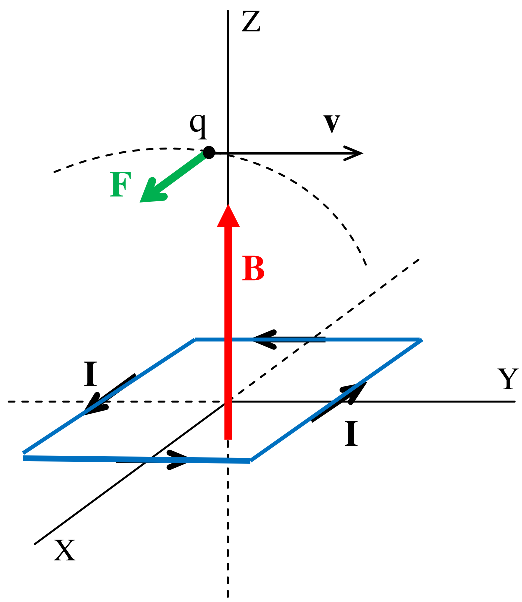
. Revised Feb 2011, Dec 2020, Feb 2024

Magnetic force

The main thesis of this paper is that magnetism is an unnecessary concept from the point of view of **fundamental** Physics since its effects, described by Maxwell electromagnetism, can also be described in a more simple way as due to the forces between electrically charged particles when they move relative to one another under the hypothesis (of the EVE model) that the intensity and direction of such electrodynamic forces depends on the relative velocity of the interacting particles.
As a first qualitative example consider a particle q of positive electric charge moving with a velocity **v** perpendicularly to what mainstream physics calls a magnetic field **B**.
A simple way to create what mainstream physics calls a magnetic field is with a current loop.
In the following example, Fig[1], the loop is shaped as a square.
When seen from above, the current (i.e. the net flow of *positive* charge) performs a counterclockwise rotation. This implies that if the current loop is made by a standard neutral wire conductor then its conducting electrons (negative charges) will perform a clockwise rotation while its positive charges (protons) will, on the average, remain still. It also implies that the magnetic field **B** will be perpendicular to the loop and point in the +Z direction.

Fig[1]



Maxwell electromagnetism (and more precisely the *Lorentz force law* with an electric field E=0) predicts correctly that a positive charge *q* moving above the loop with a velocity **v** along the semidirection +Y will suffer a force **F** (green vector in Fig[1]) along the semidirection +X.

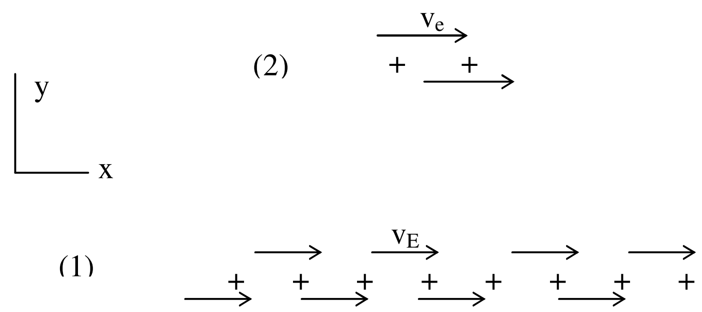
The EVE model, based on “simple” hypothesis about the properties of the electric charges (see below), predicts on its turn that the positive charge q will indeed suffer a force along the semidirection +X. This can be “qualitatively seen” considering that the model predicts that a charge moving parallel to a line (or to a segment) of charges suffers an electric force that *increases* with the relative speed v_R of the interacting charges as long as that relative speed is small (v_R<<c).

Note: when the relative speed v_R increases above some value (plausibly near $v_R > 0.01$ c) the model predicts instead that the electric force *decreases* with the relative speed v_R of the interacting charges. Therefore the current-carrying electrons of the forefront segment of the loop (that move along –Y in opposition to the current I) have a bigger speed relative to the charge *q* than the electrons of the background segment of the loop (that move along +Y) and therefore the former electrons exert a bigger attraction force on the charge *q* than the attraction force exerted on *q* by the electrons of the background segment of the loop.

That was only a qualitative description. For more precise quantitative predictions of the model see the examples in the following sections of this paper.

Electrodynamic force between two long rectilinear parallel current-carrying conductors

The force between two long rectilinear parallel current-carrying conductors will be described in a non orthodox way (ignoring by the time being the mainstream description based on the magnetic field or more generally on the Maxwell laws of electromagnetism).



Fig[2]

(1) represents an indefinitely long conductor whose current carrying electrons have a speed v_E and whose protons (or more precisely its positive ions) are at rest in the reference frame of description.
(2) represents an element of current of the second conductor that runs parallel to the first and whose current carrying electrons have a speed v_e

Let X be the direction along which both conductors proceed. Let Y be the direction perpendicular to X joining the conductors.

To simplify it will be supposed that the conductors are made just by static protons and by an equal number of moving conducting electrons. It will also be supposed that both conductors are 'homogeneous' meaning that in all small segments of length Δl of a conductor there is (macroscopically speaking) the same number of electrons, the same number of protons and the same current intensity as in any other segment of length Δl of the same conductor.

NOTE 11-A In a typical wire conductor, besides the current carrier electrons, there are of course a great number of other electrons that remain bound to the atoms of the wire and don't participate in the current in the sense that their average velocity is zero. The electric influence of these bound electrons on an external charge q will be assumed to be cancelled by the influence of an equal number of static protons of the wire. Therefore, assuming that all pieces of a wire conductor have an equal number of electrons and protons, to give a full account of the force produced by the conductor on an external charge q it is sufficient to add to the force of the moving "conducting" electrons (i.e. the current carriers) the force produced by an *equal number* of "static" protons.

To avoid second order complications it will also be supposed that, in both conductors, the conducting electrons have small speeds ($v \ll c$).
Let v_E be the lab speed of *all* the conducting electrons of conductor #1 and v_e the lab speed of *all* the conducting electrons of conductor #2. In what follows upper case letters will be used to characterize the charges of conductor #1 and lower case letters for those of the current element of conductor #2.

Note: in a real wire conductor *not all* the pertinent electrons (the current-carriers) have the same speed. It can only be said that those pertinent electrons have an *average* speed v. But since it will be shown that the *predicted* force between these simplified lines of current has a linear dependence on the speed of the electrons, it is therefore licit to extend the results to more realistic conductors in which the current carrying electrons have a wider variety of speeds (by just considering that the original conductor is the addition of a big number of conductors each of which has electrons of a specific speed).

Suppose by the time being that the lab (that is here the reference frame of description) is at rest in the aether.

Let F_{Pp} be the Y-component of the total force exerted by all the *protons* of conductor 1 on the *protons* of the current element 2.
Let F_{Ep} be the Y-component of the total force exerted by all the *electrons* of conductor 1 on the *protons* of the current element 2.
Let F_{Pe} be the Y-component of the total force exerted by all the *protons* of conductor 1 on the *electrons* of the current element 2.
Let F_{Ee} be the Y-component of the total force exerted by all the *electrons* of conductor 1 on the *electrons* of the current element 2.

The Y-component of the total force exerted by conductor (1) on the current element (2) is therefore:

[11-1] $$F = F_{Pp} + F_{Ep} + F_{Pe} + F_{Ee}$$

Consider first the case in which both the pertinent charges of the current element and the pertinent charges of the rectilinear conductor are all *at rest in the lab*.

