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Forces and Newton's laws.

As seen in Section 1, when an aetherino collides with an elementary particle with a relative velocity $\mathbf{v_R}$ it gives, **by definition**, to the particle *an elementary aetherinical impulse* $\mathbf{i_1}$ equal to:

[1-0] $$\mathbf{i_1} = h_1 \, \mathbf{v}_R$$

where h_1 is a universal constant.

The "elementary aetherinical impulse" is just an *auxiliary* concept with which to define the concept of force.

The word "elementary" is to remark that the impulse corresponds to a collision by a *single* aetherino.

(Remember: the model supposes that there exists a reference frame (and hence an infinity of them), called *rectilinear*, in which all the aetherinos of the universe travel in straight lines at constant speeds).

A force, suffered by a particle, *is defined as the net aetherinical impulse received by the particle in unit time.*

(By *net aetherinical impulse* it must be understood the *vector sum of the aetherino impulses* received by the particle).

Such definition of force is assumed to be valid for all the forces recognized by mainstream physics since according to the model they are all implemented by collisions of aetherinos. (Note: the forces of the "EVE model of the aether" are called *aetherinical* because they are implemented by aetherinos).

But, for such definition of aetherinical force to have a meaning in accordance with the concept of force of mainstream physics, it must be assumed that the evaluation of a force must be done during a time interval *long enough* for the particle to suffer a statistically significant number of aetherino impacts (while at the same time *small enough* to allow its treatment as an infinitesimal time interval from the macroscopic point of view and hence to allow an aetherinical force to be treated as an *instantaneous* force).

Hypothesis B: *when an aetherino collides with an elementary particle with a relative velocity* $\mathbf{v_R}$ *it produces on this particle an increment of velocity* $\Delta_1\mathbf{v}$ *equal to:*

[3-1] $$\Delta_1 \mathbf{v} = \frac{i_1}{\mu_P} = \frac{h_1}{\mu_P} \mathbf{v}_R$$

where μ_P is a constant specific of the collided particle that the model associates with its "*inertial mass*".

According to that hypothesis B and to the definition of force made by the model, it follows that the force suffered by an elementary particle that suffers *n* collisions of aetherinos during a time interval Δt, takes the form:

[3-2] $$\mathbf{F} = \frac{\sum_{j=1}^{j=n} \mathbf{i_{1j}}}{\Delta t} = \frac{\mu_P \sum_{j=1}^{j=n} \Delta \mathbf{v_j}}{\Delta t} = \mu_P \, \mathbf{a}$$

where $\mathbf{a}$ is the net increment of velocity suffered by the particle in unit time.

NOTE 3-0:
It is not evident that such "net increment of velocity in unit time" is coincident with the acceleration acquired by the particle from a "macrotime" point of view (e.g. when deducing its acceleration from the changes in its position (using $\Delta x = v_0 \Delta t + 1/2\, a\, \Delta t^2$) evaluated at *time intervals* Δt *long enough* for the particle to suffer a statistically significant number of aetherino impacts). It is not evident because the particle, besides receiving impacts from aetherinos "emerging" from the matter that originates the force, it also receives a high rate of random impacts of aetherinos from its surrounding aether. Therefore, supposing instead that the particle is bathed by a local aether with a *different* density and/or *different* average speed of aetherinos, but subject nevertheless to the same net force, the question arises whether the particle would suffer the same "macrotime" acceleration as in the earlier different local aether.
Computer simulations have been done supposing the particle subject to *the same net force* but in different local aethers (i.e. supposing different density and/or different average speed of its aetherinos) and evaluating its acceleration (after a big number of aetherino collisions) using the "macrotime criterion" $\Delta x = v_0 \Delta t + 1/2\, a\, \Delta t^2$
The simulations did not find any significant dependence of the average acceleration acquired by the particle on the "density" nor "temperature" of the local aether. (The word *average* has been added because the simulations show that when the rate of excess collisions implementing the force is very small compared to the rate of collisions from aetherinos of the local aether (whose global contribution to the force is negligible) then the particle accelerates with the expected average value but with specific values that change in time with some randomness).
But on the other hand it is expected that: if a given matter exerts on a given target particle a net force F when in a given local aether, it will produce a different force F' in an aether with different aetherino's "density" or "temperature" since, according to the model, the forces originate in the *redistribution of the local aetherinos* by some specific matter.

The Eq[3-2] should be understood to say that *the acceleration acquired by an elementary particle subject to a force is equal to the force divided by a constant specific of the particle that can be called its inertial mass* therefore in accordance with Newton's 2nd law.

From another point of view, focusing now on the evaluation of an *elementary aetherinical impulse,* it can be written:

[3-2b] $$\mathbf{F} = \frac{\sum_{j=1}^{j=n} \mathbf{i}_{1j}}{\Delta t} = \frac{h_1 \sum_{j=1}^{j=n} \mathbf{v}_{Rj}}{\Delta t}$$

which can be considered the theoretical way to evaluate the force suffered by a material particle that suffers *n* collisions of aetherinos (of whatever relative velocities $\mathbf{v}_{R1}$, $\mathbf{v}_{R2}$,...$\mathbf{v}_{Rn}$) during a time interval Δt.

NOTE 3-1:
A velocity *increment* (i.e. the difference between two velocities) is an invariant in the Galileo transformations between any two reference frames moving at constant velocity relative to each other. A velocity *increment* is a vector that points in the same direction and has the same modulus in all reference frames (that share the same space standards and the same clock). It is a classical, simple, defined concept that is nevertheless known to produce some discomfort when one has the habit to think in terms of the theory of Relativity thus conceiving

space time as a physical reality instead of as mathematically defined concepts. Since according to the model, *a force* can be evaluated by the velocity *increment* (divided by a time interval of the absolute time) suffered by a particle, then *forces* are also *invariants* in the Galileo transformations between any two reference frames.

The hypothesis B is a microscopic law that must not be confused with the laws of collisions between material particles with mass of mainstream mechanics. In today's physics, the concept of mass is an enigmatic attribute of a material body. The model pretends to shed some light on the concept of mass.

