Version 2.0 Oct 2011, v 2.5 Jul 2013, v 3.0 Feb 2015, v 3.1 Aug 2019, v3.2 Dic2019, v3.6 Aug 2020 (added some comments)

Abstract

The thesis of this paper is that the force of gravitation is a residual effect of the not fully balanced electrodynamic forces between the elementary particles composing the “electrically neutral" material bodies.

<u>Force between neutral bodies.</u> <u>Gravitation.</u>

Note: the forces between electrically charged particles of whatever relative velocity will be indistinctly called electric or electrodynamic. The term “electrostatic force” (the one described in Physics by Coulomb’s law) will be reserved, as is usual, for those cases of the electric force in which the interacting particles are at rest relative to one another.
An ordinary material body is ultimately composed by electrons, protons and neutrons. A body may be called “electrically neutral” when adding the electric charges (some of which are positive, some negative and some zero) of all its constituent elementary particles the sum is zero. If all the charged elementary particles of a neutral body were at rest (relative to the body itself) then the body would exert no net force on another similar neutral body because the forces (given in this scenario by the Coulomb force) exerted by the charged particles of the first body on the charged particles of the second body would exactly cancel. But according to the model the force between two charged particles also depends on the *relative velocity* of these particles and therefore, considering that in normal matter the negative particles (electrons) have high speeds (relative to the body itself) while the positive particles (protons) have small speeds, it is expected (as explained below) that the net electric force between two neutral pieces of matter (i.e. gravitation) is not zero.
<u>Note</u>: to be consistent with the fact that the neutrons of matter do also contribute to the gravitation force it must be supposed that a neutron is also an association of a slow moving proton and a fast moving electron (see the paper http://www.eterinica.net/Neutron/neutron_en.pdf).

The gravitation force is implemented by aetherinos (i.e. redistribution of aetherinos in the source and collisions with aetherinos in the target) like all the forces of the model and it could be said that is a special case of the more basic "electric" forces between non neutral particles.
The gravitation force has a big similarity with the mainstream *magnetic* force between two neutral pieces of matter since in both cases the internal velocities of some specific group of charged particles composing the neutral bodies are the cause that the net electrodynamic force (which is no longer simply the Coulomb force) between those bodies is not zero.
But the magnetic and the gravitation force have also important differences since in the first case the electrons have a distribution of velocities that contribute to a non zero net curl while in the case of gravitation the electrons can be considered to be moving randomly in all directions amounting to a zero curl. That is also the reason that the strength of the magnetic force between two neutral bodies depends strongly on the direction relative to some axes characteristic of the “magnetized” bodies while the strength of the gravitation force does not depend on the mutual orientation of the bodies (i.e. the gravitation force originated by normal bodies can be considered “isotropic”). That is also the reason that the magnetic force (which is mainly of dipole-type for common magnetic bodies) decays with the distance as $1/d^3$ while the gravitation force decays as $1/d^2$.

The more basic entities subject to the gravitation force are *pairs formed by a slow proton and a neighbour fast electron* (*pe-pairs*) and therefore *the atoms* are subject to the gravitation force (since they are formed by pe-pairs with their protons in the nucleus and their electrons orbiting such nucleus) and so are the *neutrons* (that the model also considers a special type of pe-pair). On the other hand, single elementary particles, like a single proton or a single electron, are not sources of the gravitation force and therefore the concept of "gravitational mass" has no meaning for single elementary particles, although they can be assigned an "inertial mass" (m= F/a according to Newton's 2nd law).
The *pe-pairs* can be treated as a special kind of charge in which the "gravitation charges" (of ordinary matter) are of the same type and always attract each other and *whose magnitudes are not quantized* (since they depend on the average speed of the electron of the pair that can vary widely).
Similarly, a pair made by a fast moving *positive* charge and a neighbour slow moving *negative* one (e.g. an anti Hydrogen atom, an anti neutron, etc) can be considered a "gravitation charge" *of opposite sign to that of our common pe-pairs*. According to what is explained below, those *anti pe-pairs* would also attract each other while an anti pe-pair would repel a common pe-pair.

Ordinary macroscopic matter (like the one that constitutes the planets and the normal stars) is assumed to be highly transparent to the aetherinos. Only a very small fraction of the aetherinos entering the space assigned to the volume of a macroscopic body collides with its elementary particles and contributes to the forces (e.g. the gravitation force) created or suffered by those particles. Such negligible screening of the aetherinos by macroscopic matter is the reason that the inner atoms (or more generally pe-pairs) of those bodies also contribute to the gravitation force (and hence to the gravitation mass) assigned to those bodies.
Hint: In spite of its high transparency to the aetherinos, ordinary matter is weakly transparent to the electric fields (first order component of the aetherinical disturbance that does not depend on the speed of the target charge) because, having two opposite types of electric charges, they respond to the electric fields reordering themselves slightly (matter gets slightly electrically polarized by the electric fields, e.g. forming electric dipoles) and that reordering quickly cancels the incoming electric field. On the other hand, since there is only one type of gravitation charge (in our neighbour world), the second order component of the incoming aetherino disturbance (which does depend on the speed of the target charge) does not generate polarization of the gravitation charges.

NOTE: The forces of the “EVE model” of the aether are called *aetherinical* because they are implemented by aetherinos. When an aetherino collides with a material particle it produces a small velocity change of (i.e. it gives an impulse to) the collided particle. A material particle is said to suffer a force when the net impulse by unit time received from all the aetherinos (coming from all directions of space) that collide with the particle is not zero. The force suffered by a material particle can be originated either (1) by another matter (i.e. by the redistribution of aetherinos originated at another piece of matter) or (2) by the aether itself (e.g. due to the speed of the particle relative to the aether (aether drag force) or due to a fluctuation in the distribution of aetherinos of the local aether (weak force)). Note: The so called “strong force” would, according to the model, be a short-distance manifestation of the anisotropous redistributions of aetherinos created by the proton, the neutron,… (For example a proton is understood to be a particle from which emerges an *excess* of p-type aetherinos when averaging for all directions. But assuming that the redistribution of the proton is not isotropous (but has instead an axial symmetry) it can happen that along the equatorial directions of the proton emerge a *deficit* of p-type aetherinos. In this case, two protons with their redistribution axes in parallel will attract each other (although two protons with their axes randomly aligned will on the whole repel each other). A similar scenario can be supposed to happen in the case of neutrons).

NOTE: It will be considered that a *neutral material body* is composed by an aggregation of elementary particles which either have a unit electric charge or a unit negative charge or no electric charge, and in which there is an equal number of particles with positive electric charge and with negative electric charge.
(See in the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf how the model describes the *redistributions* of aetherinos created by a particle implementing a unit positive electric charge or by a particle implementing a unit negative electric charge and how it describes the attraction and repulsion forces between those basic particles). The force that an elementary particle of unit positive charge exerts on a charged particle P is equal but opposite to the force that an elementary particle of unit negative charge exerts on such particle P. (That is true assuming that in both cases the force corresponds to the same configuration of the interacting particles, including not only the same distance but also *the same relative velocity and the same relative orientation of the internal axis of the particles*).

