is a function of the relative speed v_R and hence a function of v. More precisely:
The cross section of an elementary particle of unit electric charge (e.g. an electron or a proton) to aetherino impulsion-type collisions is by hypothesis:

[A-80] $$\sigma_I[v_R] = a_I \ \mathrm{Exp}[-b_I \, v_R^{\,2}]$$

where:
v_R is the speed of the incident aetherino relative to the SP
a_I is a constant with the dimension of area (L^2)
b_I is a constant with the dimension of speed^{-2} ($L^{-2}\,T^2$)

Note: Other expressions for the cross section of a SP to aetherino collisions, like for example $\sigma_I[v_R] = a_I$ $\mathrm{Exp}[-b_I\,(c - v_R)^2]$, have been tested obtaining very similar predictions of the main features of the forces between particles. If the expression [A.80] has instead been postulated is because, with it, the model is able to describe the results of some experiments related with relativistic particles (i.e. of speeds close to c), (see the Section 12 of this work).

Note: To obtain the trajectory (or the "orbit") acquired by the electron B due to the presence of the nucleus A it must be remembered that the electron B is not only acted by the force $\mathbf{F_{AB}}$ (whose components are given in [A-78]) but also by the Autoforce and by the "Aether Drag Force" due to the absolute speed of B relative to the aether. (See the concept of "Aether Drag Force" in the Section 2 of this model).
In fact, if only the force $\mathbf{F_{AB}}$ is taken into account, only spiral trajectories of increasing distance D are obtained. This is because the force $\mathbf{F_{AB}}$ has always a non zero tangential component that tends to increase the speed of the electron. On its turn, this is a consequence that the force $\mathbf{F_{AB}}$ exerted by the nucleus A is vehicled by aetherinos of *finite* speed. But those aetherinos of finite speed are seen by B as coming, not from the simultaneous position of A but, from an advanced position (aberration). If it were the case that from the nucleus A emerged an excess of those finite speed, efficient aetherinos, their tangential component would tend to slow the electron B but in this case of an attraction force there is a *deficit* of those finite speed aetherinos and therefore the unbalanced aetherinos of the local aether tend to increase the speed of B and hence its distance to A.
Therefore a closed stable orbit is only obtained when the drag force (due to the movement of B relative to the aether) cancels the tangential component of the force $\mathbf{F_{AB}}$.
The Autoforce has been found (see http://www.eterinica.net/EVAANA/AOE.nb) to be in general (i.e. for orbits of not too small radius and not too fast orbital speeds) many orders of magnitude weaker than the drag force and that the force F_{AB} and has therefore a negligible influence in the stabilization of the orbit.

Quantitative examples.

It will be supposed by the moment that the charged particle A creates an isotropic redistribution of aetherino speeds that will here be called $r_A[v]$.

In the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf it is asserted that if the body A is an elementary particle of unit charge (e.g. a proton or an electron) it has a cross section to aetherino *switch* collisions (in which the colliding aetherino "switches" its type) given (by hypothesis) by:

[A-82a] $$\sigma_S[v_R] = a_S \, \mathrm{Exp}[-b_S \, v_R{}^2]$$

where:
v_R is the speed of the incident aetherino relative to the SP
a_S is a constant with the dimension of area (L^2)
b_S is a constant with the dimension of speed^{-2} ($L^{-2}\,T^2$)

If the particle A is at rest in an "undisturbed" aether (i.e. in an aether whose distribution of aetherinos is not significantly disturbed by the presence of other bodies) it can be supposed to be bathed by the "canonical distribution" of aetherinos that is given (by hypothesis) by:

[A-82b] $$\rho[v] = \frac{4\,N_0}{\sqrt{\pi}\,V_M{}^3} \, v^2 \, e^{-(v/V_M)^2}$$

It can be assumed that "half" of these aetherinos (i.e. $\rho[v]/2$) are of the type able to suffer "switch-type" collisions with the charged particle A.
If the particle A has a *positive* electric charge it suffers switch-type collisions only with the n-type aetherinos, that it switches into p-type aetherinos.
(If the particle has a *negative* electric charge it suffers switch-type collisions with the p-type aetherinos, that are switched into n-type aetherinos).

Suppose in what follows that A is an elementary particle with unit positive charge (e.g. a proton).