NOTE 3-2:

Suppose that at a given initial epoch an elementary particle is at position x_0 and has a velocity $\mathbf{u}_0$. (These quantities are precise real numbers that the theorist defines without ambiguity when he operates in the world of the model. They should not be confused with the correspondent quantities that a real experiment can measure with limited resolution). Suppose that the theorist wants to predict the position x[t] and velocity **u**[t] of the particle at a later epoch t and suppose that he wants to make this prediction from the "macroscopic (i.e. statistical) knowledge of the aetherino's speed distribution of the local aether" but ignoring the detailed positions and velocities of each aetherino. It seems evident that after the first (semi-random) collision with an aetherino the particle will loose memory of its initial velocity and hence no strictly "classical" relation can be established between the initial velocity of the particle and the positions where it is found at later times. It can be said that the bigger the constant h_1/μ_P of the hypothesis B, the less classical is the behavior of the material particle. But in any case, strictly speaking, it must be admitted that there is no classical law of movement of an elementary material particle in the aetherino model.

There remains nevertheless a collective memory of their initial velocity in the behavior of a large number of identical particles; i.e. if a statistically large number of elementary particles are all prepared with the same initial velocity $\mathbf{u}_0$ in a given reference frame where there exists a specific aetherino distribution, then an exact relation may be found between $\mathbf{u}_0$ and the *average* positions of the particles at any later time t. (No proof is given of this assertion but a rough computer simulation of aetherino collisions shows that such relation exists). This allows to define a semi classical probabilistic law of movement of a material particle.

Let ρ[**v**] be, in a reference frame S, the aetherino's velocity distribution in the neighborhood of a material particle. To be able to mathematically predict a law of movement of the material particle subject to the aetherinical force produced by its local aetherino's distribution, this force must be unambiguously evaluated. But, in the way that the *aetherinical force* has been defined, its value will only be unambiguous if the material particle has a constant velocity in S during a time interval big enough for many aetherino collisions to occur. This is so because such force is dependent on the velocity of the particle *relative to* the distribution of aetherinos and because a classical force (able to conveniently predict a the movement of a particle) is a macroscopic statistical concept that must be understood as the "average" net impulse per unit time. But if the material particle keeps jiggling about (due to the aetherino collisions implementing the force) it can no longer be strictly said that it has a constant velocity in S during the evaluation of the force. (Only if the constant h_1/μ_P of Eq [3-1] happened to be so small that all aetherino collisions produced a speed change of the material particle much smaller than the experimental power of resolution of a particle's speed it could be said that the definition of a *classical aetherinical force* is an unambiguous concept. But nothing can be said a priori of the size of the constant h_1/μ_P). There nevertheless seems to be a semi classical "way out" of this description problem without the need of a quantum mechanic's formalism. The instantaneous value of a force may by definition be understood to evaluate the sum of impulses (by unit time) of the aetherinos on an hypothetic material particle that doesn't jiggle but has a constant velocity equal to the average velocity of the real jiggling particle that it represents. It is when calculating *the "effect"* (velocity change) of this aetherinical force *on the* average *movement* of the material particle that the description will take into account the consequences of the microscopic jiggling. Therefore a classical force can be supposed to admit a classical treatment and there is then no contradiction in imagining for it a time interval big enough for the averaging of many aetherino collisions and at the same time small enough to allow its treatment as an infinitesimal time interval from the macroscopic point of view and hence to allow the aetherinical force to be treated as an *instantaneous* force. This force can then be assumed to be expressible by a continuous function of continuous time derivatives without conflicting with its microscopic roughness.

NOTE 3-3:

(This note is just a first glance at some epistemological questions related with the model. It tries to give a feeling of how the model is understood, but most of what is said here might need to be revised or simply ignored).

From some point of view the laws of physics can be classified either as "classical laws" or as "statistical (or probabilistic) laws". Let *unknown* be the generic name of a physical magnitude predicted by a (mathematical) law when a given set of other magnitudes is known.

A given theory might define exactly all the magnitudes involved in some phenomena, relate them in a deterministic way and enounce some laws predicting single exact values for the corresponding unknowns. These laws will be called *classical*. The experimental physicist will assert the validity of this classical law when each experimentally determined error segment of the unknown contains the exact mathematical value given by the function defining the law.

Another type of law occurs when a theory makes use (together perhaps with non fluctuating magnitudes) of magnitudes defined in a probabilistic (but unambiguous) way (e.g. leaning on some well defined mathematical *distribution*) and relates them enouncing some laws that will therefore make probabilistic predictions of the corresponding unknowns as well as precise predictions of their averages. These laws are called *statistical*. The experimental physicist will check the validity of this statistical law when, experimentally measuring the *unknown* an enough number of times (through a repetition of the experiment under the same conditions), he obtains a distribution of values that fits the probability distribution predicted by the law. The measured average value of such unknown must differ from the predicted average value given by the law less than the experimental error. But the individual measured values differ in general from the predicted average more than the experimental error.

In the *aetherino's model*, a law predicting the movement of a material body cannot be classical from a strict theoretical point of view although it may happen, from the experimental point of view, that if the body is made of a big number of material particles, the averaging between these may hide the fluctuations in the position assigned to the global body by the experimenter. But *from a theoretical point of view*, the time and space resolving powers of the observer could be increased at will and hence even the fluctuations in the position of a big body, caused by the statistical behavior of the aetherinos could "in principle" be observed with the consequence that any previously called classical law should from then on be treated as a statistical one.

From the point of view adopted in this work, a *quantum mechanics* law is considered simply a statistical law whose statistical character is caused by the aetherino's semi-random behavior. The main difference between quantum mechanics and mainstream *statistical mechanics* would perhaps be that in the former there is interest in knowing (as precisely as possible) the "partially" random positions and velocities of some microscopic constituents (the material particles, although not the aetherinos) while in the latter there is no interest and no point in describing the "entirely" random positions and velocities of its microscopic constituents (atoms, molecules, …).

From another point of view the proposed model is a *deterministic* description of the physical world. This does not contradict the assertion that the laws deduced from the model are intrinsically statistical: The aetherinos are admitted to exist and behave in a deterministic precise way. But on the other hand they can not be seen (by a real observer making physics) because they are the vehicles of light and touch..., and therefore only statistical predictions can be made from a strict point of view.

Nevertheless the acceptance of determinism is considered a matter of convention, because, (even supposing that the model proposed could explain all the main experimental facts), since the aetherinos cannot be "seen", no claim can be made to identify the model with the "reality" of Physics, because it could happen that a different non deterministic theory (e.g. quantum mechanics) could also explain *all* the main experimental facts.