Gravitation force between two Hydrogen atoms.

As an example of a force between neutral bodies it will here be calculated the force between two Hydrogen atoms, at rest, and placed at a distance d much bigger than the "radius" of the Hydrogen atom.

(Suppose, just for the sake of the following explanation, that the redistribution of aetherinos due to a proton is equal to that of a positron and hence exactly equal but of opposite sign to the redistribution due to an electron).

If an Hydrogen atom consisted in a proton and an electron *both at rest* relative to the atom itself, then, according to what has been said above, the force exerted by the proton on any distant charged particle P would be exactly cancelled by the force exerted by the electron on such particle P. But it has been shown in other sections of this work that the aetherinical forces between elementary particles depend on the *relative velocity* of the particles. Therefore it can be expected that the *average* force exerted by the *high speed* electron of an Hydrogen atom on a particle P is no longer exactly opposite to the force exerted by the slow proton on such particle P.

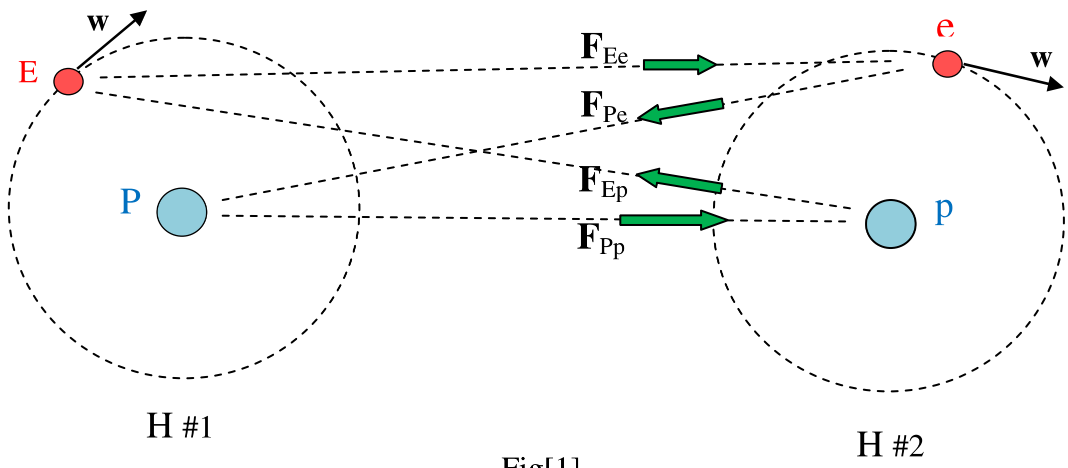
An Hydrogen atom will here be represented by a proton at rest and an orbiting electron of speed w (relative to the atom) and such that its velocity **w** has the same probability to point in any direction of the 3D space.

The force that the atom #1 exerts on the atom #2 can be analysed as:

[G-1] $$\mathbf{F}_{H1H2} = \mathbf{F}_{Pp} + \mathbf{F}_{Pe} + \mathbf{F}_{Ep} + \mathbf{F}_{Ee}$$

where
$\mathbf{F}_{Pp}$ is the force exerted by the proton of the atom #1 on the proton of the atom #2.
$\mathbf{F}_{Pe}$ is the average force exerted by the proton of the atom #1 on the electron of the atom #2. (The "average" is over all directions of the velocity **w** of the electron #2).
$\mathbf{F}_{Ep}$ is the average force exerted by the electron of the atom #1 on the proton of the atom #2. (The "average" is over all directions of the velocity **w** of the electron #1).
$\mathbf{F}_{Ee}$ is the average force exerted by the electron of the atom #1 on the electron of the atom #2. (The "average" is over all directions of the velocities **w** of both electrons #1 and #2).

Naturally the forces F_{Pp} and F_{Ee} are positive (repulsion) while the forces F_{Pe} and F_{Ep} are negative (attraction).
The thesis is that $F_{H1H2} < 0$ (i.e. the net force between the two Hydrogen atoms is of attraction) and that F_{H1H2} can be interpreted as the *gravitation force* between those atoms.



Fig[1]

But before calculating the specific force between two distant atoms of Hydrogen it seems interesting to calculate first the more *generic* force between two "systems" implemented as follows:

- The system #1 consists in a unit charge particle (e.g. an electron) that moves always at a speed w_1 in the reference frame S of description. The velocity $\mathbf{w}_1$ of this particle is oriented with equal probability in all directions of space. This authorizes to assign the particle a fixed position $\mathbf{r}_1$ in the reference frame S.
- The system #2 consists also in a particle of unit charge (e.g. another electron) that moves always at a speed w_2 in the reference frame S of description. The velocity $\mathbf{w}_2$ of this particle is also oriented with equal probability in all directions of space. This authorizes to assign this particle a fixed position $\mathbf{r}_2$ in the reference frame S.

The purpose of calculating the force between these two single-particle systems is that each of these systems can be considered to represent an average atomic electron in a randomly oriented orbit. (Note: the "*random*" orientation of these orbits is a form of describing the orientations of the orbits that can be found in two blocks of ordinary matter made by a great number of atoms).

Suppose that the straight line joining both systems is taken as the axis X of the reference frame S of description.
Let d be the distance (the same at all epochs) between the two elementary particles.
The following figure shows a possible velocity $\mathbf{w}_1$ of the particle #1 lying in the XY plane and forming an angle α_1 with the axis X.
It also shows a possible velocity $\mathbf{w}_2$ of the particle #2 making an angle α_2 with the axis X but with an azimuth (angle that the projection of $\mathbf{w}_2$ on the plane YZ makes with the axis Y) equal to φ_2

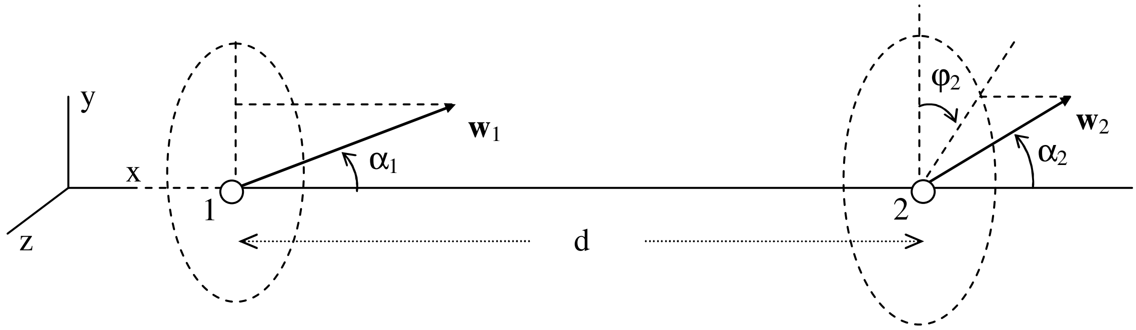


Fig [G-1]

There are several ways to do the calculus of the force exerted by the particle-system #1 on the particle-system #2.