The number of n-type aetherinos of relative speed v_R that collide with a proton by unit time and by unit solid angle can be calculated to give:

[A-82c] $$\phi[v_R] = \sigma_S[v_R] \, \frac{\rho[v_R]}{2} \, \frac{v_R}{4\pi}$$

The redistribution of n-type aetherinos created by a proton consists therefore in a *deficit* of n-type aetherinos.
Since A is assumed to be at rest both in the aether and in the reference frame of description, the speeds v_R relative to A are also speeds relative to the aether and to the reference frame. And since the aetherino speeds relative to the reference frame of description are being called "v" then replacing in [A-82c] $v_R \rightarrow v$, the n-type redistribution created by A is:

$$[A\text{-}82d] \qquad r_A[v] = -\phi[v] = -\sigma_S[v]\,\frac{\rho[v]}{2}\,\frac{v}{4\pi} = -\frac{N_0}{2\pi^{3/2}\,V_M{}^3}\,\sigma_S[v]\,v^3\,e^{-(v/V_M)^2}$$

This n-type redistribution of the proton is the pertinent one to evaluate its force on a target *electron* since the electron does only suffer impulsion-type collisions by the n-type aetherinos.
In what follows it will be supposed that the target particle B is an electron.

Examples:

See also the new paradigms proposed in the section Eve10 related to the Hydrogen atom

- ***Example (1).*** *The particle B moves along the straight line AB.*

See the section "Aetherinical *frontal* force between two elementary particles" in the paper
https://www.eterinica.net/redistribs_eterinicas_en.pdf

- ***Example (2)****.* *The particle B is moving "abeam" A (i.e. the velocity of B is perpendicular to AB).*
See the section "Transversal force exerted by a particle A on a particle B that is moving with a velocity *u* perpendicular to the straight line AB joining the particles" in the paper
https://www.eterinica.net/redistribs_eterinicas_en.pdf

- *Example (3)**.* *An electron B orbiting a proton A.*

Some example simulations have been done. A few of them have been detailed in a *Mathematica 5.1* notebook that can be downloaded right-clicking the following link
http://www.eterinica.net/EVAANA/AOE.nb

(3a) Supposing that the proton's redistribution is *isotropic* (i.e. the same in all its directions).

Evaluations have been made of the trajectory {x(t), y(t), z(t)} followed by the electron B in presence of the aetherinical redistribution created by the proton A. It has been supposed that the redistribution of the proton is of the type [A-82d]. In this case of isotropy of the redistribution created by the proton, only one non-trivially distinct stable (closed) orbit can been found:

NOTE (sketch of the appearance in the evaluations of one fully stable and closed orbit):

In the "EVE" model of the aether, an orbiting electron suffers (1) the electrodynamic force of the nucleus Fn, and (2) the "aether drag force" Fd that opposes its velocity relative to the local aether.

The force Fn exerted by the nucleus is "transported" by finite speed aetherinos of which the most effective in giving impulse to the electron have a speed close to the speed of light c. The aetherinos of speed c are seen by the moving electron to come from the "retarded" position of the nucleus (i.e. their velocity suffers aberration). This implies that an orbiting electron when hit by an aetherino coming from the nucleus suffers an impulse that can be analyzed into two components: (a) a tangential component (tangent to the orbit) that opposes the electron's velocity, and (b) a radial component along the instantaneous (non retarded) position of the nucleus that tends to move the electron straight away from the nucleus.

But the nucleus actually emits a *deficit* of these effective aetherinos of speed close to c. This deficit implies that a given amount of aetherinos coming from the direction of the proton must be subtracted from the total of aetherino collisions, coming from all directions, that will suffer the electron bathed by the aether if the proton was not there. Therefore the mentioned components (a) and (b) actually act in the opposite semi-directions: i.e. the tangential component of Fn tends to accelerate the electron while the radial component of Fn tends to move the electron directly towards the (non retarded) position of the nucleus. (The tangential component Fn is being called the *forward force* in other articles of the model).

The aether drag force increases linearly with the absolute speed of the material bodies. The aether drag force acting on the electron has no radial component since it always acts in opposition to the electron's absolute velocity. (Note: the nucleus also has in general, i.e. in most celestial bodies, a non zero absolute velocity that can somehow be subtracted from the electron's absolute velocity).

Let Fnt and Fnr be respectively the tangential and the radial components of the nucleus-force.
Let Fdt be the tangential component of the drag force.
Let m be the mass of the electron, let v be the orbital speed of the electron, let r be the distance of the electron from the nucleus.