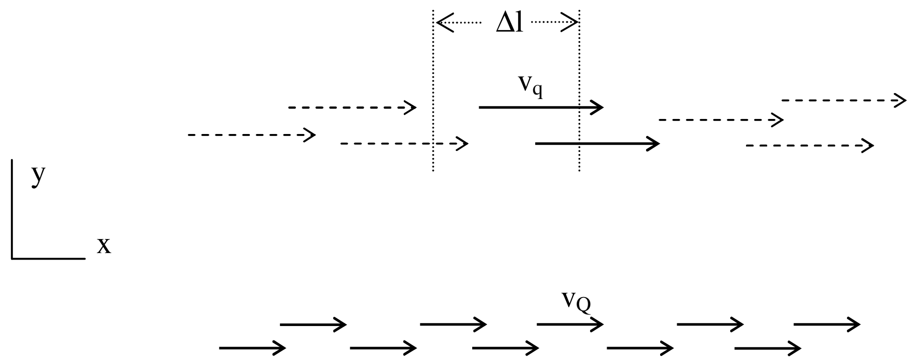
In mainstream electromagnetism, since Coulomb's law $F = k_C\, Q\, q/r^2$ gives the force between two charged particles at rest, whose electric charges are respectively Q and q and whose distance is r, it is straightforward to calculate/integrate that, for charges at rest in the frame of description, the total force that the Q-type charges of a uniform rectilinear infinitely long conductor exert on the q-type charges of an element Δl of a second conductor, whose distance to the first conductor is "y", can be expressed by:

[11-2] $F_{Qq}[0] = (2/y)\, k_C\, \lambda_Q\, \lambda_q\, \Delta l$

where k_C is Coulomb's constant, λ_Q is the linear density of charge of the Q-type charges of the first conductor, λ_q is the linear density of charge of the q type charges of the second conductor, Δl is the length of the element of the second conductor (target of the force being measured) and where *it has been supposed that both the Q-type charges of the first conductor and the q-type charges of the second are at rest in the lab.*

(It is assumed that a linear density of charge λ is of *negative* sign if its overall charge is of negative sign, e.g. for a line of electrons. Therefore if λ_Q and λ_q are both of the same sign, the force $F_{Qq}[0]$ of [11-2] will be positive, meaning *repulsion*).

<u>Hypothesis</u>



Fig[3]

The known force between two long rectilinear parallel *currents* can be predicted if the following hypothesis is made:

A uniform infinitely long rectilinear line of Q type charges that move at a speed v_Q along the +X direction *exerts* on an element of q type charges that move at a speed v_q along the +X direction (and hence parallel to the line of Q type charges, see Fig[3]) *a force* whose Y-component (i.e. perpendicular to the straight line of the Q type charges) is given by:

[11-3] $F_{Qq}[v_Q, v_q] = F_{Qq}[0]\,(1 + k_B\,(v_q - v_Q)^2\,)$

where k_B is a constant (with dimension of speed^{-2}) and where $F_{Qq}[0]$ is the force given in [11-2] corresponding to $v_Q = v_q = 0$.

Note: in the hypothesis [11-3] it must be understood that, when the pertinent group of charges moves instead along the –X semi-direction, the sign of its speed must be changed in the expression. For example, if the Q-type charges of the line move along +X but the q-type charges of the target move along the –X (minus) semi-direction, the force [11-3] must be calculated as $F_{Qq}[v_Q, v_q] = F_{Qq}[0]\,(1 + k_B\,(-v_q - v_Q)^2\,)$

As explained below the expression [11-3] must be considered only an approximation valid for speeds v_Q and v_q much smaller than the speed of light c.

Therefore the Y-component of the total force expressed in [11-1], considering both the protons and the electrons, acting on the current element of conductor #2 due to the indefinitely long conductor #1 is:

[11-4] $$F = F_{Pp} + F_{Ep} + F_{Pe} + F_{Ee} =$$

$$= F_{Pp}[0]\,(1 + k_B\,(v_p - v_P)^2) + F_{Ep}[0]\,(1 + k_B\,(v_p - v_E)^2) + F_{Pe}[0]\,(1 + k_B\,(v_e - v_P)^2) + F_{Ee}[0]\,(1 + k_B\,(v_e - v_E)^2)$$

Calling

λ_P = linear density of charge due to the protons of the 1st conductor,

λ_E = linear density of charge due to the electrons of the 1st conductor,

λ_p = linear density of charge due to the protons of the 2nd conductor,

λ_e = linear density of charge due to the electrons of the 2nd conductor

then *in the case that both conductors are electrically neutral* and that therefore

$\lambda_P = -\lambda_E$ and $\lambda_p = -\lambda_e$

it follows, according to [11-2], that $F_{Pp}[0] = F_{Ee}[0] = - F_{Pe}[0] = - F_{Ep}[0]$ and therefore the force F of Eq[11-4] acting on the current element of conductor #2 due to the indefinitely long rectilinear conductor #1 simplifies to

$$F = F_{Pp}[0]\,\big(\,(1 + k_B\,(v_p - v_P)^2) - (1 + k_B\,(v_p - v_E)^2) - (1 + k_B\,(v_e - v_P)^2) + (1 + k_B\,(v_e - v_E)^2)\,\big) =$$

[11-5]

$$= -2\,F_{Pp}[0]\,k_B\,(v_e - v_p)(v_E - v_P)$$

Calling $\lambda_1 = \lambda_P = -\lambda_E$ and $\lambda_2 = \lambda_p = -\lambda_e$ then the force $F_{Pp}[0]$ that represents the force that a long straight line of uniformly distributed protons *at rest* exerts on an element (short segment) of length Δl of a parallel line of other uniformly distributed protons *also at rest*, can be written according to [11-2] as:

[11-6] $$F_{Pp}[0] = (2/y)\,k_C\,\lambda_1\,\lambda_2\,\Delta l$$

and therefore the expression [11-5] (that represents the force that an indefinitely long electrically neutral, current carrying, conductor exerts on an element of length Δl of a parallel, also electrically neutral, current carrying, conductor) can be rewritten as:

[11-7] $$F = -\,(4/y)\,k_C\,\lambda_1\,\lambda_2\,\Delta l\,k_B\,(v_e - v_p)(v_E - v_P) =$$

$$= -\,(4/y)\,k_C\,\Delta l\,k_B\,\lambda_1\,(v_P - v_E)\,\lambda_2\,(v_p - v_e) =$$

$$= -\,(4/y)\,k_C\,\Delta l\,k_B\,I_1\,I_2$$

where it has been taken into account that $I_1 = \lambda_1 (v_P - v_E)$ is the intensity of the current of the first conductor and $I_2 = \lambda_2 (v_p - v_e)$ that of the second.

When both intensity currents I_1 and I_2 are of the same sign (semi direction) it is an experimental fact that the force is of attraction. That implies that the constant k_B introduced in the hypothesis [11-3] must be positive so that F takes a negative value when both I_1 and I_2 have the same sign.

The force exerted by the 1^{st} conductor on a *unit length* segment of the second conductor is of course, taking $\Delta l=1$ in [11-7]:

[11-8] $$F = - (4/y) k_C k_B I_1 I_2$$

But, according to mainstream electromagnetism (and experimentally), the Y-component of the force exerted by an infinitely long rectilinear conductor with current I_1 on a *unit* length of a second parallel conductor with current I_2 is known to be given (in MKS units) by:

[11-9] $$F = - \mu_0/(2 \pi y) I_1 I_2$$

and therefore the comparison of the model's description [11-8] with the mainstream's description [11-9] implies that the constant k_B of the model must take the value:

[11-10] $$k_B = \mu_0/(8 \pi k_C)$$

and replacing Coulomb's constant k_C by its MKS value $k_C = 1/(4 \pi \varepsilon_0) = \mu_0 c^2/(4 \pi)$

[11-11] $$k_B = 1/(2c^2)$$

(where c is the speed of light)

NOTES 11-B.

- It is interesting to notice that if both conductors are given a constant velocity **V** along the direction X and therefore the new speeds of the pertinent charges (including the protons) are all increased by V according to:

$v_E \rightarrow v_E + V$
$v_P \rightarrow v_P + V$
$v_e \rightarrow v_e + V$
$v_p \rightarrow v_p + V$

then, making those substitutions in [11-4] and making the same assumptions ($\lambda_1 = \lambda_P = -\lambda_E$ and $\lambda_2 = \lambda_p = -\lambda_e$) as before, all the terms containing a V cancel out and the same expression [11-5], independent of V, is obtained.

- Below in this paper, it has been *calculated* (assuming the paradigms and the hypothesis of the model related with the forces between material particles) that, the Y-component of the force that a uniform infinitely long rectilinear line of Q type charges *at rest in the lab* (i.e. when $v_Q=0$) exerts on a q type charge that moves at a speed v_q parallel to the line behaves indeed according to $F_{Qq}[v_Q, v_q] = F_{Qq}[0] (1 + k_B v_q^2)$ with $k_B > 0$. This assertion is true only if $v_q << c$.