Method (I)

P.S. The calculus done with the method (II), see below, is somewhat simpler and gives rise to simpler expressions with which more reliable numerical results are obtained. Therefore the reading of this Method (I) is not necessary.

For example applying the generic expressions of the Annex A (in particular the Eq[A-20]) based on the integration of the epochs t_E of emergence of the pertinent aetherinos from the particle #1, the calculus would proceed as follows:

Let $\mathbf{f}_{12}$ be the force exerted by the electron #1 on the electron #2 for the specific velocities $\mathbf{w}_1$ and $\mathbf{w}_2$ shown in Fig[G-1].

Let T be the epoch at which is measured the force. (This is just to recall the meaning of the variable T used in the expressions of the paper http://www.eterinica.net/EVAANA/annex_a.pdf that will be applied here, but for the systems described here the forces do not depend on T).
Let t_E be the epoch at which emerge from the electron #1 the pertinent aetherinos being considered in the integration of the force.

The velocity $\mathbf{v}$ (in the reference frame S of description) of the aetherinos that emerge from #1 at the epoch t_E and reach #2 at the epoch T has the Cartesian components:

[G-1b] $\mathbf{v} = \{v,0,0\} = \{d/(T - t_E),\ 0,\ 0\}$

The velocity $\mathbf{v}_R$ of those aetherinos *relative to the target* electron #2 has the components:

[G-1c] $\mathbf{v}_R = \mathbf{v} - \mathbf{w}_2 = \{d/(T-t_E) - w_{2X},\ - w_{2Y},\ - w_{2Z}\} =$

$= \{d/(T-t_E) - w_2 \text{ Cos } \alpha_2,\ - w_2 \text{ Sin } \alpha_2 \text{ Cos } \varphi_2,\ - w_2 \text{ Sin } \alpha_2 (-\text{Sin } \varphi_2)\}$

and its module (i.e. the speed) is:

$v_R = |\mathbf{v}_R| =$

$= \left((d/(T-t_E) - w_2 \text{ Cos } \alpha_2)^2 + (w_2 \text{ Sin } \alpha_2 \text{ Cos } \varphi_2)^2 + (w_2 \text{ Sin } \alpha_2 \text{ Sin } \varphi_2)^2 \right)^{1/2} =$

[G-2]

$= (d^2/(T-t_E)^2 + w_2^2 - 2\, d/(T-t_E)\, w_2 \text{ Cos } \alpha_2)^{1/2}$

The velocity $\mathbf{v}_E$ of those aetherinos *relative to the* electron #1 from which they emerge at the epoch t_E has the components:

$$\mathbf{v}_E = \mathbf{v} - \mathbf{w}_1 =$$
$$= \{d/(T-t_E) - w_{1X},\ -w_{1Y},\ -w_{1Z}\} = \{d/(T-t_E) - w_1 \operatorname{Cos} \alpha_1,\ -w_1 \operatorname{Sin} \alpha_1,\ 0\}$$

whose module is:

[G-3] $$v_E = |\mathbf{v}_E| = \left((d/(T-t_E) - w_1 \operatorname{Cos} \alpha_1)^2 + (w_1 \operatorname{Sin} \alpha_1)^2 \right)^{1/2}$$

The force $\mathbf{f}_{12}$ suffered by the electron #2 at the epoch T is therefore (see Eq[A-20] of the Annex A):

[G-4] $$\mathbf{f}_{12}[T] = h_1 \int_{-\infty}^{T} \frac{\sigma_2\, v_R[t_E,T]\ \mathbf{v_R}[t_E,T]\ r[v_E[t_E,T]]}{v_E^2[t_E,T]\,(T-t_E)^3}\, dt_E$$

where σ_2 is the cross section of the target particle #2 to impulsion-collisions by aetherinos. For most elementary particles, this cross section (when averaged over all directions) is, by hypothesis (see for example the [R-1] of the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf), given by:

[G-5] $$\sigma_2[v_R] = a_I \operatorname{Exp}[-b_I\ v_R^2]$$

where

v_R is the speed (given here by [G-2]) of the aetherino *relative to* the target electron.

c is the speed of light

a_I and b_I are constants

Exp[x] means as usual e^x

The $r[v_E]$ appearing in [G-4] is the *redistribution*, created by the source particle #1, of the "type" of aetherinos(either *n* or *p*) able to produce impulse (and hence force) on the target particle #2.

Supposing that the collision cross section of a unit charge particle with *switch-type* aetherinos (those that in their collisions with matter suffer a switch of type that is the cause of the redistribution created by matter) is:

[G-5b] $$\sigma_S[v_E] = a_S \operatorname{Exp}[-b_S\, v_E^2]$$

then the redistribution of the type of aetherinos (those able to give impulse to the target particle #2) created by a particle #1, at rest in the aether, is given by (see for example the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf):

[G-5c] $$r_1[v_E] = \sigma_S[v_E]\ \frac{\rho[v_E]}{2}\ \frac{v_E}{4\pi} =$$

where

[G-5d] $$\rho[v] = \frac{4 N_0}{\sqrt{\pi}\ V_M^3}\ v^2\ e^{-(v/V_M)^2}$$ is the canonical distribution of the aether (i.e. the distribution of speeds v of the aetherinos in a reference frame in which the aether as a whole can be considered at rest).

(Note: The model assumes that both the p-type aetherinos and the n-type aetherinos have the same distribution equal to $\rho[v]/2$).

NOTE: it has been seen in another paper of the model that the redistribution of aetherinos created by a particle that moves with a speed w, relative to the reference frame in which the local aether can be considered at rest, does not vary significantly from the redistribution created when the particle is at rest in the aether, as long as the speed w is not too big (say, not much bigger than the speed of light). Since the typical speeds w_1 of an orbital electron are significantly smaller than c and assuming that the atoms whose mutual force is being calculated do not move themselves at high speeds relative to the aether, then the expression [G-6] can be applied in the present calculus.
Due to this approximate "relativity principle", the expression [G-5d] of the canonical distribution of the aether can be directly input into the redistribution r_1 (Eq [G-5c]) created by the particle #1, *simply replacing* v by v_E, even if this particle #1 moves (not too fast) relative to its local aether.

And therefore:

[G-6] $$r_1[v_E] = \frac{N_0}{2\pi^{3/2} V_M^3} \; a_S \; Exp[-b_S \, v_E^2] \; v_E^3 \; e^{-(v_E/V_M)^2}$$

where v_E is the speed of the aetherinos relative to the particle taken as source of the force (that creates the pertinent redistribution). (And if this particle is at rest in the aether, v_E is also the speed of the aetherinos relative to the aether).

Only the x-component of the force $\mathbf{f}_{12}$ needs to be calculated because, when later taking into account (i.e. integrating for) all the possible orientations of the velocities $\mathbf{w}_1$ and $\mathbf{w}_2$, the other two components of the net force will cancel due to symmetry reasons.