The conditions for a stable "orbit" of the electron are:
A) Fnt = -Fdt (i.e. the tangential components cancel).
B) Fnr = $-(m\ v^2)/r$ (i.e. centripetal force = - centrifugal force)

Fnr can be approximated by a Coulomb force of the type $-k_1/r^2$
Fnt can be approximated by $-(v/c)$ Fnr $= (v/c)\ k_1/r^2$
Fdt can be approximated by $-k_2\ v$

Solving the system of the two equations:
$(v/c)\ k_1/r^2 == k_2\ v$
$k_1/r^2 == (m\ v^2)/r$
gives only one stable circular orbit at $r = (k_1\ c/k_2)^{1/2}$

But many more elliptical orbits are predicted assuming that the deficit of the pertinent aetherinos emerging from the nucleus is not the same in all directions but depends on the direction relative to some internal axis of symmetry of the proton. (This is called "anisotropy of the proton's redistribution of aetherinos").

Note: This is only a qualitative sketch of the capabilities of the model to describe the atomic levels. No claim is being made of having succeeded to make quantitative predictions consistent with the experimental facts.

Therefore in this example of isotropy of the redistribution created by the proton, only one non-trivially distinct stable (closed) orbit can been found. But assuming that the aether drag force is very small, it can be shown that quasi stable orbits (that take a very long time to decay to the strictly stable orbit) can be found for a wide range of atomic radii. This fact together with the paradigm proposed in the paper https://www.eterinica.net/EVE10/Eve10.pdf (that predicts a discrete (quantized) set of allowed stable orbits) is by the moment the main approach to atomic physics made by the model of the aether.

(3b) Supposing that the proton's redistribution along any given direction depends on the angle that such direction makes with a privileged axis of the proton that will be called its preferred redistribution axis (PRA), many hypothesis about the mathematical function describing the redistribution of the proton are possible. For example it may be supposed that its redistribution of aetherinos is stronger by the equatorial directions (relative to the internal structure of the proton) than by its polar directions or it may be supposed that the opposite is true. The experimental facts should decide.

(3b-1) In this first example it will be supposed that the proton has no intrinsic rotation. i.e. that its PRA axis points at all epochs in the same direction of space.
Let φ be the angle that the direction of emergence of the pertinent aetherinos makes with the equatorial plane of the proton (i.e. with a plane that crosses the "centre" of the proton orthogonally to its PRA). The angle φ can therefore be considered a "latitude" angle.
Suppose for simplicity that the proton's redistribution varies in intensity (not in form) as a function only of the angle φ. More precisely, suppose that the proton's anisotropous (and average) redistribution is given, for example by:

[A-90] $$r_P[v] = (Qp + \mathrm{Sin}[\varphi]^2)\ r_A[v]$$

where:
Qp is a numerical constant.
$r_A[v]$ is the isotropous redistribution defined above in [A-82d] (that with a + (plus) sign gives the excess of p-type aetherinos emerging from the proton and with a - (minus) sign gives the deficit of n-type aetherinos emerging the proton).

The redistribution [A-90] can be normalized multiplying it by a factor 3/(1+3 Qp) that allows that the average redistribution over all 3D space directions is $r_A[v]$. Let therefore, the redistribution of the proton be:

[A-90a] $$r_P[v] = 3/(1+3Qp)\ (Qp + \mathrm{Sin}[\varphi]^2)\ r_A[v]$$

Suppose as said above that the proton A remains at all epochs in the position {0,0,0} and suppose (without loss of generality) that the proton's PRA is aligned with the direction z of the reference frame of description.
Therefore an electron that is in the position {x,y,z} is "seen" from the proton at a latitude angle

[A-90b] $$\varphi = \mathrm{ArcSin}[z/D]$$

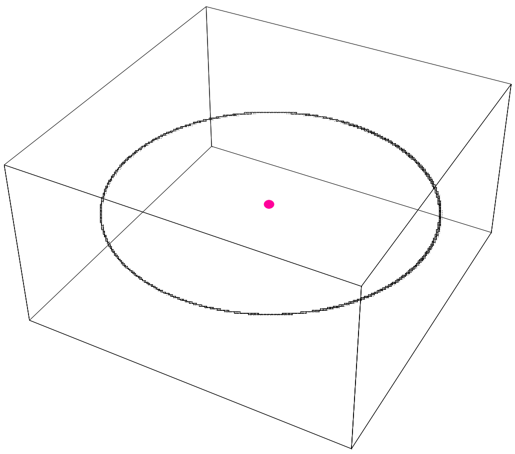
and therefore the proton's redistribution affecting such electron can be rewritten as:

[A-90c] $$r_P[v, z] = 3/(1+3Qp)\ (Qp + \mathrm{Sin}[\mathrm{ArcSin}[z/D]\ ]^2)\ r_A[v] =$$