This section seeks to deduce a "classical" law (like Newton's 2nd law) for the movement of a material body in the aether of the model. A classical law will only fit the real microscopic movement of a *single* elementary particle if for it $h_l/\mu_P \ll 1$. For a composite body made of *n* elementary particles, a classical law will fit the microscopic movement of the body (represented by the average position of its component particles) when $h_l/(\mu_P\, n) \ll 1$. All these considerations seem to be directly related with the conventions of mainstream physics in setting the boundaries between classical and quantum phenomena (i.e. Heisenberg's principle of uncertainty, etc). It is believed that the particles of small mass of the real world (like the electron) move in a typical jiggling way, being the reason why a quantum probabilistic description is needed to explain the experimental facts. Newton's second law is more appropriate for the description of material bodies made of a *big* number of elementary particles, i.e. it doesn't seem likely for most elementary particles that $h_l/\mu_P \ll 1$, but bigger bodies can always be found for which $h_l/(\mu_P\, n) \ll 1$.

The mainstream concepts of position, velocity and acceleration of a compact body can be extended to a "composite (not necessarily compact) body" of the model as follows:

The *position* of a composite body will be defined as the *mean* position of its Simple particles:

[3-3]
$$\mathbf{r}_C = \bar{\mathbf{r}}_i = \frac{1}{n}\sum_{i=1}^{n}\mathbf{r}_i$$

It is then natural to define the *velocity* of a composite body as:

[3-4]
$$\mathbf{v}_C = \frac{d\,\mathbf{r}_C}{d\,\tau}$$

therefore:

[3-5]
$$\mathbf{v}_C = \frac{1}{n}\sum_{i=1}^{n}\frac{d\,\mathbf{r}_i}{d\,\tau} = \frac{1}{n}\sum_{1}^{n}\mathbf{v}_i = \bar{\mathbf{v}}_i$$

Similarly for higher derivatives. E.g. for the *acceleration*:

[3-6]
$$\mathbf{a}_C = \frac{d\,\mathbf{v}_C}{d\,\tau} = \frac{1}{n}\sum_{i=1}^{n}\frac{d\,\mathbf{v}_i}{d\,\tau} = \frac{1}{n}\sum_{1}^{n}\mathbf{a}_i = \bar{\mathbf{a}}_i$$

Imagine first a single elementary particle in a given "macroscopically smooth" aetherino distribution. At the microscopic level, according to hypothesis B, it can be inferred that the particle suffers abrupt short living velocity changes at each collision (i.e. it jiggles).

To calculate the macroscopic movement of the particle (e.g. its *average* velocity in a time interval in which it suffers a big number of aetherino collisions) it will seem reasonable to postulate that between two consecutive collisions with aetherinos, the particle maintains a constant velocity in any given *rectilinear frame* (i.e. in a reference frame where the aetherinos travel, by definition, at constant velocity).

The next goal is to deduce a law for the *macroscopic* movement of a material body that suffers an aetherinical force. The deduction will lean on the application of hypothesis B to the aetherinical collisions suffered by the body.

When the material body is composite (i.e. an ensemble of several elementary particles), an aetherinical impulse is said to be given to the body every time that an aetherino gives an impulse to any of its component particles.

The "macroscopic movement" is understood to be described by the time evolution of the macroscopic or average position of the body over many identical experiments . If the body is made of many, say *n*, elementary particles and hence $h_1/(\mu_P\, n) << 1$, such average position will be in practice relatively very close to the real position (see [3-3]) of the body in any single experiment.
The "macroscopic (or average) velocity" of a particle or body at the epoch τ can be defined as the time derivative of its average position at the epoch τ. Again, if the body has a small $h_1/(\mu_P\, n)$, this velocity $v[\tau]$ will in practice be relatively very close to the actual velocity (see [3-4]) of the body in any single experiment.

Suppose that a material body made of n elementary particles is subject to an aetherinical net force $\mathbf{F}[\tau]$. $\mathbf{F}[\tau]$ is the net aetherinical impulse given *to all the particles of the body* in unit time, at the epoch τ, by all the colliding aetherinos whatever their origin (i.e. whatever ascription to a specific type of influence might be made for other purposes). Therefore, by definition, the aetherinical force on a composite particle (or body) is the vector sum of the aetherinical forces acting at a given epoch on its elementary particles:

[3-7] $$\mathbf{F}[\tau] = \sum_{i=1}^{n} \mathbf{F}_i[\tau]$$

Example 1

The body is supposed to be made of *n* *equal* elementary particles (all with the same mass constant μ_P).

It can then be written

[3-8] $$\mathbf{F} = \sum_{i=1}^{n} \mathbf{F}_i = \sum_{i=1}^{n} \mu_P\, \mathbf{a}_i =$$

where, according to [3-2], the force $\mathbf{F}_i$ suffered by the i_{th} elementary particle has been replaced by the product of its acceleration $\mathbf{a}_i$ and its mass constant μ_P

[3-8b] $$= \mathbf{F} = n\, \mu_P \frac{1}{n} \sum_{i=1}^{n} \mathbf{a}_i = n\, \mu_P\, \overline{\mathbf{a}}_i = n\, \mu_P\, \mathbf{a}_C$$

where the product ($n\, \mu_P$) can be called, by similitude, the inertial mass of such body.
Equation [3-8b] is an expression relating *a generic aetherinical force* acting on a composite body (made of n equal elementary particles) with the acceleration $\mathbf{a}_C$ suffered by it. The Eq[3-8b] is valid in the rectilinear reference frames (where the Eq[3-2] has been supposed (by hypothesis) to be valid).

Example 2

A bound compact body composed of many, not necessarily equal, elementary particles.

Let a composite body or particle CP be composed of k elementary particles, not necessarily equal, of mass constants given respectively by $\mu_1, \mu_2, ..., \mu_k$, but now suppose that those component *particles are tightly bound to the ensemble* (by internal mutual forces) so that when the CP suffers an external force **F** (due to a given flow of aetherinos) all the component particles move with the same acceleration **a**, which is also the acceleration of the CP.