The x-component of the velocity $\mathbf{v}_R$ is:

$$v_{RX} = d/(T-t_E) - w_2 \cos \alpha_2$$

The x-component of the force $\mathbf{f}_{12}$ exerted by the electron #1 (in its state $\mathbf{w}_1$) on the electron #2 (in its state $\mathbf{w}_2$) is (written in an abbreviate form without expliciting now its temporal dependencies):

[G-7] $$f_{12X} = h_1 \int_{-\infty}^{T} \frac{\sigma_2[v_R] \; v_R \; v_{RX} \; r[v_E]}{v_E^2 \; (T-t_E)^3} \, dt_E$$

When considering all the possible azimuth angles φ_2 that can take the velocity $\mathbf{w}_2$ of the target particle, the *average* value of the x-component of the force that the particle#1 exerts on a particle #2 whose velocity $\mathbf{w}_2$ makes an angle α_2 with the axis X (and whose azimuth angle is randomly oriented) will be:

[G-8] $$f_X[\alpha_1, \alpha_2] = \frac{1}{2\pi} \int_0^{2\pi} h_1 \int_{-\infty}^{T} \frac{\sigma_2[v_R] \; v_R \; v_{RX} \; r[v_E]}{v_E^2 \; (T-t_E)^3} \, dt_E \; d\varphi_2$$

When considering all the possible angles α_2 that can take the velocity $\mathbf{w}_2$ of the target particle, the *average* value of the x-component of the force that the particle #1 exerts on a particle #2 of *speed* w_2 whose velocity $\mathbf{w}_2$ is oriented with equal probability in any direction of space is:
(remember that the number of "states" in which the vector $\mathbf{w}_2$ makes an angle α_2 with the x-axis is proportional to Sin α_2)

$$[G\text{-}9] \quad f_X[\alpha_1] = \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_2 \; \frac{1}{2\pi}\int_0^{2\pi} h_1 \int_{-\infty}^{T} \frac{\sigma_2[v_R]\; v_R\; v_{RX}\; r[v_E]}{v_E^{\,2}\,(T-t_E)^3}\, dt_E\, d\varphi_2\, d\alpha_2$$

When considering all the possible angles α_1 that can take the velocity $\mathbf{w}_1$ of the "source" particle, the *average* value of the x-component of the force that a particle #1 (e.g. an orbital electron) of speed w_1 exerts on a particle #2 (e.g. an orbital electron of the other atom) of speed w_2 whose velocity $\mathbf{w}_2$ is oriented with equal probability in any direction of space is finally:
(remember again that the "normalized" number of "states" in which the vector $\mathbf{w}_1$ makes an angle α_1 with the x-axis is 1/2 Sin α_1)

$$[G\text{-}10] \quad f_X = \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_1 \; \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_2 \; \frac{1}{2\pi}\int_0^{2\pi} h_1 \int_{-\infty}^{T} \frac{\sigma_2[v_R]\; v_R\; v_{RX}\; r[v_E]}{v_E^{\,2}\,(T-t_E)^3}\, dt_E\, d\varphi_2\, d\alpha_2\, d\alpha_1 =$$

$$= \frac{h_1}{8\pi}\int_0^{\pi} \mathrm{Sin}\,\alpha_1 \int_0^{\pi} \mathrm{Sin}\,\alpha_2 \int_0^{2\pi}\int_{-\infty}^{T} \frac{\sigma_2[v_R]\; v_R\; v_{RX}\; r[v_E]}{v_E^{\,2}\,(T-t_E)^3}\, dt_E\, d\varphi_2\, d\alpha_2\, d\alpha_1$$

But, since the integrand of [G-10] does not depend on the azimuth angle φ_2 (because neither $\mathbf{v_R}$ nor $\mathbf{v_E}$ depend on φ_2), the integral of this variable can be omitted and a simpler expression of the force f_X would be:

$$[G\text{-}10b] \quad f_X = \frac{h_1}{4}\int_0^{\pi} \mathrm{Sin}\,\alpha_1 \int_0^{\pi} \mathrm{Sin}\,\alpha_2 \int_{-\infty}^{T} \frac{\sigma_2[v_R]\; v_R\; v_{RX}\; r[v_E]}{v_E^{\,2}\,(T-t_E)^3}\, dt_E\, d\alpha_2\, d\alpha_1$$

Of course, the sought force f_X will not depend on the epoch T of observation since it has been supposed that the systems #1 and #2 do not vary in time (neither their positions nor their internal configurations).

Note: expressing, as in [G-3], the speed v_E of an aetherino relative to the particle #1 as a function of the epochs t_E and T, the redistribution $r[v_E]$ takes the explicit form:

$$r[v_E] = \frac{N_0\, a_S}{2\pi^{3/2}\, V_M^{\,3}}\; \mathrm{Exp}\left[-b_S\left(\left(\frac{d}{T-t_E} - w_1 \mathrm{Cos}\,\alpha_1\right)^2 + (w_1 \mathrm{Sin}\,\alpha_1)^2 \right)\right].$$

$$\cdot \left(\left(\frac{d}{T-t_E} - w_1 \mathrm{Cos}\,\alpha_1\right)^2 + (w_1 \mathrm{Sin}\,\alpha_1)^2 \right)^{3/2} \mathrm{Exp}\left[- \frac{\left(\frac{d}{T-t_E} - w_1 \mathrm{Cos}\,\alpha_1\right)^2 + (w_1 \mathrm{Sin}\,\alpha_1)^2}{V_M^{\,2}} \right]$$

Note: expressing, as in [G-2], the speed v_R of an aetherino relative to the target particle #2 as a function of the epochs t_E and T, the cross section $\sigma_2[b]$ takes the explicit form:

$$\sigma_2[v_R] = a_I\; \mathrm{Exp}\left[-b_I \left(\frac{d^2}{(T-t_E)^2} + w_2^{\,2} - 2\frac{d}{T-t_E} w_2 \,\mathrm{Cos}\,\alpha_2 \right)\right]$$

Some numerical evaluations of the force [G-1] between two Hydrogen atoms have been done using the expression [G-10b] to evaluate each of the four terms of the sum [G-1], taking:

$$F_{Pp} = +f_X\,[w_1{=}0,\ w_2{=}0]$$
[G-10d] $$F_{Pe} = -\,f_X\,[w_1{=}0,\ w_2{=}w]$$
$$F_{Ep} = -\,f_X\,[w_1{=}w,\ w_2{=}0]$$
$$F_{Ee} = +f_X\,[w_1{=}w,\ w_2{=}w]$$

(Notice that the speeds w_1 or w_2 are assigned a value zero when the particle represents a static proton).

The following alternative, and more natural, way of calculating the force between two Hydrogen atoms has been carried out.