A controversial feature of this description is the prediction of a *non-zero force between a long rectilinear neutral wire with current and a charge at rest in the lab*. According to mainstream Electrodynamics this force should be zero because (1) the electric force is zero since the neutral conductor has a zero net charge, and (2) the magnetic field due to the current produces (according to the Lorentz-force) a zero force on a charge at rest. But according instead to the description proposed above the force exerted by the long neutral conductor with current I_1 on a charge *q* at rest relative to the conductor (i.e. relative to the protons of the wire) is no longer zero. Consider first, according to the hypothesis [11-3], the Y-component of the force that the long current-carrying wire exerts on a test charge *q moving* parallel to the wire with speed v_q at a distance *y*.

[11-12] $$F_Y = F_{Pq} + F_{Eq} = F_{Pq}[0]\,(1 + k_B\,(v_q - v_P)^2) + F_{Eq}[0]\,(1 + k_B\,(v_q - v_E)^2)$$

where v_P and v_E are respectively the speeds of the protons and of the electrons of the current carrying wire. (A positive speed means a movement along the +x semidirection of the wire).
But since the protons of the conductor are here assumed to be at rest (v_P=0) :

[11-14] $$F_Y = F_{Pq} + F_{Eq} = F_{Pq}[0]\,(1 + k_B\,v_q^2) + F_{Eq}[0]\,(1 + k_B\,(v_q - v_E)^2)$$

But the force that a rectilinear long line of protons *at rest* exerts on a single test charge +*q* also *at rest* can be written (in analogy with [11-2] but replacing $\lambda_q\,\Delta l$ by *q*) as

[11-15] $$F_{Pq}[0] = (2/y)\,k_C\,\lambda_P\,q$$

And similarly, considering that $F_{Eq}[0]$ is the force that a rectilinear long line of electrons *at rest* exerts on a single test charge +*q* also *at rest*

[11-16] $$F_{Eq}[0] = (2/y)\,k_C\,\lambda_E\,q$$

and therefore the force [11-14] of both the protons and the electrons of the wire on the test charge *q* takes the form:

[11-17] $$F_Y = (2/y)\,k_C\,q\,\left(\lambda_P\,(1 + k_B\,v_q^2) + \lambda_E\,(1 + k_B\,(v_q - v_E)^2)\right)$$

but the assumed electric neutrality of the conductor implies that $\lambda_P = -\lambda_E$
and calling $\lambda_1 = \lambda_P = -\lambda_E$ then

$$F_Y = (2/y)\,k_C\,q\,\lambda_1\left((1 + k_B\,v_q^2) - (1 + k_B\,(v_q - v_E)^2)\right) =$$

[11-18] $$= -(2/y)\,k_C\,q\,\lambda_1\,k_B\,(v_E^2 - 2\,v_E\,v_q)$$

that for $v_q = 0$ (i.e. for a test charge at rest in the lab) has the non-zero value:

[11-19] $F_Y[0] = -(2/y)\ k_C\ q\ \lambda_1\ k_B\ v_E^2$

and replacing Coulomb's constant k_C by its MKS value $1/(4\ \pi\ \varepsilon_0)$, the force $F_Y[0]$ would adopt the expression:

[11-20] $F_Y[0] = -(2/y)\ q\ \lambda_1\ k_B\ v_E^2\ /(4\ \pi\ \varepsilon_0) =$

replacing $k_B = 1/(2\ c^2)$

$$= -(1/y)\ q\ \lambda_1\ v_E^2\ /(4\ \pi\ \varepsilon_0\ c^2)$$

where v_E is the speed of the electrons of the electrically neutral current carrying wire.
Notice that if the charge q is negative then the sign of $F_Y[0]$ is positive, meaning repulsion (i.e. a long standard wire carrying a current due to the "slow" drift of its electrons should repel an electron that is at rest in the lab). The drift speed v_E of the electrons of the wire should be "slow" because the equation [11-20] has assumed the hypothesis [11-3] and therefore should be considered valid only for $v_E \ll c$. It will be shown below to what extent the model predicts the hypothesis [11-3] with a constant $k_B>0$.

It has recently been found that other authors support independently the existence of this force (that is non-orthodox in mainstream Electrodynamics). See for example: A.K.T. Assis et al [1]. In an earlier paper A.K.T. Assis [2] deduced such force from Weber's electrodynamics.

NOTE 11-D

It is recognized that the prediction made by the model of the force between parallel conductors is by itself of limited interest since it corresponds to a very specific non-fundamental force. It is believed nevertheless that a description based in a unique fundamental "electro-dynamic force" between two charges moving relative to one another can describe *all* the interactions between moving electric charges using Galilean relativity and without the need to introduce the concept of the magnetic field. To be consistent with the other paradigms of this work such electro-dynamic force must be an aether-implemented force and is therefore expected to behave according to the features already described in this work. In particular, since the aetherinos carrying the information of the source charge Q to the target charge q do not travel at infinite speed but at a plurality of finite speeds, the force suffered by q at the epoch t due to the presence of Q will depend not so much on the state of Q at the epoch t but on the history of Q (previous to the epoch t). Since this history can be as varied as can be imagined, the expression of the so called "electro-dynamic force" will only be analysed for simple cases of practical interest and for which the source charge has had a simple history (e.g. has always been moving at constant velocity, or has been moving in a circle at constant speed, or has been oscillating in some simple way, etc).

The next step of this study of the forces between electrically charged particles should be to deduce, according to the basic hypothesis of the model about the electric charges, the general expression of the force produced by a "current element" on a test charge that moves in a general way relative to the current element and not necessarily parallel to it. It is believed that this will lead to the right prediction of the "Ampère expression" that gives the force between two circuits of current of any shape.

This "Ampère expression" is interpreted in mainstream physics as the consequence of applying both the Lorentz force and the Biot-Savart Law.
It is advanced that the thesis of this section is to show that from the theoretical point of view, the mainstream interpretation is an unnecessary complication and that "the magnetic field is an unnecessary concept from the point of view of **fundamental** Physics since all the forces between moving charges can be described by a unique electro-dynamic force (like the one described in this aether model) that depends on the relative velocities of the interacting charges (and is therefore different from the electric force of mainstream physics)."

REFERENCES

[1] A. K. T. Assis, W. A. Rodrigues Jr., and A. J. Mania, The Electric Field Outside a Stationary Resistive Wire Carrying a Constant Current, *Foundations of Physics*, *Vol . 29*, *No. 5*, *1999* (also at http://www.ifi.unicamp.br/~assis/Found-Phys-V29-p729-753(1999).pdf) See their equation (22)

[2] A. K. T. Assis, *Phys. Essays* **4**, 109 -114 (1991).

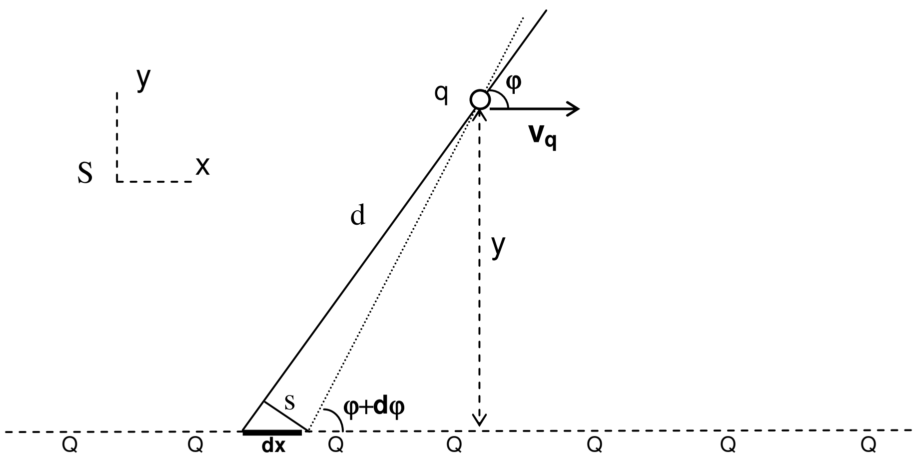
Calculus of the force exerted, according to the aether model, by a long rectilinear uniform line of charges on a test charge that moves parallel to the line with a speed v_q.

It will be shown that the model is consistent with the above hypothesis [11-3].