But the acceleration suffered by each elementary component particle is the ratio between the force that it suffers and its mass constant:

[3-9] $\mathbf{a}_1 = (\mathbf{F}_1+\mathbf{F}_{i1})/\mu_1, \quad \mathbf{a}_2 = (\mathbf{F}_2+\mathbf{F}_{i2})/\mu_2, \quad ... \ , \quad \mathbf{a}_k = (\mathbf{F}_k+\mathbf{F}_{ik})/\mu_k$

where $\mathbf{F}_1, \mathbf{F}_2, ..., \mathbf{F}_k$ are the *external* forces (aetherinical impulses by unit time) suffered by the respective component particles due to the flow of aetherinos coming from outside the CP (and therefore, by definition the force **F**, suffered by the CP is $\mathbf{F} = \mathbf{F}_1 + \mathbf{F}_2 + ... + \mathbf{F}_k$). (Note: one or more of the net values of these external forces could be zero, for example if the external force corresponds to an electric field and the pertinent component particle has zero electric charge).
and where the forces $\mathbf{F}_{i1}, \mathbf{F}_{i2}, ... \mathbf{F}_{ik}$ are the *internal* forces that act on each component particle due to the rest of the particles of the CP. (These internal forces are responsible of sustaining the bounding of the CP).
But since the CP is supposed to maintain a stable bounding, the individual accelerations $\mathbf{a}_1, \mathbf{a}_2, ..., \mathbf{a}_k$ of the component particles can be supposed to be equal to themselves and equal to the acceleration assignable to the CP, i.e.
$\mathbf{a}_1 = \mathbf{a}_2 = ... = \mathbf{a}_k = \mathbf{a}$

and therefore (see [3-9]) =>
[3-10] $(\mathbf{F}_1+\mathbf{F}_{i1})/\mu_1 = (\mathbf{F}_2+\mathbf{F}_{i2})/\mu_2 = ... = (\mathbf{F}_k+\mathbf{F}_{ik})/\mu_k = \mathbf{a}$

and from the well known algebraic relation that "for a set of equal fractions the ratio of the sum of their numerators to the sum of their denominators is also a fraction equal to the rest" it can be written according to [3-10]:

[3-11] $... (\mathbf{F}_k+\mathbf{F}_{ik})/\mu_k = \mathbf{a} = (\mathbf{F}_1+\mathbf{F}_{i1} + \mathbf{F}_2+\mathbf{F}_{i2} + ... + \mathbf{F}_k+\mathbf{F}_{ik}) / (\mu_1 + \mu_2 + ... + \mu_k)$

but it is reasonable to assume that the *sum of the internal forces* between the particles is zero
$\mathbf{F}_{i1} + \mathbf{F}_{i2} + ... + \mathbf{F}_{ik} = 0$
(which is evident in the case of a CP composed of only 2 component particles A and B since, according to Newton's 3rd law, $\mathbf{F}_{iB} = - \mathbf{F}_{iA}$)
and therefore the equality of expression [3-11] implies:

[3-12] $\mathbf{a} = (\mathbf{F}_1 + \mathbf{F}_2 + ... + \mathbf{F}_k) / (\mu_1 + \mu_2 + ... + \mu_k)$

that since the external force **F** is equal to $\mathbf{F}_1 + \mathbf{F}_2 + ... + \mathbf{F}_k$ it can be written:

[3-12b] $\mathbf{a} = \mathbf{F} / (\mu_1 + \mu_2 + ... + \mu_k)$

that means that, to extend **Newton's 2nd law** to a _bound_ composite particle CP, *the inertial mass that must be assigned to the bound CP is the sum of the inertial masses of its component particles.*

Both expressions [3-12b] (for a composite particle) and [3-2] (for the case of a single elementary particle) can be summarized as:

[3-12c] $$\mathbf{a} = \mathbf{F}/\mathrm{m}$$

which is Newton's Second Law. This law is a prediction of the model based on the hypothesis B (about the velocity increment suffered by a particle when collided by an aetherino) and on the definition of force made by the model. Therefore according to the model, that disposes of an unambiguous definition of force, Newton's second law must not be considered the primary definition of force but an experimental law (predicted by ad hoc hypothesis of the model) that gives the acceleration of a particle when suffering a given force. Furthermore, since the model disposes also of an unambiguous definition of inertial mass (related to the cross section of a material particle to aetherino collisions) then Newton's second law should neither be considered the primary definition of mass (as argued by some theorists of Physics).
According to the model, Newton's Second Law is still valid (with the same rest mass constant *m*) for high speeds of the particle as long as such speed relative to the aether is not many orders of magnitude higher than the speed of light. The relativistic effects invoked by mainstream physics in the behavior of high speed particles subject to a force are interpreted by the model as an inadequate assessment (done by mainstream physics) of the strength of the force suffered by the particle (when the target particle has a high speed relative to the matter source of the force, see Section 12) and not due to the paradigms (Lorentz transformations) proposed by the Special Theory of Relativity.

The law [3-12c] is valid in those reference frames that the model calls "*floating reference frames*" (see below) that are not the equivalent, in general, to the reference frames that mainstream physics calls "*inertial reference frames*".

NOTE 3-4: Although the expression [3-12c] is, by construction, strictly valid when considering *all* the aetherinos colliding with the particle including those aetherinos of the local aether coming from all directions but not directly from the matter "source" of the force, it is not evident that the expression [3-12c] is still valid when the force F of Eq[3-12c] is evaluated considering *only* the aetherinos coming from (i.e. redistributed at) the matter "source" of the force.
A rough analysis of the influence of the environment aether in the acceleration suffered by a particle subject to a specific net force F has been made doing computer simulations in 1D. It has been found that:
- For a given net force F (implemented by a given number of collisions by unit time by aetherinos coming from the matter source of the force) *the acceleration* suffered by a particle of mass m (implemented by a given surface σ with which the aetherinos collide) *increases linearly with F* whatever the rate of aetherino collisions of the environment aether (i.e. whatever the average number of collisions that the particle suffers by unit time, *in the same amount*, by its both sides). But:
- For a given net force F (implemented by a given number of collisions by unit time by aetherinos coming from the matter source of the force) *the acceleration* suffered by a particle of mass m (implemented by a given surface σ with which the aetherinos collide) decreases slowly when the rate of aetherino collisions of the environment aether is increased (assuming again that the particle suffers the same rate of collisions from the environment aether by its both sides). This suggests that the inertial mass m of a particle depends not only in the cross section that it presents to the aetherinos but also in the aetherinical "density" of the local aether.

Charge and mass.

The electric charge and the inertial mass of a material particle are described and related as follows.

According to the model there exist two types of matter p-type matter and n-type matter.
If the "amount" of p-type matter of a particle is bigger than its n-type matter the particle is said to have a positive electric charge.
If the "amount" of n-type matter of a particle is bigger than its p-type matter the particle is said to have a negative electric charge.
If the particle has an equal amount of both types of matter the particle is said to be electrically neutral or equivalently that its electric charge is zero.

The "amount" of matter of a given type (either p-type or n-type) of a particle can be described by the cross section that this matter presents to the aetherinos.