Method (II)

The calculus of the force between the two electron systems (represented by the isotropous systems described above) can be done integrating for all the pertinent aetherino *speeds* v (instead of integrating like in Method (I) for all epochs t_E of emergence of the pertinent aetherinos from the particle #1) the calculus could proceed as follows:

Let $\mathbf{f}_{12}$ be the force exerted by the electron #1 on the electron #2 *for the specific velocities* $\mathbf{w}_1$ and $\mathbf{w}_2$ shown in Fig[G-1].
Due to the averaging of velocity directions made below it is allowed to suppose that each electron has always remained in its respective location, at a distance d from the other.

An aetherino that travels at speed v in the reference frame S of description from electron #1 to electron #2 (and therefore along the x-axis) has a velocity relative to the electron #1 (from which it emerged) given as said above by:

$$\mathbf{v_E} = \mathbf{v} - \mathbf{w}_1$$

and hence a speed v_E relative to the electron #1 given by:

[G-11] $$v_E = |\mathbf{v}_E| = \left((v - w_1 \,\mathrm{Cos}\, \alpha_1)^2 + (w_1 \,\mathrm{Sin}\, \alpha_1)^2 \right)^{1/2}$$

The travel time, from #1 to #2, of an aetherino of speed v is d/v. During this time interval the aetherino travels *in the reference frame associated with the* electron #1 a distance:

[G-12] $$d_1 = v_E\, d/v$$

Since, by hypothesis, from the source electron #1 emerges a redistribution of $r[v_E]\,\delta v_E$ aetherinos of speeds in the interval $\{ v_E, v_E + \delta v_E \}$ by unit time and by unit solid angle, their *density* (number by unit volume of space) at a distance d_1 from its source is:

[G-14] $$\delta\rho[v_E] = \frac{r[v_E]}{v_E\, d_1^{\,2}}\,\delta v_E = \frac{r[v_E]\, v^2}{v_E^{\,3}\, d^2}\,\delta v_E$$

(notice that since $r[v_E]\,\delta v_E$ represents a flux *by unit solid angle*, then $(r[v_E]\,\delta v_E)/d_1^{\,2}$ is the number of aetherinos of speeds in $\{v_E, v_E + \delta v_E\}$ crossing in unit time, at the distance d_1 from the extrapolated position of the moving source, a unit area orthogonal plane surface. The number of aetherinos of speed (approximately) v_E having crossed such unit surface in a unit time interval can therefore be found in an imaginary "quasi-cylinder" of unit base and length v_E whose volume has therefore a numerical value equal to that of the speed v_E).

Parenthesis: Reminder of the concept of *redistribution* of the model.

The $r[v_E]$ appearing in [G-14] is the *redistribution*, created by the source particle #1, of the "type" of aetherinos (either *n* or *p*) able to produce impulse (and hence force) on the target particle #2.

When the aetherinos collide with an elementary particle they re-emerge from the collision either unchanged (impulsion interactions) or as the opposite type of aetherino (switch interactions).
An *electrically charged particle* (with an unequal amount of type-p and type-n matter) bathed by the aether will create, due to the switch interactions, a *redistribution of aetherinos*.
Due to the switch interactions, the aetherinos re-emerge from a particle with a distribution that is different from that of the standard undisturbed aether (or more precisely, is different from the distribution of aetherinos (types and velocities) that would emerge from the region of space assignable to the particle if this particle was not there).
Due to this redistribution, a "particle with electric charge" exerts a force on another charged particle since the latter will receive from the "side" of the redistributing particle a distribution of impulsion aetherinos different from the distribution that it receives on the opposite "side" (from the undisturbed aether).

The *redistribution* $r[v_E]$ of a material particle is defined in the model as the "excess or deficit *number* of aetherinos of speed v_E (relative to the particle that creates such redistribution) emerging from the particle *by unit time*, by unit solid angle and by unit speed interval". Its dimension is therefore: L^{-1}.

(The *excess* or the *deficit* are in relation to the number of aetherinos of that speed and type that would emerge from a region of space of the "size" assignable to the particle if this particle was not there).

Supposing that the collision cross section of a unit charge particle (e.g. the electron #1) with its *switch-type* aetherinos (those that in their collisions with matter suffer a switch of type that is the cause of the redistribution created by matter) is (by ad hoc hypothesis):

[G-5b] $$\sigma_S[v_E] = a_S\ \mathrm{Exp}[-b_S\, v_E^{\,2}]$$

then the redistribution of the type of aetherinos (those able to give impulse to the target particle #2) created by a particle #1, "at rest" in the aether, is given by (see for example the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf):

[G-5c] $$r_1[v_E] = \pm\,\sigma_S[v_E]\,\frac{\rho[v_E]}{2}\,\frac{v_E}{4\pi}$$

where

[G-5d] $$\rho[v] = \frac{4 N_0}{\sqrt{\pi}\, V_M{}^3} v^2 e^{-(v/V_M)^2}$$ ***is the canonical distribution of the aether***

i.e. the, by hypothesis, distribution of speeds v of the aetherinos of an undisturbed aether in the local reference frame in which the aether can be considered at rest.
("distribution" means here the number of aetherinos by unit volume and by unit speed interval).

V_M is the speed for which there is a maximum number of aetherinos (i.e. for which the distribution reaches its maximum).
N_0 is the *total* (considering all speeds) average number of aetherinos in unit volume of vacuum.

(Note: The model assumes that both the p-type aetherinos and the n-type aetherinos have, in an undisturbed aether, the same distribution equal to $\rho[v]/2$).

Note: it has been seen in another paper of the model that the redistribution of aetherinos created by a particle that moves with a speed w, relative to the reference frame in which the local aether can be considered at rest, does not vary significantly from the redistribution created when the particle is at rest in the aether, as long as the speed w is not too big (say, not much bigger than the speed of light). Since the typical speeds w_1 of an orbital electron are significantly smaller than c and assuming that the atoms whose mutual force is being calculated do not move themselves at high speeds relative to the aether, then the expression [G-6] (see below) can be applied in the present calculus.
Due to this approximate "relativity principle", the expression [G-5d] of the canonical distribution of the aether can be directly input into the redistribution r_1 (Eq [G-5c]) created by the particle #1, *simply replacing* v by v_E, even if this particle #1 moves (not too fast) relative to its local aether.

And therefore:

[G-6] $$r_1[v_E] = \frac{N_0}{2\pi^{3/2} V_M{}^3} a_S \operatorname{Exp}[-b_S v_E{}^2] v_E{}^3 e^{-(v_E/V_M)^2}$$

where v_E is the speed of the aetherinos relative to the particle taken as source of the force (that creates the pertinent redistribution). (And if this particle is at rest in the aether, v_E is also the speed of the aetherinos relative to the aether).