It was above asserted that the *force between two long rectilinear parallel currents* can be predicted if the following hypothesis is made:
A uniform, infinitely long, rectilinear line of Q-type charges that move at a speed v_Q along the direction of the line **exerts** on a q-type charge that moves at a speed v_q parallel to the line of Q type charges **a force** whose component perpendicular to the straight line of the Q type charges is given by:

[11-3] $$F_{Qq}[v_Q, v_q] = F_{Qq}[0]\,(1 + k_B\,(v_q - v_Q)^2\,)$$

where $k_B = 1/(2c^2)$ and where $F_{Qq}[0]$ is the force, given in [11-2], corresponding to $v_Q = v_q = 0$.



Fig[A-11]

Suppose an infinitely long rectilinear uniform line of Q-type charges along the X axis.
Suppose, by the moment, that those charges are at rest in the aether (that will also be the reference frame S of description).
Suppose that the (macroscopic) linear density of the Q-type charges is λ all along the line.
Suppose a q-type charge (not necessarily of a different type from Q) *moving* parallel to the line of charges at a distance y and with a speed v_q.

Consider in the rectilinear line of Q charges an element of length dx that will therefore have a charge λ dx.
Let φ be the angle that the vector joining the "beginning point" of such element with q makes with the axis +x.

It will first be calculated the force exerted on the test particle *q* by such element. (See Fig A-11).

(Note: This first part of the calculus is similar to the one of Section 5 although the variables involved have been given different names).

As has been explained in other papers of this work, a material particle (like for instance a Q-type charged particle) produces a "redistribution" of the aetherinos that collide with it. Such redistribution, that will here be called $r_Q[v_R]$, represents the excess (or deficit if $r_Q[v_R] < 0$) of aetherinos emerging from the particle with the speed v_R (relative to the particle), by unit time and by unit solid angle.

It will here be assumed that such $r_Q[v_R]$ is *isotropic* relative to the particle Q and that $r_Q[v_R]$ does not change significantly in time.
Note: In other sections of this work it is postulated that the redistributions of the basic elementary particles of the model are **not** isotropic (but are instead characterized by an axis of symmetry). It can here be interpreted that the Q-type charged particles considered have their intrinsic structure randomly oriented in space and that therefore their global redistribution can be considered isotropic.

It will also be assumed here that the function $r_Q[v_R]$ depends only on the *type* of charged particle considered but not on its (absolute) velocity relative to the local aether. This assumption can be seen[3] to be approximately true when the absolute speed of the particle causing the redistribution is "small" in comparison to the *average speed* of the aetherinos. For example, a particle speed equal to 2c is considered "small" in this context.
(Note: the mentioned *average speed* of the aetherinos refers to the reference frame in which the local aether can be considered at rest).

NOTE: According to the model, the aether is made by aetherinos of two types (n and p) of which, in an undisturbed aether, there is approximately an equal number of both types. Furthermore, in an undisturbed aether, both types of aetherinos have the same distribution of speeds. The material particles of negative electric charge suffer impulsions (i.e. a change of their velocity) when they are collided by the n-type aetherinos, while the particles of positive electric charge suffer impulsions when they are collided by the p-type aetherinos. When a particle of negative electric charge is collided by a p-type aetherino it does not suffer an impulsion but it *switches* the p-type aetherino into a n-type aetherino.

Similarly, when a particle of positive electric charge is collided by a n-type aetherino it does not suffer an impulsion but it *switches* the n-type aetherino into a p-type aetherino.

The **redistribution** $r_Q[v_R]$ of aetherinos created by a charged particle (e.g. a Q-type particle) can be calculated as follows:

The *redistribution* $r[v_R]$ of a material particle is defined in the model as the "excess or deficit *number* of aetherinos of speed v_R (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 $1/(T\ LT^{-1}) = L^{-1}$). (The *excess* or the *deficit* are in relation to the number of aetherinos of that speed that would emerge from a region of space of the "size" assignable to the particle if this particle was not there).

Suppose that Q is a particle of unit electric charge and suppose by the time being that Q is *at rest* in the environment (local) aether and that this local aether has an homogeneous and isotropic distribution of ρ[v] aetherinos of speed v by unit volume. The number of (switch-type) aetherinos of speed v colliding with Q by unit time and by unit solid angle can be calculated to give:

[A-11-0] $$\phi_I[v] = \sigma_S[v]\ \frac{\rho[v]}{2}\ \frac{v}{4\pi}$$

where

ρ[v] is the canonical distribution of aetherinos in an undisturbed aether (see [A-11-1] below).

$\sigma_S[v]$ is the cross section of a unit-charge particle to collisions with (its) *switch-type* aetherinos of speed v relative to the particle.

Note: If Q is a particle of unit positive charge (e.g. a proton) its switch-type aetherinos are the n-type aetherinos. If Q is instead, for example, an electron then its switch-type aetherinos are the p-type aetherinos. Only the collisions with its switch-type aetherinos contribute to the redistribution created by a particle since (by hypothesis) its impulsion-type aetherinos do not change their type neither their speed in their collisions with the material particles.

By hypothesis the *cross section* (averaged over all directions) of a particle of unit electric charge to collisions with its *switch-type* aetherinos is:

[A-11-0b] $$\sigma_S[v_R] = a_{S1}\ \mathrm{Exp}[-b_{S1}\ v_R^{\ 2}] + a_{S2}\ \mathrm{Exp}[-b_{S2}\ (c - v_R)^2]$$

where v_R is the speed of the incident aetherino relative to the particle, c is the speed of light, b_{S1} and b_{S2} are positive constants, a_{S1} is a positive constant but a_{S2} is a negative constant.

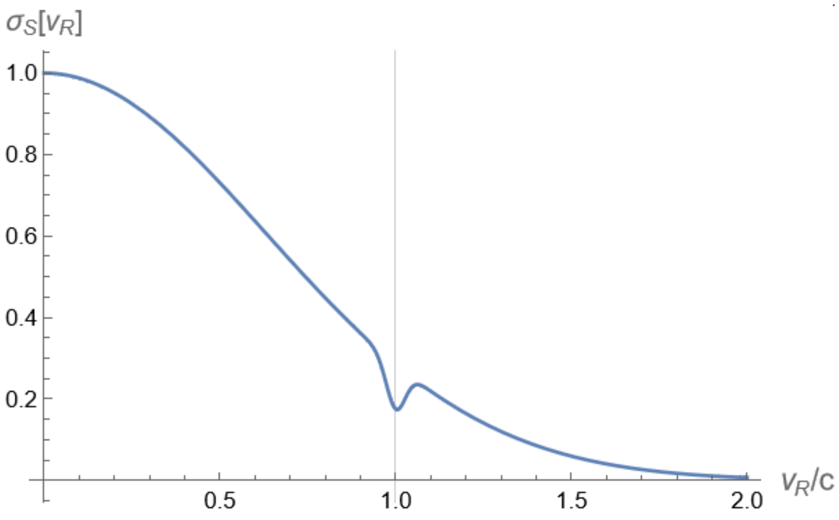
Note: in the earlier version of this paper, the constant a_{S2} was inadequately also assigned a positive value giving rise to quantitative inconsistencies.

Note: the second term of the sum (in the right hand side of [A-11-0b]) will be called a negative *resonance* in the cross section.

The cross section σ_S is the same function (with the same values of the constants) whether the unit charge particle is positive or negative (the only difference being that the positive elementary particles switch the n-type aetherinos into p-type aetherinos while the negative elementary particles do the opposite).

Note: The hypothesis [A-11-0b] about the switch cross section σ_S of a charged particle to aetherinos (as well as the mirror hypothesis related to the other interaction cross section σ_I , see below [A-11-3c]) was enounced in earlier analysis of this work with only its first term (i.e. as $\sigma_S = a_S \,\mathrm{Exp}[- b_S\, v_R^2]$). The second term $a_{2S}\, \mathrm{Exp}[- b_{S2}\, (c\text{-}v_R)^2]$, whose goal is to implement a sharp resonance of the interaction, centered at v_R=c, was added later as an attempt to account for the stability of aetherino waves in spite of the longitudinal dispersion predicted by the model.

The constants a_{S2} and b_{S2} have been assigned ad hoc values in this section to account for the correct prediction of the constant k_B of Eq[11-3].