The **electric charge** of a particle is, by definition, given by the *net* cross section of the particle taking account of its both types of matter.
More precisely if a_{Sp} is the cross section of the p-type matter in the particle and a_{Sn} is the cross section of the n-type matter in the particle then the **electric charge Q of the particle** is

[3-14a] $Q = k_Q (a_{Sp} - a_{Sn})$

where k_Q is a constant for dimensional consistency whose value depends on the election of units (for charge and for area).
(The force that a charged particle P exerts on a test particle of unit charge is indeed proportional to the *net* cross section of P (net=cross section of its p-matter minus cross section of its n-matter) since that net cross section a_S determines the excess (or the deficit) of aetherinos emerging from P).

The **inertial mass** of a particle is proportional to the *total* amount of its both types of matter, and therefore, in a scenario of forces implemented by aetherino collisions, is proportional to the total cross section of the particle taking account of its both types of matter.
More precisely, the inertial mass M of the particle is:

[3-14b] $M = k_M (a_{Sp} + a_{Sn})$

where k_M is a constant for dimensional consistency whose value depends on the election of units (of mass and of area).
(The acceleration acquired by a particle when suffering a specific net force F is indeed inversely proportional to its *total* cross section (sum of the cross sections of its both types of matter) since it can be reasoned as follows: Suppose that the particle P target of the force is made of Np “units” of p-type matter and Nn “units” of n-type matter and suppose just for the sake of the argument that each unit of matter is an elementary sub-particle of the particle P. The velocity of P is defined as the average of the velocities of all the Np + Nn sub-particles of P. According to hypothesis of the model when a p-type sub-particle is collided by a p-type aetherino of relative velocity $\mathbf{v_R}$ (or when a n-type sub-particle is collided by a n-type aetherino) the sub-particle increases its velocity by an amount $\Delta\mathbf{v} = \mathbf{i}_1 / \mu_1 = (h_1/ \mu_1)\, \mathbf{v_R}$ (where h_1 is a universal constant and μ_1 would be a constant specific of the "unit matter sub-particle"). Averaging over all the Np + Nn sub-particles making P, the particle P, due to the collision of an aetherino with one of its subparticles, would suffer a velocity increase $\Delta\mathbf{V} = \Delta\mathbf{v}/(Np + Nn)$ but the total cross section of P (sum of the cross sections of both types of matter) is proportional to the total number of Np + Nn of its subparticles (unless there is screening between its subparticles).

Notice also that $\mathbf{\Delta V} = \mathbf{\Delta v}/(Np + Nn) = \mathbf{i}_1 / (\mu_1 Np + \mu_1 Nn)$ and $(\mu_1 Np + \mu_1 Nn)$ in which participate both types of matter (and hence the addition of the cross sections of both types of matter) should be called *the inertial mass of the particle* P).

(Note: In the paper *Redistribution of aetherino speeds* it is asserted that the model also postulates the existence of two types of aetherinos (n-type and p-type aetherinos) and it is there explained in more detail how they interact with the two types of matter making more reasonable the assertions [3-14a] and [3-14b] about the electric charge and the inertial mass).

<u>Types of forces</u>.

In general, the elementary particles (electron, proton, neutron,…) are assumed by the model to have some internal anisotropous structure (due to a non isotropous spatial distribution of its p-type and n-type matter content) that would be the cause that the redistributions of aetherinos created by those particles are anisotropous (meaning that their redistributions vary with the direction relative to the particle itself by which emerge the redistributed aetherinos).

- **The electric force** is simply explained by the redistribution of aetherinos created by those material particles in which there is a bigger amount of p-type matter than n-type matter or vice versa.
A charged particle, when considered as target of the force, in presence of the redistribution of aetherinos caused by another particle (considered the source of the force), receives from the direction of this "source particle" either an excess or a deficit of impulsion aetherinos and therefore the target particle suffers a net force.
(The magnetic force is considered just a special case of the electric force when the interacting charged particles move relative to one another).

- **The strong force** takes place between closely spaced material particles that maintain a given relative orientation of their internal structures and redistributions. The anisotropies of their redistributions play in this case an important role in the forces that they exert on each other. (In the electric force instead it is considered that, in general, the interacting particles have their internal structures and redistributions randomly oriented in space). Two particles stick together due to the strong force when the n-type matter of one of the particles is in "contact" with the p-type matter of the other particle.

- **The gravitation force** is considered a residual effect of the electric forces that two neutral bodies exert on each other. In spite of their charge neutrality the attraction and repulsion forces do not exactly cancel because in all ordinary matter the negative charges (electrons) have a bigger internal speed than the positive charges (protons) and it must be remembered that the strength of the electric force depends, according to the model, on the relative velocity between the charged particles. See the Gravitation section for more details.

- **The weak force** is caused by the fluctuations in the distribution of aetherinos of the local aether.
Since the nuclei of atoms, the atoms themselves and the molecules are quasi-stable systems bound by aetherinical forces, it must be recalled that, due to the nature of the aether, those internal bounding forces will be subject to fluctuations (in the number and speeds of the aetherinos relative to the average) of the local aether. Furthermore the material particles suffer also the fluctuations of the local aether affecting those aetherinos coming from all other directions which also contribute to the total force suffered by a particle (i.e. those aetherinos that are not directly assignable to the excess or deficit of aetherinos (i.e. redistribution) originated at the "source" particles).
In the case of "bound particles", these fluctuations in the forces that they suffer are very suited to explain the phenomena of *radioactivity* and "quantum" *barrier penetration.*