The differential δv_E of the speed v_E appearing in Eq[G-14] is related with the corresponding differential δv of the speed v by (differentiating G-11):

[G-15] $$\delta v_E = \frac{v - w_1 \operatorname{Cos}\alpha_1}{v_E} \delta v$$

and therefore the density $\delta\rho$ of aetherinos at the position of the target #2 can be rewritten as:

[G-16] $$\delta\rho[v_E] = \frac{r[v_E]\, v^2 (v - w_1 \operatorname{Cos}\alpha_1)}{v_E{}^4\, d^2} \delta v$$

The speed *relative to the target* electron #2 of these aetherinos, whose speed in S is v, is:

[G-17] $v_R = |\mathbf{v}_R| = |\mathbf{v} - \mathbf{w}_2| =$

$$= \left((v - w_2 \cos \alpha_2)^2 + (w_2 \sin \alpha_2 \cos \varphi_2)^2 + (w_2 \sin \alpha_2 \sin \varphi_2)^2 \right)^{1/2} =$$

$$= (v^2 + w_2^2 - 2\, v\, w_2 \cos \alpha_2)^{1/2}$$

The number of collisions suffered in unit time by the target electron with those aetherinos whose number-density is given in [G-16] is therefore:

[G-18] $$\delta Y = \sigma_2[v_R]\ v_R\ \delta\rho[v_E]$$

because the number of aetherinos that collide in unit time with the electron #2, are those in a quasi-cylinder of space whose base is the cross section $\sigma_2[v_R]$ of the particle and whose length is v_R.
$\sigma_2[v_R]$ is the cross section of the target particle #2 to impulsion-collisions by aetherinos. For most elementary particles, this cross section (when averaged over all directions of a particle with intrinsic structure) is, by hypothesis (see for example the [R-1] of the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf), given by:

[G-5] $$\sigma_2[v_R] = a_I\ \mathrm{Exp}[-b_I\ v_R^{\,2}]$$

v_R is the speed of the incident aetherino relative to the target particle.
a_S is a constant, with the dimension of area, specific of the elementary particle.
b_S is a constant, with the dimension of speed $^{-2}$, of the same value for all elementary particles.

Notice that both cross sections σ_I and σ_S are, by hypothesis, described by the same function.

Each of those δY collisions gives by hypothesis to the target electron an *aetherinical impulse* given by:

$$\mathbf{i}_1 = h_1\, \mathbf{v}_R$$

whose x-component (the only of interest in this calculus, see Fig[G-1]) is:

$$i_{1X} = h_1\, v_{RX} = h_1\, (v - w_2 \cos \alpha_2)$$

and therefore, when considering the aetherinos of any speed v, the total impulse per unit time (i.e. force) along the direction X exerted by the electron #1 (in its state $\mathbf{w}_1$) on the electron #2 (in its state $\mathbf{w}_2$) is:

[G-19]
$$f_{12X} = \int_{v=0}^{\infty} h_1\, v_{RX}\ \delta Y =$$
$$= \frac{h_1}{d^2} \int_0^{\infty} \frac{(v - w_2 \cos\alpha_2)\, \sigma_2[v_R]\ v_R\ \ r[v_E]\, v^2\, (v - w_1 \cos\alpha_1)}{v_E^{\,4}}\ \delta v$$

where
the cross section $\sigma_2[v_R]$ is given in [G-5]
the redistribution $r[v_E]$ is given in [G-6]
the speed v_E is given in [G-11]
the speed v_R is given in [G-17]

When considering all the possible azimuth angles φ_2 that can take the velocity $\mathbf{w}_2$ of the target electron, the *average* value of the x-component of the force that the electron #1 exerts on an electron #2 whose velocity $\mathbf{w}_2$ makes an angle α_2 with the axis X (and whose azimuth angle is randomly oriented) will be:

$$\text{[G-20]} \quad f_X[\alpha_1, \alpha_2] = \frac{1}{2\pi}\int_0^{2\pi} f_{12X}\ d\varphi_2$$

When considering all the possible angles α_2 that can take the velocity $\mathbf{w}_2$ of the target electron, the *average* value of the x-component of the force that the electron #1 exerts on an electron #2 of *speed* w_2 whose velocity $\mathbf{w}_2$ is oriented with equal probability in any direction of space is:
(remember that the "normalized" number of “states” in which the vector $\mathbf{w}_2$ makes an angle α_2 with the x-axis is 1/2 Sin α_2)

$$\text{[G-21]} \quad f_X[\alpha_1] = \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_2\ \frac{1}{2\pi}\int_0^{2\pi} f_{12X}\ d\varphi_2\ d\alpha_2$$

When considering all the possible angles α_1 that can take the velocity $\mathbf{w}_1$ of the “source” electron, the *average* value of the x-component of the force that an orbital electron #1 of speed w_1 exerts on the electron #2 (that of the target H atom) of speed w_2 whose velocity $\mathbf{w}_2$ is oriented with equal probability in any direction of space is finally:
(remember again that the “normalized” number of “states” in which the vector $\mathbf{w}_1$ makes an angle α_1 with the x-axis is 1/2 Sin α_1)

$$\text{[G-22]} \quad f_X = \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_1\ \frac{1}{2}\int_0^{\pi} \mathrm{Sin}\,\alpha_2\ \frac{1}{2\pi}\int_0^{2\pi} f_{12X}\ d\varphi_2\ d\alpha_2\ d\alpha_1 =$$

$$= \frac{h_1}{8\pi d^2}\int_0^{\pi} \mathrm{Sin}\,\alpha_1 \int_0^{\pi} \mathrm{Sin}\,\alpha_2 \int_0^{2\pi} \int_0^{\infty} \frac{(v - w_2\,\mathrm{Cos}\,\alpha_2)\,\sigma_2[v_R]\ v_R\ r[v_E]\ v^2\,(v - w_1\,\mathrm{Cos}\,\alpha_1)}{v_E^{\ 4}}\ \delta v\ d\varphi_2\ d\alpha_2\ d\alpha_1$$

But, since the integrand of [G-22] does not depend on the azimuth angle φ_2 (because neither $\mathbf{v}_R$ nor $\mathbf{v}_E$ depend on φ_2), the integral of this variable can be omitted and a simpler expression of the force f_X would be:

[G-22b]

$$f_X = \frac{h_1}{4d^2}\int_0^{\pi} \mathrm{Sin}\,\alpha_1 \int_0^{\pi} \mathrm{Sin}\,\alpha_2 \int_0^{\infty} \frac{(v - w_2\,\mathrm{Cos}\,\alpha_2)\,\sigma_2[v_R]\ v_R\ r[v_E]\ v^2\,(v - w_1\,\mathrm{Cos}\,\alpha_1)}{v_E^{\ 4}}\ \delta v\ d\alpha_2\ d\alpha_1$$

This force f_X given in Eq[G-22b] is, remember, the average force that a charged particle of speed w_1 (whose velocity $\mathbf{w}_1$ has the same probability to point in any direction of 3D space) exerts on another charged particle of speed w_2 (whose velocity $\mathbf{w}_2$ has the same probability to point in any direction of 3D space) located at a distance *d* from the first particle. The direction of the force is, due to symmetry reasons, along the direction joining the two particles (that in the above description has been called direction X).