Fig[A-11-7]
Proposed *interaction cross section* σ_S (see Eq [A-11-0b])
of a unit-charge particle with its switch-type aetherinos.
It has a "negative resonance" centered at v_R=c
In this example: a_{1S}=1, a_{2S}= –0.11, b_{S1} =1.255/c^2, b_{S2} =700/c^2

Notice that since the particle Q (whose redistribution is being calculated) has been supposed to be at rest in the aether, the speed v_R of the incident aetherinos relative to Q is equal to the speed v of those aetherinos relative to the reference frame of the aether (as a whole).

In the reference frame in which the aether can be considered at rest (i.e. in which the *average velocity* of its aetherinos is zero), the **local undisturbed aether** is assumed to have an isotropous **distribution of aetherino *speeds*** given by:

[A-11-1]
$$\rho[v] = \frac{4 N_0}{\sqrt{\pi}\, V_M{}^3}\, v^2\, e^{-(v/V_M)^2}$$

where
ρ[v] is the total number of aetherinos of speed v 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) number of aetherinos in unit volume.

Notes:
- The constant factor $4/(\pi^{1/2} V_M^3)$ in the expression of the distribution has been chosen so that, whatever V_M, the constant N_0 always represents the total number of aetherinos by unit volume. This makes easier to test the model for different V_M.
- The *distribution* [A-11-1] of aetherino speeds (in the reference frame associated with the local aether) that the model assigns to the aether has been called "canonical distribution" in other sections of this work.
- As shown elsewhere in this work, there are many possible mathematical functions that could *a priori* be assigned to the canonical distribution of the aether, giving all very similar predictions. Considering that the aether of the model, made of "point-like aetherinos that do not collide with each other", is not comparable to a gas in thermodynamic equilibrium, it is *not* imperative to postulate an aether's canonical distribution of the Maxwell type like the $\rho[v]$ of [A-11-1].

Since the $\phi_1[v]$ of [A-11-0] gives the number of switch-type aetherinos of speed v colliding with Q in unit time and by unit solid angle, then from the definition of redistribution and according to the suppositions made above:

If Q is a particle of unit *positive* charge its redistribution $r_p[v]$ of p-type aetherinos (equal to minus its redistribution of $r_n[v]$ of n-type aetherinos) will be simply given by:

[A-11-2]

$$r_{+p}[v] = -r_{+n}[v] = \phi_1[v] = \sigma_S[v]\frac{\rho[v]\, v}{8\pi} = \left(a_{S1}\ \mathrm{Exp}\left[-b_{S1}\ v_R^{\,2}\right] + a_{S2}\,\mathrm{Exp}\left[-b_{S2}\,(c-v_R)^2\right]\right)\frac{\rho[v]\, v}{8\pi}$$

that, since a_{S1} is a positive constant together with the assumption that $|a_{S2}| << a_{S1}$ then $r_{+p}[v]$ represents an *excess* of p-type aetherinos.

But if Q is a particle of *negative* unit charge its redistribution of p-type aetherinos (equal to minus its redistribution of $r_n[v]$ of n-type aetherinos) will be given by:

[A-11-2b]

$$r_{-p}[v] = -r_{-n}[v] = -\phi_1[v] = -\sigma_S[v]\frac{\rho[v]\, v}{8\pi} = -\left(a_{S1}\ \mathrm{Exp}\left[-b_{S1}\ v_R^{\,2}\right] + a_{S2}\,\mathrm{Exp}\left[-b_{S2}\,(c-v_R)^2\right]\right)\frac{\rho[v]\, v}{8\pi}$$

that represents now a *deficit* of p-type aetherinos.

The **aetherinical force that a charge Q of the line element dx exerts on the test charge q** (in the arrangement shown in Fig [A-11]) can now be evaluated as follows:

In the vicinity of q, that at the epoch of observation of the force is at a distance *d* from the given charge Q (see the Fig[A-11] above), the density of aetherinos (in excess or in deficit) of *speed* v (per unit speed interval) having emerged from Q is:

[A-11-3] $$\rho_Q[v,d] = \frac{r_Q[v]}{v\,d^2}$$

where:

$\rho_Q[v, d]$ gives the excess/deficit number of *such* speed v aetherinos in unit volume at the position of q.

d is the distance between a particle Q of the specific element dx and the test particle q at the epoch of observation of the force.

$r_Q[v]$ is the redistribution created by Q (given at [A-11-2] if Q is positive or at [A-11-2b] if Q is negative).

The expression [A-11-3] should be evident considering that, according to the definition of $r_Q[v]$ as a flux *by unit solid angle*, $r_Q[v]/d^2$ is the number of aetherinos crossing in unit time, at the vicinity of q, a unit area surface placed perpendicular to Qq. The number of speed v aetherinos having crossed such unit surface in a given unit time interval can therefore be found in an imaginary "cylinder" of base 1 and length v whose volume 1*v has therefore a numerical value equal to that of the speed v.

The model postulates that, when an aetherino (of the adequate *impulsion-type* for the target particle) collides with an elementary particle it gives to this particle an *elementary aetherinical "impulse"* equal to

[A-11-3b] $$\mathbf{i}_1 = h_1\,\mathbf{v_R}$$

where

$\mathbf{v_R}$ is the velocity of the aetherino *relative to the particle*

h_1 is a positive constant.

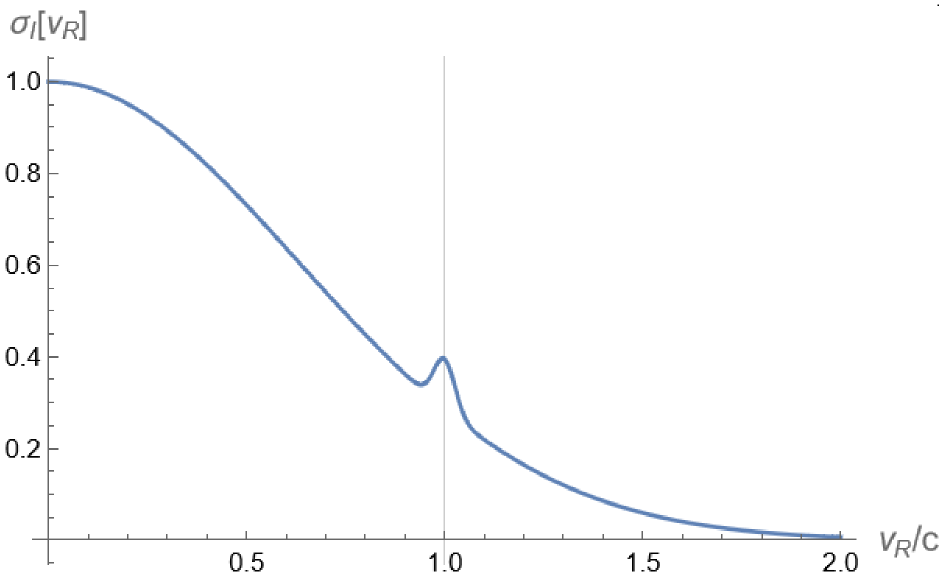
Note: as said above, the p-type aetherinos give impulse to the positive charges (but not to the negative particles) when they collide with them. Similarly the n-type aetherinos give impulse to the negative charges (but not to the positive particles) when they collide with them.

The collision cross section of a unit charge *with its impulsion-type aetherinos* is by hypothesis:

[A-11-3c] $$\sigma_I[v_R] = a_{I1}\,\mathrm{Exp}[-b_{I1}\,v_R^{\,2}] + a_{I2}\,\mathrm{Exp}[-b_{I2}\,(c-v_R)^2]$$

where c is the speed of light and a_{I1}, a_{I2}, b_{I1}, b_{I2} are positive constants. This cross section σ_I is by hypothesis exactly *the same* (with the same values of its constants) whether the collided particle of *unit* charge is positive or negative.