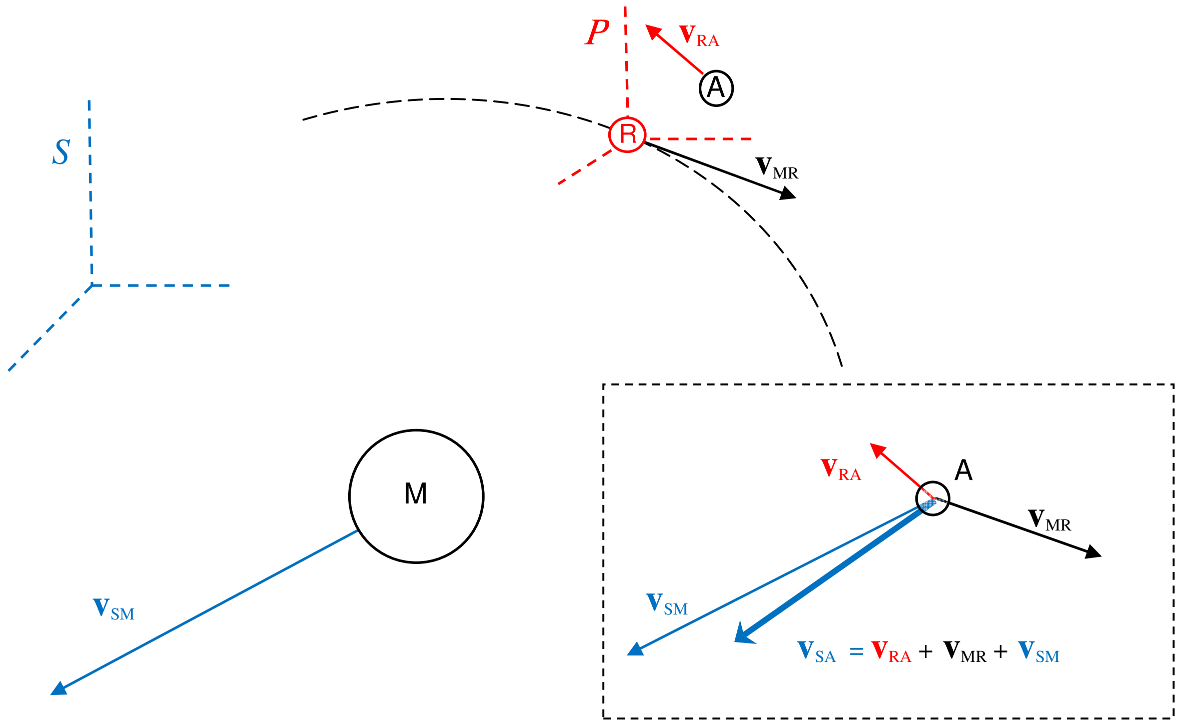
To those four fundamental forces recognized by mainstream Physics, the model adds another force:

- The aether drag force that is the slow down force that the aether exerts on the material bodies that move relative to it. The model (see its Section 2) shows that this force is proportional to the speed of the body relative to the aether. But in most cases the material bodies are orbiting other bodies (in either gravitational or atomic orbits) and in those cases the aether drag force is counteracted by the "forward component" of the centripetal force suffered by the orbiting body (as explained below in the "Floating reference system" section of this paper).

If, in a given reference frame S', a body suffers velocity increments (i.e. accelerations) that are not due to collisions with aetherinos, then the reference frame S' is a "fictitious" reference frame and those accelerations suffered by the bodies (that are not due to collisions with aetherinos) must be assigned to "fictitious forces". The opposite is not true, i.e. if a body suffers collisions with aetherinos but does not change its velocity relative to a reference frame S'', this reference frame S'' is not necessarily fictitious. Examples of this last assertion are the "floating reference systems" defined below.

Floating reference system.

Example of floating reference system.



S reference frame of the aether at rest

P *floating reference system* (it is here orbiting a massive body M).

$\mathbf{v}_{RA}$ velocity of the body A relative to the floating reference system *P*.

$\mathbf{v}_{MR}$ velocity of the reference system *P* relative to the body M, that *P* is orbiting.

$\mathbf{v}_{SM}$ velocity of the body M relative to the reference frame *S* of the aether.

$\mathbf{v}_{SA}$ (in the box) velocity of A relative to *S*.

Suppose a material body R, with mass, "floating in space". This floating condition must be understood as meaning that the body is subject to (1) the gravitation force from all the rest of the bodies of the universe, mainly from those near bodies (e.g. a planet or a star or...) that exert on it a stronger gravitation force and (2) the aether drag force due to its movement through its local aether. But it will be supposed that the body is otherwise free of all other external forces (like for example electric or magnetic forces, radiation, cosmic particles knockings, etc..). (These "floating bodies" will commonly be orbiting other bodies. For example, the Earth would be a floating body).

Suppose next a small enclosure (or region) P of space centered at the body R that follows the body in its floating movement through space.
Suppose that the mass of the body R is so small that it has a negligible influence on other bodies that may be introduced in the region P,, or even better, suppose that the body R, that has only be invoked to define the floating reference system associated to P is now removed from the region.

It must also be supposed:
- that the region P is small enough so that all its parts suffer the same gravitation influence (field) from the exterior bodies of the Universe.
- that the reference frame associated to P *does not rotate* (or more precisely, that its rotation is negligible) relative to the "rectilinear" reference frames (that are those in which all the aetherinos move in straight lines at constant speed). This "negligible rotation" can be "certified" if, during the experiments, the distant celestial bodies do not change noticeably their directions (relative to the floating enclosure P).

With those spatial and temporal validity limitations, it will be said that the floating region P defines a "*floating reference system*".

It can then be asserted that every small body B, with mass, placed inside the region P and at rest relative to the imaginary walls of the region, will remain at rest relative to P. The reason is that the only forces acting on B are the gravitation force (due to the rest of the bodies of the Universe) and the aether drag force (due to its velocity relative to the local reference frame in which the aether can be considered at rest), and both forces are directly proportional to the mass of the body, and hence B will suffer the same acceleration **a** (relative to the aether and to any other rectilinear frame) than the acceleration suffered by the body R that was invoked to define the floating reference system P.
But if another body A, with mass, is placed inside P with an initial velocity $\mathbf{v}_{RA}$ relative to P, this other body A will have, in general, a different velocity relative to the aether and will suffer a different drag force to that suffered by a body at rest in P.
Consider then what happens from the point of view of the reference frame *S* associated to the aether at rest:
Let $\mathbf{V}_R$ be the velocity of P *relative to S*. Therefore, a body R (at rest in P) will suffer an aether drag force:

[1] $\mathbf{F}_{DR} = - m_R\, k\, \mathbf{V}_R$ (where m_R is the mass of R).

The body A will suffer an aether drag force:

[2] $\mathbf{F}_{DA} = - m_A\, k\, (\mathbf{V}_R + \mathbf{v}_{RA})$ (where m_A is the mass of A).