Several evaluations of the force [G-1] between two Hydrogen atoms have been done using the expression [G-22b] to evaluate each of the four terms of the sum [G-1], taking:

[G-22c]
$$F_{Pp} = +f_X\,[w_1=0,\ w_2=0]$$
$$F_{Pe} = -\,f_X\,[w_1=0,\ w_2=w]$$
$$F_{Ep} = -\,f_X\,[w_1=w,\ w_2=0]$$
$$F_{Ee} = +f_X\,[w_1=w,\ w_2=w]$$

It was found that the software Mathematica 10.5 (of Wolfram Research) was able to obtain an analytic expression f[v] for the solution of the double integral on the variables α_1 and α_2 of the expression [G-22b] but was unable to solve the remaining integral of f[v] on the variable v. Doing numerical integrations of f[v] it was found that:

- The gravitation force $F_G = F_{H1H2} = F_{Pp} + F_{Pe} + F_{Ep} + F_{Ee}$ (see Eq[G-1]) between the two Hydrogen atoms takes negative values (i.e. is an attraction force) for w>0.
- The gravitation force F_G increases as the average speed w of the electrons increases.
- The relation between the strength of the gravitation force F_G and that of the electric force F_{Pp} is of the order of 10^{-36} when it is assumed that approximately $w = 2*10^{-9}$ c
 (Note: according to mainstream physics, the relation between the strength of the gravitation force and that of the electric force (e.g. between a proton and an electron) is of the order of 10^{-36}).
- The values of the four electric component forces depend of course strongly on the constants V_M, N_0, h_1, c, a_I, a_S... of the model but the value of the relation F_G/F_{Pp} does not.
 Note: Some of these evaluations were done supposing (arbitrarily) for example:
 $h_1=10^{-40}$; $c=10^8$; $V_M=10^{20}$ c; $N_0=10^{30}$; $a_S=1$; $b_S=1.255/c^2$; $a_I=1$; $b_I=1.255/c^2$; d=1;

No analytic solution has been found for the force fx (see Eq[G-22b]) that the single electron system #1 exerts on the single electron system #2. But performing numerical integrations (for different values of the speeds w_1 and w_2) it has been found that a very good *approximation of such force*, if both w_1 and w_2 are much smaller than the speed of light c, is

[2-G]
$$F_X[w_1,w_2] = \frac{h_1\, a_I\, a_S\, N_0\, c^5}{V_M^3\, d^2}\left(a_0 - a_1\frac{w_1^2}{c^2} - a_2\frac{w_2^2}{c^2} - b_1\frac{w_1^4}{c^4} - b_2\frac{w_2^4}{c^4} - b_{12}\frac{w_1^2 w_2^2}{c^4}\right)$$

(valid for $w_1 \ll c$, $w_2 \ll c$)

The numerical coefficients a_0, a_1, a_2, b_1, b_2, b_{12} of Eq[2-G] take always *positive* real numbers for all reasonable values of the constants of the model. They must all be dimensionless for dimensional consistency. Furthermore, those numerical coefficients are always related as follows:

[3-G]
$$a_1 = 0.766944\ a_0$$
$$a_2 = 0.766944\ a_0$$
$$b_1 = 0.135627\ a_0$$
$$b_2 = 0.135293\ a_0$$
$$b_{12} = 0.450978\ a_0$$

If the speeds w_1 and w_2 of both particles are zero, the force given in Eq[2-G] must be coincident with the electrostatic Coulomb force which is:

[4-G] $F_X[0, 0] = k_e \frac{e^2}{d^2}$ when w_1=0, w_2=0

where k_e is Coulomb's constant and *-e* is the charge of the electron.

Therefore equating Eq[4-G] with Eq[2-G] particularized for w_1=0, w_2=0 it follows that the constants V_M, N_0, h_1, c, a_I, a_S... of the model must take values that allow:

[5-G] $$\frac{h_1\, a_I\, a_S\, N_0\, c^5}{V_M^3} a_0 = k_e\, e^2$$

Considering now the net force F_{H1H2} that a hydrogen atom #1 exerts on a hydrogen atom #2 placed at a distance d, its four parts described in Eq[G-1] must be replaced, according to Eq[2-G] as follows:

Calling K_0 to the product of constants $\frac{h_1\, a_I\, a_S\, N_0\, c^5}{V_M^3}$ of the aether model

$$F_{Pp} = F_X[0, 0] = \frac{K_0\, a_0}{d^2}$$

[6-G]

$$F_{Pe} = F_X[0, w] = -\frac{K_0}{d^2}\left(a_0 - a_2 \frac{w^2}{c^2} - b_2 \frac{w^4}{c^4} \right)$$

$$F_{Ep} = F_X[w, 0] = -\frac{K_0}{d^2}\left(a_0 - a_1 \frac{w^2}{c^2} - b_1 \frac{w^4}{c^4} \right)$$

$$F_{Ee} = F_X[w, w] = \frac{K_0}{d^2}\left(a_0 - a_1 \frac{w^2}{c^2} - a_2 \frac{w^2}{c^2} - b_1 \frac{w^4}{c^4} - b_2 \frac{w^4}{c^4} - b_{12} \frac{w^4}{c^4} \right)$$

The net force that a hydrogen atom #1 exerts on a hydrogen atom #2 placed at a distance d is therefore:

[7-G] $$F_{H1H2} = F_{Pp} + F_{Pe} + F_{Ep} + F_{Ee} = -\frac{K_0}{d^2}\, b_{12} \frac{w^4}{c^4}$$

and replacing b_{12} by its value given in Eqs[3-G] and then the product $K_0\, a_0$ by its value given in Eq[5-G]:

[8-G] $$F_{H1H2} \cong -0.451 \frac{K_0}{d^2} a_0 \frac{w^4}{c^4} = -0.451\, k_e \frac{e^2}{d^2} \frac{w^4}{c^4}$$

which is the *Gravitation force between two hydrogen atoms* (made each of one *pe-pair*) and where *ke* is Coulomb's constant; *e* and *–e* are the electric charges of the proton and the electron; *d* is the distance between the two atoms; *c* is the speed of light in vacuum; and *w* is the average speed (relative to the proton) of the electron in the Hydrogen atom.

It is known from experiments that the electric force is about 10^{36} times stronger than the gravitation force. This fact is normally understood as meaning that the electrostatic force between a proton and an electron is about 10^{36} times stronger than the gravitation force between those two particles. But as explained above, the gravitation force (and hence the concept of gravitation mass) does not apply to *single* elementary particles with electric charge. It only applies to pe-pairs or to bulks of matter made by many pe-pairs. A comparison can nevertheless be made between the strength of the electrostatic force between a proton and an electron and the proposed gravitation force between two hydrogen atoms. Since the electrostatic force is $-k_e e^2/d^2$ then from Eq[8-G] it follows that the relation between that force and the gravitation force between the two hydrogen atoms is:

[9-G] $$\frac{F_{elec\,PE}}{F_{grav\,HH}} = \frac{1}{0.451}\frac{c^4}{w^4}$$

which suggests that the average speed w of the electrons of the Hydrogen atom should be of the order of $w = 10^{-9}$ c to account for a relation of strengths of the order of 10^{36} between the electric and the gravitation force. This value of w seems a "too slow" average speed for the orbiting electron of a Hydrogen atom but does no longer seem too slow when it is ascribed to the average speed of the electrons in a macroscopic piece of ordinary matter.