Furthermore, also by hypothesis of the model, the function giving the *impulsion* cross section of a particle (to its impulsion-type aetherinos) (e.g. [A-11-3c]) is the same function giving the *switch* cross section of a particle (to its switch-type aetherinos) (e.g. [A-11-0b]) and with the same values of their constants i.e. $a_{I1}=a_{S1}$, $a_{I2} = -a_{S2}$, $b_{I1}=b_{S1}$, $b_{I2} = b_{S2}$ (except for the negative sign of a_{S2})



Fig[A-11-3]

Proposed *interaction cross section* σ_I (see Eq [A-11-3c])
of a unit-charge particle with its impulsion-type aetherinos.
It has a positive "resonance" centered at v_R=c
In this example: a_{I1}=1, a_{I2}= 0.11, b_{I1} =1.255/c^2, b_{I2} =700/c^2

(P.S. Another possibility consistent with the model is that the switch cross section and the impulsion cross section of a particle are related by $a_{S1}= \kappa\, a_{I1}$, $a_{S2} = - \kappa\, a_{I2}$ with the constant κ being the same for all elementary particles. The "*b*" constants are by hypothesis the same, i.e. $b_{I1}=b_{S1}$, $b_{I2} = b_{S2}$ for all ordinary elementary particles).

<u>NOTES</u>:

a) To predict, for low current carrier speeds, a force between two long rectilinear parallel *currents* equal to $F_{Qq}[v_Q, v_q] = F_{Qq}[0]\ (1 + k_B\ (v_q - v_Q)^2\ )$ with $k_B = 1/(2c^2)$ (see Eqs [11-3] and [11-11]) the constants a_{S2} and b_{S2} of the switch cross section $\sigma_S[v_R]$ given in [A-11-0b] can be assigned, <u>for example</u> the following values:
$b_{S2} = 700/c^2$ $\quad a_{S2} = -0.11\ a_{S1}$
together with the following constants of the impulsion cross section (see Eq[A-11-3c])
$b_{I2} = 700/c^2$ $\quad a_{I2} = +0.11\ a_{S1}$
or other sets of similar, ad hoc, adequate values.
The constants b_{S1} and b_{I1} will always be assigned the value
$b_{S1} = b_{I1} = 1.255/c^2$
to account also for other predictions of the model.

In any case the constant $|a_{S2}|$ of the second term of Eq[A-11-0b] can (and must) be assumed to be much smaller (say, two orders of magnitude smaller) than the constant a_{S1} of the first term. Similarly the constant a_{I2} of the second term of Eq[A-11-3c] must be assumed to be much smaller than the constant a_{I1} of the first term. Due to it, in some contexts (e.g. in the model's descriptions of the aether drag force, gravitation…) the second term is ignored (after having checked that its contribution to those phenomena can be neglected).

b) The constants a_{S1} , a_{S2} , a_{I1} and a_{I2} , have the dimension of cross section (i.e. of surface or L^2).

c) Although the contribution of the second term to the *"average over all directions" cross section* is much weaker than the contribution of the first term, other physical facts (studied in other sections of the model) suggest that the contribution of the weak term (called resonance) is as follows:
As explained in the paper *Redistributions of aetherinos due to elementary electric charges* of this work, the basic charged elementary particles (e.g. electrons and positrons) have, according to the model, an internal *non-isotropic* structure that causes that their collision cross sections with aetherinos (e.g. the σ_S and the σ_I shown in Eqs [A-11-0b] and [A-11-3c]) are also non-isotropic and, as a consequence, the redistributions of aetherinos emerging from those elementary charged particles (e.g. those shown in Eqs [A-11-2] and [A-11-2b] below) are also non-isotropic. More precisely, the cross sections emerging from those elementary particles as well as their redistributions are assumed to have an axial symmetry. It must therefore be understood that the cross sections (and redistributions) of those particles is different along the different directions depending on the angle that the direction forms with the symmetry axis of the particle. It seems plausible (in other scenarios) that the function describing the cross sections along the orthogonal directions to the symmetry axes (i.e. along the equatorial directions of the particle) is fully of the type $\mathrm{Exp}[-b_2 (c-v_R)^2]$ (i.e. that of the second term of the sums) while the function describing the cross sections along the polar directions is fully of the type $\mathrm{Exp}[-b_1 v_R^2]$ (i.e. that of the first term).

In the scenario of Fig[A-11], the aetherinos responsible of the force being calculated travel along the semi direction Q→q and therefore, an aetherino of speed v (in the reference frame S of description) has a velocity *relative to* q given by: $\mathbf{v_R} = \mathbf{v} - \mathbf{v_q}$
The Cartesian components of $\mathbf{v}_R$ are

$$v_{RX} = (\mathbf{v} - \mathbf{v_q})_X = v \,\mathrm{Cos}\, \varphi - v_q$$

$$v_{RY} = (\mathbf{v} - \mathbf{v_q})_Y = v \,\mathrm{Sin}\, \varphi$$

and therefore the modulus of $\mathbf{v_R}$ can be written as:

[A-11-4] $$v_R = |\mathbf{v}_R| = (v^2 + v_q^2 - 2\, v\, v_q \,\mathrm{Cos}\, \varphi)^{1/2}$$

The Cartesian components of the elementary aetherinical impulse that such aetherino gives to *q* are

[A-11-5]
$$i_X = h_1\; v_{RX} = h_1 (v \,\mathrm{Cos}\, \varphi - v_q)$$
$$i_Y = h_1\; v_{RY} = h_1\; v \,\mathrm{Sin}\, \varphi$$

The number of collisions in unit time between *q* and the pertinent aetherinos (those whose density is given in [A-11-3]) can be calculated considering that *in the special reference frame where these pertinent aetherinos (those of speed* v *in S) are at rest* the particle *q* of cross section $\sigma_q[v_R]$ sweeps in unit time a cylindrical volume of length v_R. Hence this rate of collisions with aetherinos of speed v is:

[A-11-6] $n[v] = \rho_Q[v,d]\,\sigma_q[v_R]\,v_R = \rho_Q[v,d]\,\sigma_q[v_R]\,(v^2 + v_q^{\,2} - 2\,v\,v_q\,\mathrm{Cos}\,\varphi)^{1/2}$

Assuming in what follows that *q* is an elementary particle of unit electric charge, its cross section $\sigma_q[v_R]$ to impulsion aetherino collisions is just the $\sigma_I[v_R]$ postulated above, i.e.

[A-11-7] $\sigma_q[v_R] = \sigma_I[v_R] = a_{I1}\ \mathrm{Exp}[-b_{I1}\ v_R^{\,2}] + a_{I2}\,\mathrm{Exp}[-b_{I2}\,(c - v_R)^2]$

The aetherinical impulse given to *q* by all the n[v] collisions occurring in unit time has therefore the Cartesian components:

[A-11-8]
$$F_{nX}[v] = n[v]\,i_X = \rho_Q[v,d]\,\sigma_I[v_R]\,v_R\,h_1\,(v\,\mathrm{Cos}\,\varphi - v_q)$$
$$F_{nY}[v] = n[v]\,i_Y = \rho_Q[v,d]\,\sigma_I[v_R]\,v_R\,h_1\,v\,\mathrm{Sin}\,\varphi$$

(Remember that the *force* is defined in the model as the *net aetherinical impulse in unit time*).

The components of the aetherinical force $\mathbf{F}_{Qq}$ that a charge Q of the specific line element shown in Fig[A-11] exerts on the test charge *q* are finally obtained adding for the pertinent aetherinos of all speeds:

[A-11-9]
$$F_{QqX} = \int_0^\infty F_{nX}[v]dv = \frac{h_1}{d^2}\int_0^\infty r_Q[v]\,\sigma_I[v_R]\,v_R\,(\mathrm{Cos}\,\varphi - \frac{v_q}{v})\,dv$$
$$F_{QqY} = \int_0^\infty F_{nY}[v]\,dv = \frac{h_1}{d^2}\int_0^\infty r_Q[v]\,\sigma_I[v_R]\,v_R\ \mathrm{Sin}\,\varphi\ dv$$

where the substitution [A-11-3] has been made.

The Y-component of the force exerted by *all* the Q-type charges *of the* dx *element* is therefore:

[A-11-10] $$F_{dx\,qY} = \frac{h_1\,\lambda_Q\,dx}{d^2}\mathrm{Sin}\,\varphi\int_0^\infty r_Q[v]\,\sigma_I[v_R]\,v_R\ dv$$

where λ_Q is the number of Q-type particles by unit length in the long rectilinear uniform line of charges.