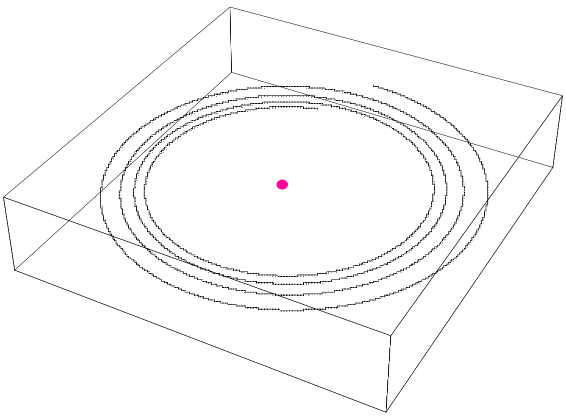
$$= 3/(1+3Qp)\ (Qp + z^2/D^2)\ r_A[v]$$

Here is a brief summary of some observations from the simulations:
- No stable orbits have been obtained assuming that the electron is acted *only* by the proton force (Eqs[A-78]). Assuming only such attraction force, trajectories of *ever increasing distance* to the proton are, in general, obtained.
- Assuming that, together with the proton force, the electron suffers the *aether drag force* tending to decrease its speed (see Section 2 of this work), then, stable (repetitive) orbits have been found. That is consistent with the model since it must be realized that the calculus of the spatial *trajectory* of a particle acted by aetherinical forces must be made taking into account *all* aetherinical influences, including the drag force.

- When the simulations are done assuming that the proton's redistribution has a "moderate" anisotropy with an axial symmetry then some inclined (tilted) and non-trivially different stable orbits can been found.

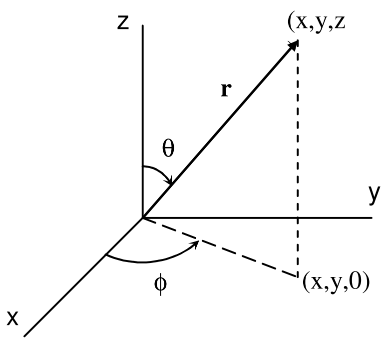


An equatorial "stable" orbit.



A not yet stabilized equatorial orbit

(3c) Supposing that the proton's redistribution at a given epoch and along a given direction **r** depends on the *two* angles that such direction makes with two inner reference directions of the proton structure.



Suppose that at the epoch τ the two reference directions that characterize the proton's inner structure are aligned respectively with the axis z and x of the description reference frame. Let θ and ϕ be the angles that the direction **r** of emergence of the pertinent aetherinos makes respectively with the two reference directions of the proton.
If the direction **r** is that of the position of the electron {x,y,z} and since |**r**|=D

[A-101] $$\theta = \mathrm{ArcCos}\left[\frac{z}{(x^2+y^2+z^2)^{1/2}}\right] = \mathrm{ArcCos}\left[\frac{z}{D}\right]$$

[A-102] $$\phi = \mathrm{ArcCos}\left[\frac{x}{(x^2+y^2)^{1/2}}\right]$$

Intrinsic rotation of the proton in time. It will also be supposed that the two directions that characterize the structure of the proton change in time according to the following:
- The first reference direction of the proton remains aligned at all epochs along the direction Z.
- The second reference direction of the proton remains in the XY plane but rotates with a constant angular speed making an angle with the X axis given by $\alpha(\tau) = 2\,\pi\,\nu\,\tau$. Therefore at the epoch τ, the angle that the projection of **r** on the XY plane makes with the reference direction #2 of the proton is given by

[A-102b] $$\phi(\tau) = \mathrm{ArcCos}\left[\frac{x}{(x^2+y^2)^{1/2}}\right] - 2\pi\nu\tau$$

The dependence of the proton's redistribution on the two angles θ and ϕ should be deduced from some plausible model of the inner structure of the proton according to redistribution paradigms of the type assumed in the Annex D. This "deduction" is postponed and instead the angular dependencies of the redistribution will be postulated to perform some simulations. For example it will be supposed in the simulations that the redistribution of the proton is of the following type:

[A-104] $$R[v,\theta,\phi] = r_A[v]\left(1+a_\theta \mathrm{Cos}[2\theta]\right)\left(1+a_\phi \mathrm{Cos}[2\phi(\tau)]\right)$$

where the constants a_θ and a_ϕ characterizing the anisotropies should be given some values between -1 and $+1$, and where the epoch τ of emergence of the aetherinos of speed v that reach the electron at the observation epoch t when it is at a distance D from the proton is $\tau = t-D/v$

All the calculi of the simulations mentioned here and all the graphical plots have been done with *Mathematica* 5.1 of Wolfram Research. (Wolfram's *Mathematica* is a great tool that has been very useful for these types of evaluations).

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