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Further reading.

Gravitation orbits.
(pending revision and debugging)

In the Annex-A of this work, expressions are obtained that give the force exerted by a particle A on another particle B in very general conditions. In particular, the equations [A-78] of such Annex give the components of the force exerted by a proton A (that remains at rest in the rectilinear frame of description) on an electron B that is moving with a velocity $\mathbf{V}_B$ at a distance d of the proton. (With the help of those expressions, evaluations were later made (shown in a *Mathematica* notebook named AOE.nb) predicting some stable orbits of the electron around the proton).
Written in vector form, this force [A-78] exerted by a rest proton A on a moving electron B is:

[G-30] $$\mathbf{F_{AB}} = \frac{h_1}{d^2}\int_0^\infty \mathbf{v_R}\, v_R\, \sigma_B[v_R]\, \frac{r_A[v]}{v}\, \delta v$$

where:
v is, in the reference frame of description associated to A, the speed of the “pertinent” aetherinos (those that travel from A to the instantaneous position of B).
v_R is the speed of the pertinent aetherinos relative to the electron B
$\mathbf{v_R}$ is the velocity of the pertinent aetherinos relative to the electron B
$\sigma_B[v_R]$ is the cross section of the electron to impulsion-collisions by aetherinos of relative speed v_R.
$r_A[v]$ is the redistribution of aetherinos created by the proton A.
d is the distance AB at the instant of evaluation of the force.
h_1 is a constant.

and where it must be recalled that

(1) the cross section σ_B of the electron to aetherino impulsion collisions is (by hypothesis) given by:

[G-31] $$\sigma_B[v_R] = a_I \; Exp[-b_I \, v_R^{\,2}]$$

(2) the redistribution of aetherinos by the proton is proportional to the cross section σ_S of the proton to aetherino switch-type collisions which is (by hypothesis) given by:

[G-32] $$\sigma_S[v] = a_S \; Exp\left[-b_S \, v^2\right]$$

In this model of the aether the conditions to obtain a stable (closed) orbit are not as simple as equating the centripetal and the centrifugal forces (as is done in classical mechanics) because now there is a new force, the *aether drag force* (due to the speed of the orbiting body relative to the aether) that must also be taken into account.

Note: As explained in the Section 2 of this work the aether drag force suffered by the electron when moving at a velocity $\mathbf{V}_B$ relative to the aether can be approximated by:

[G-33] $$\mathbf{F}_{Drag} \cong -\,0.385 \frac{h_1 \, a_I \, N_0 \, c^6}{V_M^{\;5}} \mathbf{V}_B$$

that may be considered "valid" for: $c << V_M$, and V_B smaller than, say, 10c (ten times the speed of light)

It has been found for example that a *circular* orbit can be considered strictly stable (i.e. closed) when its orbital velocity is such that the aether drag force is exactly cancelled by the “forward component” of the centripetal force.

Note: the name “centripetal force” is here given to the force exerted by the central heavy body A on the orbiting light body B although this force does not have strictly the direction BA because it suffers an “aberration” due to the finite speed of the aetherinos responsible of such force (or more precisely to the deficit of aetherinos coming from A).

In the case of an electron orbiting a proton, it can be seen (e.g. in the evaluations shown in the *Mathematica* notebook AOE.nb) that for a given azimuth of the orbital plane (relative to the anisotropous field of the proton) there is only one *circular* orbit that can be considered fully stable (closed). Let r_E be the radius of such circular stable orbit. It can be seen that when the electron is placed in an orbit of radius r (different from r_E) with a “classical” orbital speed V_B such that $F_{AB}[r] = m_e V_B^2/r$ it happens that the electron spirals towards the stable orbit of radius r_E

In the case of bodies subject to the force that the model interprets as *gravitation*, no rigorous evaluations of the allowed orbits have been done yet because the model lacks at this stage of a sufficiently simple expression of the gravitation force to be used as input in the differential equations giving the orbits. Nevertheless, *just for the purpose of a qualitative test*, the above expressions [G-30-33] related with an electron orbiting a proton have been adapted to the peculiarities of the gravitational orbiting as follows:

(1) It has been supposed that the very weak force identified above as gravitation can be somehow implemented supposing that the constant a_I (related with the cross section of the target particle to aetherino impulsion collisions) must, in the case of gravitation, be assigned a very small value.

(2) Assuming that the target orbiting body is no longer a single elementary particle but an aggregation of a great number *m* of *pe-pairs (made by a proton of low internal speed and an electron of high internal speed and random direction*) then the constant a_I (related with the cross section of

the target particle) should be multiplied by such number *m* in both the expression of the central force (see [G-30] and [G-31]) and the expression of the drag force F_{Drag} (given in [G-33]).

(3) Assuming that the *central* body is no longer a single elementary particle but an aggregation of a great number *M* of *pe-pairs* then the cross section σ_S (given in [G-32]) should be multiplied by such number *M*.

With these three modifications it can be seen that even when the orbital radius r differs from the stable radius r_E by one order of magnitude (i.e. when r has any value in the 2-orders of magnitude interval $10\, r_E > r > 10^{-1}\, r_E$) the orbital decay of the gravitating body towards the orbit of radius r_E is so “slow” that those orbits can be considered quasi-stable during a very high number of revolutions. (Remember in this respect that in our solar system the orbital radius of the inner planet (Mercury) differs from the orbital radius of the outer planet (Neptune) by two orders of magnitude (since the orbital radius of Mercury is of 0.3 AU while the orbital radius of Neptune is 30 AU). In other words, the model seems a priori able to explain the gravitational orbits of the planets of our solar system as quasi-stable orbits.

It can also be seen that the so called stable radius r_E of a central force system increases in proportion to the parameter M of the central force.

Note: It has been found in the simulations (done with numerical approximate methods) of *circular* orbits that:

(a) In a fully stable orbit it happens that Fdrag = - Ffwd

(b) Let Δr be the increase (or decrease) of the orbital radius during a single revolution of the orbiting body. The “*instability*” of a quasi circular orbit of initial radius r can be defined for example as the quotient $\Delta r/r$. (The “stability” can be defined as $r/\Delta r$ i.e. as the inverse of the instability).

Other simulations (not yet fully reliable) show that:

(c) the instability increases when the absolute value of quotient (|Fdrag|-|Ffwd[r]|) / F_{AB}[r] increases (where F_{AB}[r] is, for a given radius r, the force exerted by the central body on the orbiting body).

Furthermore, those simulations show that:

(d) For a given value of r/r_E, the instability of an orbit of radius r decreases (is more stable) when the model assumes a smaller aether drag force, i.e. a smaller value of the constants giving the aether drag force for a given speed V_B of the body. That would imply for example a bigger value of the speed V_M (for which the canonical distribution of the aether reaches its maximum).