The calculus is especially interested in evaluating the net Y-component of the force that *the total line* of Q-type charges exerts on the test particle q that is moving at speed v_q parallel to the line.
To integrate to all the φ it must be observed (see Fig A-11) that the differentials dx and $\delta\varphi$ are related by:

$$s = d\ \delta\varphi$$

and by $s = \mathrm{Sin}\ \varphi\ dx$

[A-11-11] $\Rightarrow\quad dx = \dfrac{d}{\mathrm{Sin}\,\varphi}\,\delta\varphi$

and since $d = y/(\text{Sin}\ \varphi)$ then $dx/d^2 = \delta\varphi\ /y$ and therefore the Y-component of the force on *q due to the whole line* of Q-type charges is:

[A-11-12] $$F_Y = \frac{h_1\,\lambda_Q}{y}\int_0^{\pi} \text{Sin}\,\varphi \int_0^{\infty} r_Q[v]\,\sigma_I[v_R]\,v_R\,dv\,\delta\varphi$$

which is the Y-component (i.e. perpendicular to the line of charges) of the force exerted by a long rectilinear line of Q-type charges, at rest in the lab, on a unit charge q that moves at a speed v_q *parallel to the line (at a distance y).*

Where (see [A-11-4]) the "explicit" expressions of the *impulsion cross section* $\sigma_I[v_R]$ of an elementary particle *q* of unit charge (see [A-11-7]) and of the *redistribution* $r_Q[v]$ of a Q-type unit charge (see [A-11-2]) are:

$$\sigma_I[v_R] = a_{I1}\ \text{Exp}\left[-b_{I1}\ (v^2 + v_q^{\ 2} - 2\,v\,v_q\,\text{Cos}\,\varphi)\right] + a_{I2}\,\text{Exp}\left[-b_{I2}\ \left(c - (v^2 + v_q^{\ 2} - 2\,v\,v_q\,\text{Cos}\,\varphi)^{1/2}\right)^2\ \right]$$

$$r_Q[v] = \sigma_S[v]\frac{\rho[v]\,v}{8\pi} = \frac{N_0}{2\pi^{3/2}\,V_M^{\ 3}}\left(a_{S1}\ \text{Exp}\left[-b_{S1}\ v^2\right] + a_{S2}\,\text{Exp}\left[-b_{S2}\,(c-v)^2\right]\right)\,v^3\ \text{Exp}\left[-\left(\frac{v}{V_M}\right)^2\right]$$

where the distribution $\rho[v]$ of aetherino speeds of the local aether (see [A-11-1]) has been made explicit.

Some quantitative analysis.

It can be seen that, for very small values of v_q, the modulus of the force F_Y of the expression [A-11-12] *increases first in a quadratic way* and later, for higher values of v_q starts to decrease (see the blue curve of Fig[A-11-15]).

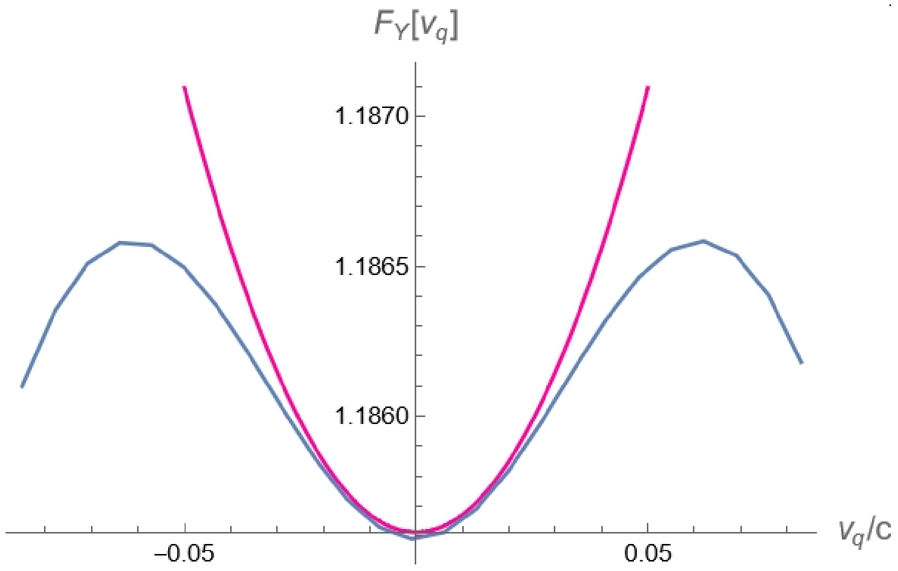
If it is assumed, ad hoc, that the constants (that appear in the expression [A-11-12]) have, for example, the values:

$a_{S1} = a_{I1} = 1$; $b_{S1} = b_{I1} = 1.255/c^2$; $-a_{S2} = a_{I2} = 0.11$; $b_{S2} = b_{I2}\ 700/c^2$

then it happens that the force F_Y can, in its increasing zone (corresponding to small values of v_q), be very accurately approximated (see the red curve of Fig[A-11-15]) by:

[A-11-15] $F_Y[v_q] = F_Y[0]\ (1 + (0.5/c^2)\ v_q^{\ 2})$ *approximation of the force* F_Y *for* $v_q \ll c$,

confirming therefore that the hypothesis [11-3] enounced above to describe the force between two long rectilinear wires of current can actually be considered a prediction of the model.



Fig[A-11-15]
In blue, prediction of the force [A-11-12]
that a long rectilinear line of charges exerts on a test charge
that moves parallel to the line at a speed v_q.
In red, approximation $F_Y[0](1 + 0.5\, v_q^2/c^2)$ valid for vq << c

The blue curve of Fig[A-11-15] corresponds to the assignment $a_{S1} = a_{I1} = 1$; $b_{S1} = b_{I1} = 1.255/c^2$; $-a_{S2} = a_{I2} = 0.11$; $b_{S2} = b_{I2}\ 700/c^2$ of the parameters appearing in such expression of F_Y. With slightly different values of the parameters (maintaining a given relation with each other) adequate predictions can also be made in this and in other contexts. But with pairs of values outside such limited range, the curve of F_Y can no longer be approximated (for $v_q << c$) by the function $F_Y[0](1 + k_B\, v_q^2)$ with $k_B = 1/(2\, c^2)$ as is the thesis of this paper. (It can still be approximated by a function of the type $F_Y[0](1 + k_B\, v_q^2)$ but with a value of k_B different from $k_B = 1/(2\, c^2)$).

In other study of the aether model it has been shown that the redistribution of aetherinos created by an elementary particle does not depend significantly on the absolute speed V of the particle relative to the aether as long as $V << V_M$ (where V_M is the speed for which the local aether has a maximum number of aetherinos). For example, since it is expected that the average speed of the aetherinos of the aether is many orders of magnitude bigger than the speed of light, it follows that the redistribution of a particle does not vary significantly as long as the absolute speed of the particle is smaller than, say, a few times the speed of light.

Considering also that, according to the model, the force between two particles depends only on their redistributions of aetherinos and on the *relative velocity* of the particles, it follows that the force that a long rectilinear line of charges at rest (V_Q=0) in the reference frame of description exerts on a charge q that moves parallel to the line at a speed v_q must be very approximately equal to the force that a long rectilinear line of charges that move at a speed V_Q in the reference frame of description exerts on a charge q that moves parallel to the line at a speed $v_q + V_Q$ and therefore the result [A-11-15] $F_Y[v_q] = F_Y[0]\,(1 + (0.5/c^2)\, v_q^2)$ predicted by the model implies also that

[A-11-16] $F_Y[v_Q, v_q] = F_Y[0]\ (1 + (0.5/c^2)\ (v_q - v_Q)^2\ )$

which is equivalent to the hypothesis [11-3] enounced above.

The following graphics (Figs[A-11-16,…,A-11-20]) are also specific evaluations of the above equations corresponding to

$a_{S1} = a_{I1} = 1$; $b_{S1} = b_{I1} = 1.255/c^2$; $-a_{S2} = a_{I2} = 0.11$; $b_{S2} = b_{I2} = 700/c^2$

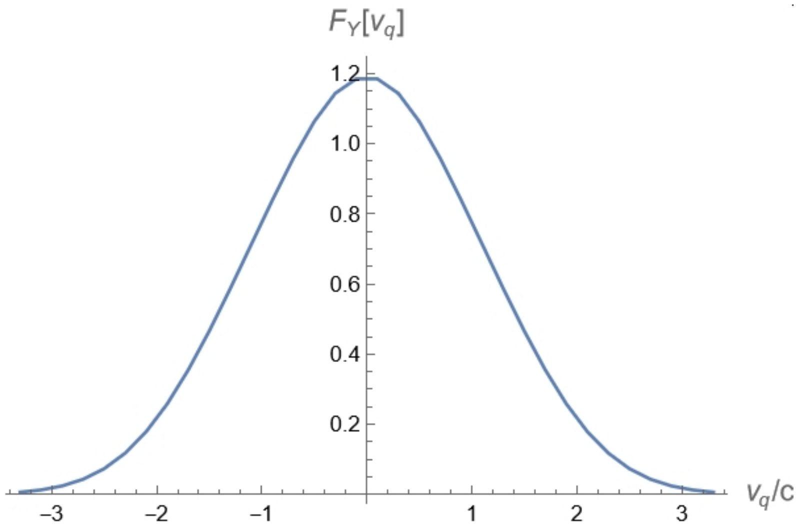
and where it has been supposed (only for the purpose of showing the graphics) that:

$V_M = 10^{10}\ c$, $c=1$, $N_0 = 10^{32}$

and that in arbitrary units

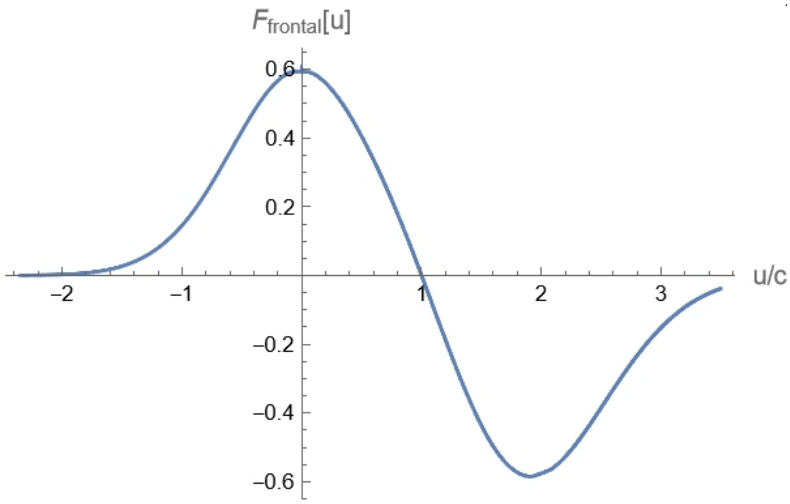
$y=1$, $h_1=1$, $\lambda_Q=1$,

Note: It can be seen that the values assigned by the model to V_M and to N_0 do not affect the shape (but only the height) of the following three graphics



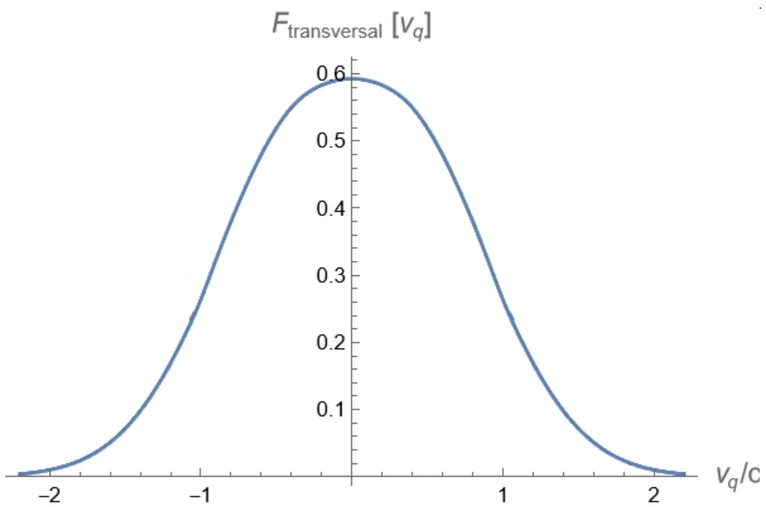
Fig[A-11-16]

In arbitrary units, prediction, **for a wide range of speeds** v_q, of the force [A-11-12] that a long rectilinear line of charges exerts on a test charge that moves parallel at a speed v_q.



Fig[A-11-17]

In arbitrary units, prediction of the force that a *single* charge exerts on a test charge that *moves directly towards or away* from the first at a speed v_q.



Fig[A-11-18]

In arbitrary units, prediction of the **transversal force** that a *single* charge exerts on a test charge moving at a speed v_q at the instant that this test charge passes at its shortest distance from (*abeam*) the first. (*Transversal* means here the component of the force along the direction joining the two charges at the instant of observation of the force)

P.S. While writing this paper it has been found that, if it is supposed that the sharp resonance terms in the interaction cross sections are of the type
a_2 Exp[-b_2 $((c\text{-}v_R)^2)^{\mathbf{1/2}}$] instead of a_2 Exp[-b_2 $(c\text{-}v_R)^2$]
then, better results are predicted in other contexts of the model like for instance a greater stability of the wave form and the modulation of radiation when traversing great distances (see Section 8). Therefore the new hypothesis for the averaged cross sections of a charged particle to interact with the aetherinos of relative speed v_R could be:

[A-11-20] $\sigma_S[v_R] = a_{S1}$ Exp[- b_{S1} v_R^2] + a_{S2} Exp[-b_{S2} $((c-v_R)^2)^{\mathbf{1/2}}$] (switch cross section, with $a_{S2} < 0$)

[A-11-21] $\sigma_I[v_R] = a_{I1}$ Exp[- b_{I1} v_R^2] + a_{I2} Exp[-b_{I2} $((c-v_R)^2)^{\mathbf{1/2}}$] (impulsion cross section)

With those cross sections, a set of parameters that makes a good prediction of the force between two long rectilinear parallel current carrying conductors, or more precisely a good fit of the above Eq[A-11-15] i.e. of

[A-11-15] $f_Y[v_q] = F_Y[0]\ (1 + (0.5/c^2)\ v_q^2)$ *approximation, valid for* $v_q << c$, *of the force* F_Y

is for example:
$a_{S1} = a_{I1} = 1$; $b_{S1} = b_{I1} = 1.255/c^2$; $-a_{S2} = a_{I2} = 0.1$; $b_{S2} = b_{I2} = 42/c$

It has also been found that, if it is supposed that the sharp resonance terms in the interaction cross sections are of the type

a_2 Exp[-b_2 $((c\text{-}v_R)^2)^{\mathbf{1/4}}$]

then, still better results are predicted in other contexts of the model like for instance a greater stability of the wave form and the modulation of radiation when traversing great distances (see Section 8). The full expressions of these cross sections of a charged particle to interact with the aetherinos of relative speed v_R would now be:

[A-11-22] $\sigma_S[v_R] = a_{S1}$ Exp[- b_{S1} v_R^2] + a_{S2} Exp[-b_{S2} $((c-v_R)^2)^{\mathbf{1/4}}$] (switch interaction cross section)

[A-11-23] $\sigma_I[v_R] = a_{I1}$ Exp[- b_{I1} v_R^2] + a_{I2} Exp[-b_{I2} $((c-v_R)^2)^{\mathbf{1/4}}$] (impulsion interaction cross section)

And in what respects this paper, the goal of predicting within the model that the force exerted by a long rectilinear line of charges on a charge q that moves parallel to the line at a speed v_q is of the type of the above Eq[A-11-15] can now (with these new cross sections) be fulfilled for example with:
$a_{S1} = a_{I1} = 1$; $b_{S1} = b_{I1} = 1.255/c^2$; $-a_{S2} = a_{I2} = 0.0015$; $b_{S2} = b_{I2} = 7/c^{1/2}$

Note: Often in this work (like in the second term of Eq[A-11-20]) a function is written in the form $(F^2)^{1/2}$ instead of in the equivalent and simpler form Abs[F]. This is just to remind that the *Mathematica* (of Wolfram Research) software (used in the background all along this work) makes its calculations in a much more effective way when the expression is written in the first form.

[3] The paper *Redistributions of aetherinos due to elementary electric charges* of this work explains the simulations that have been done to evaluate the influence that the speed of a particle relative to the aether has on the redistribution of aetherinos created by such moving particle.