The gravitation forces (due to the outside bodies of the Universe) suffered respectively by R and A are:
$\mathbf{F}_{GR} = m_R\, \mathbf{g}$, $\mathbf{F}_{GA} = m_A\, \mathbf{g}$ where **g** is the same vector for both bodies, since according to Newton's gravitation law,
it only depends on the distribution, observed in the small region P, of masses of the rest of the bodies of the Universe. Due to these forces (aether drag and gravitation), the accelerations (relative to *S*) of the bodies R and A are respectively:

[3] $\mathbf{a}_{SR} = (\mathbf{F}_{DR} + \mathbf{F}_{GR})/m_R = - k\, \mathbf{V}_R + \mathbf{g}$

[4] $\mathbf{a}_{SA} = (\mathbf{F}_{DA} + \mathbf{F}_{GA})/m_A = - k\, (\mathbf{V}_R + \mathbf{v}_{RA}) + \mathbf{g}$

and therefore (in the Galilean framework with absolute Time chosen by the model for its description) the acceleration of A *relative* now *to the floating reference frame* P (associated with R) is:

[5] $\mathbf{a}_{RA} = \mathbf{a}_{SA} - \mathbf{a}_{SR} = - k\, \mathbf{v}_{RA}$

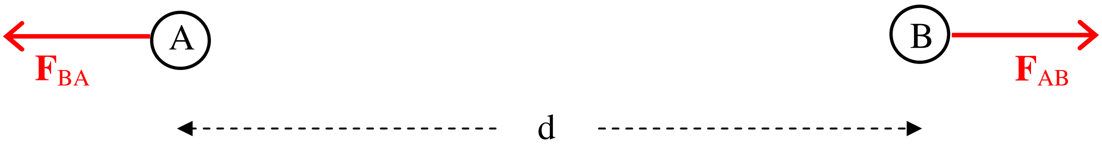
that is *the same aether drag acceleration* that would suffer the body A if the reference frame P *was that of the aether at rest.*
In other words, a body A (with mass) with "any[1]" given speed "u" relative to a floating reference system (whatever), behaves, *relative to that floating frame*, in *the same way as* it would behave if "u" was its speed *relative to the reference frame of the aether at rest.*

It will later be also shown that the force that a body P exerts on a body Q only depends on the velocity of Q relative to P and does not depend on the absolute (relative to the aether) velocities of those bodies (except if those velocities are much bigger than c).
It can therefore be expected that the laws of mechanics are the same in any floating reference system and equal to the laws of mechanics that hold in the aether-at-rest reference frame. This equivalence between floating reference frames is similar to the equivalence between inertial frames of mainstream Physics.

[1] More precisely, the speed u (and the speed of the floating frame) relative to S should not be much bigger than a few times the speed of light since the aether drag force $F_D = - k\, u$ is only an approximation for those speeds.

Newton's third law.

Force between two elementary particles at rest and Newton's 3rd law.



Fig[16]

It will here be described the case of two *equal* particles that are at rest relative to one another but it will be easy to generalize the results for two *different* particles. The force that the particle A exerts on the particle B is, according to the model:

[18] $$F_{AB} = \frac{1}{d^2}\int_0^\infty r_A[v]\ \sigma_{IB}[v]\, h_1\ v\ dv\ = $$

$$= \frac{1}{d^2}\int_0^\infty \sigma_{SA}[v]\ \frac{\rho[v]}{8\pi}\, v\ \sigma_{IB}[v]\, h_1\ v\ dv$$

where the redistribution $r_A[v]$ of aetherinos created by A has been replaced by its value:

$$r_A[v] = \sigma_{SA}[v]\ \frac{\rho[v]}{2}\ \frac{v}{4\pi}$$

and where

$\sigma_{SA}[v]$ is the cross section of A to "switch interactions".

$\sigma_{IB}[v]$ is the cross section of B to "impulse interactions".

Similarly, the force exerted by the particle B on the particle A is:

[19] $$F_{BA} = -\frac{1}{d^2}\int_0^\infty \sigma_{SB}[v]\ \frac{\rho[v]}{8\pi}\, v\ \sigma_{IA}[v]\, h_1\ v\ dv$$

where

$\sigma_{SB}[v]$ is the cross section of B to "switch interactions".

$\sigma_{IA}[v]$ is the cross section of A to "impulse interactions".

Since it has been supposed that the particles A and B are equal, it is evident that:

[20] $\sigma_{SA}[v] = \sigma_{SB}[v]$

[21] $\sigma_{IA}[v] = \sigma_{IB}[v]$

and there would be so far no objection to suppose that the switch cross sections σ_S of the particles are different (e.g. stronger) than their impulsion cross sections σ_I because, in this case of two equal particles, it would still happen that $F_{AB} = -F_{BA}$ and therefore Newton's 3rd law (action equals reaction) would be preserved (as it must be since Newton's 3rd law is an experimental fact for two particles *at rest relative to one another*).
(Notice that in this case in which A and B are equal particles, it will be $F_{AB} = -F_{BA}$ because the integrands of these forces contain respectively the products $\sigma_{SA}[v]\ \sigma_{IB}[v]$ and $\sigma_{SB}[v]\ \sigma_{IA}[v]$ that are equal due to the equalities [20] and [21] and could both have been written simply as $\sigma_S[v]\ \sigma_I[v]$).

But consider now the case in which A and B are different particles and suppose for example that A creates a strong redistribution of aetherinos (because of having a big σ_{SA}) but instead A is weakly sensible to its impulsion aetherinos (because of having a small σ_{IA}), and suppose at the same time that with the particle B the opposite is true, so, for example, it happens that $\sigma_{SB} < \sigma_{SA}$ together with $\sigma_{IB} > \sigma_{IA}$. Then, since the integrand of F_{AB} contains the product $\sigma_{SA}\ \sigma_{IB}$ while the integrand of F_{BA} contains the product $\sigma_{SB}\ \sigma_{IA}$ it would happen that $\sigma_{SA}\ \sigma_{IB} > \sigma_{SB}\ \sigma_{IA}$ implying that $|F_{AB}| > |F_{BA}|$ and hence contradicting Newton's 3rd law.
To avoid such inadequate prediction the model adopts the following hypothesis:

[22] *"For every (ordinary) elementary particle X its switch cross section* $\sigma_{SX}[v_R]$ *is, by hypothesis, equal to its impulsion cross section* $\sigma_{IX}[v_R]$*"*

With that hypothesis, in the previous case in which the particles A and B are different (and are at rest) it will now be $|F_{AB}| = |F_{BA}|$ since now the products $\sigma_{SA}\ \sigma_{IB}$ and $\sigma_{SB}\ \sigma_{IA}$, that appear in their respective integrands, will be equal since the product in the integrand of F_{AB} can be for example rewritten as $\sigma_{SA}\ \sigma_{SB}$ and the product in the integrand of F_{BA} can be rewritten as $\sigma_{SB}\ \sigma_{SA}$
In the case of anisotropous particles with an axis of symmetry (PRA), their cross sections will depend not only on the relative speed v_R of the aetherinos but also on the angle α that their velocity $\mathbf{v}_R$ makes with the equatorial plane of the particle, and the previous hypothesis will be generalized as follows:

[22b] *"By hypothesis, for every (ordinary) elementary particle X with axial symmetry, the equality* $\sigma_{SX}[v_R, \alpha] = \sigma_{IX}[v_R, \alpha]$ *(concerning the directional cross sections of the particle) is fulfilled"* (where α is the angle that the velocity $\mathbf{v}_R$ of the incident aetherino makes with the equatorial plane of the particle).
Summarizing, by hypothesis:

[22b] $\sigma_{SX}[v_R, \alpha] = \sigma_{IX}[v_R, \alpha]$

Therefore, in the case of the force between 2 particles A and B (different or equal) at rest, it will happen that, independently of the relative orientation of their PRA, the integrands of the forces F_{AB} and F_{BA} will contain respectively the products $\sigma_{SA}[v,\alpha_A]\ \sigma_{IB}[v,\alpha_B]$ and $\sigma_{SB}[v,\alpha_B]\ \sigma_{IA}[v,\alpha_A]$ that, according to the previous hypothesis can be rewritten respectively as $\sigma_{SA}[v,\alpha_A]\ \sigma_{SB}[v,\alpha_B]$ and $\sigma_{SB}[v,\alpha_B]\ \sigma_{SA}[v,\alpha_A]$ making evident that $|F_{AB}| = |F_{BA}|$
(Notice that in the case of two particles A and B at rest (and whose PRA don't rotate), the angle α_A that the velocity of an aetherino emerging from A (with semidirection AB) makes with A's equator is equal to the angle that the velocity of an aetherino coming from B (with semidirection BA) makes with A's equator. And the same is true for the particle B and its angle α_B).

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----------------- From an older (obsolete) version of this paper -------------------

Consider first the case where the net force $\mathbf{F}(\tau)$ reduces to the *aether drag force*. (i.e. the body can be imagined to be moving at the epoch τ with a velocity $\mathbf{u}$ in an "undisturbed" canonical aether and therefore suffering the corresponding aether drag force. No other external forces are supposed to be present. Standard Physics would say that the body does not experiment any force).

Using the linear approximation deduced in Section 2 for the aetherinical drag force acting on a composite particle then Eq [3-8b] becomes:

$$\mathbf{F_D}(\tau) = -k\,n\,\mathbf{u} = \frac{n}{Q}\mathbf{a} \qquad [3\text{-a}]$$

therefore

$$\mathbf{a} \equiv \frac{\mathbf{du}}{d\tau} = -k\,Q\,\mathbf{u} \qquad [3\text{-b}]$$

The integration of differential equation [3-b] gives:

$$u(\tau) = u(0)\,e^{-\mathbf{kQ}\,\tau} = u(0)\,e^{-\mu\,\tau} \qquad [3\text{-c}]$$

where $\mu = k\,Q$ is a constant and u(0) is the aether speed of the body at the epoch $\tau=0$.

Expression [3-c] will be called the "aether *Slow Down Law* of free bodies" in a canonical aether.

NOTE 3-5:

As can be seen in Section 2 (e.g. in 2-30) where the approximate expression $-k\,n\,u$ of the Aether Drag Force is deduced, the constant k appearing in [3-a] and [3-c] depends only on the following constants of the model: q, σ, N_0 and V_M

where q is the arbitrary constant used to define an aetherinical impulse (see Eq [1-0]).

σ is the geometrical cross section of a Simple Particle.

N_0 and V_M are constants related only to the canonical distribution of the aether.

therefore k is independent of the nature of the body and so is the constant $\mu = k\,Q$ appearing in Eq [3-c].

As has been said in Notes 2-1, and 2-2 of Section 2, the expression $\mathbf{F}_{DRAG} = - k\, n\, \mathbf{u}$ is only an approximation for particle speeds u that are not big compared with the average speed of the aetherinos (in the aether "rest" frame). Therefore, as a consequence, Eq[3-c] should also be an approximation.

NOTE 3-6:

The "law" Eq [3-11] for the slow down of bodies moving in the aether has statistical validity and limitations. It is a macroscopic law in contrast with hypothesis B that can be considered a microscopic law. The speed $u(\tau)$ of the body must be considered an average speed along a time interval "big enough" to allow for many aetherino collisions to occur on the body but at the same time "small enough" compared with the resolution power of the clocks used in the observation of the law so that it can be considered as an instantaneous speed. In other words such speed u is "average" in relation with microscopic time and "instantaneous" in relation with macroscopic time (i.e. the time read in normal clocks).

Insisting again, although the model does not allow a strictly classical law for the movement of a particle the possibility of a (non strict) classical law can happen in the following sense: Imagine a composite particle made of many Simple particles. Its position has been defined in Eq [3-3]. If the number n of components is big enough it may happen that the positions of the composite particle in a set of identical experiments never fluctuate from the average more than a given quantity Δx. If Δx is smaller than the space resolution of the experimenter then this observer will not detect such fluctuations and he will conclude that the composite particle behaves classically.

Macroscopic time (the reading of real clocks) could in some way be treated as a mean statistical magnitude conditioned by the microscopic postulated time. First it can be postulated that microscopic time advances uniformly (in relation with a description postulate of constant velocity of all the aetherinos), being for example given by the x component of the position vector (in a rectilinear reference frame) of a given aetherino. Then, some cumulative process can be imagined to be fed by microscopic statistical events so that the quantity accumulated in a given system determines the macroscopic reading of the time elapsed in a given real clock. It will then happen that not all real clocks advance in exact synchrony when compared at their maximum resolution due to the hazards of the statistical cumulative process in each clock.

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to be completed

Note: What follows below, belongs to an older version of this work and is now (year 2013) considered obsolete.

At the epoch in which what follows was written (about the year 2002) the model assumed that, due to the aether drag, all the particles of the universe decreased their speeds in an asymptotic way, according to the same law, when observed by the Ideal Observer (IO) (Note: for the Ideal Observer all the aetherinos travel at constant velocity until they collide with matter). Such speed decrease included a slowdown of the orbital speeds of electrons in atoms, planets around stars, etc..

But lately the model assumes that the aether drag does not slowdown the orbiting bodies bound by forces of attraction, mainly because of "the forward force".

The paper has not been removed because it is considered that it contains paradigms that could be of interest in other domains of Physics.

Official time and Ideal time.

It seems reasonable to state that the advance of the clocks used in official physics to measure "time" is conditioned by the movement (oscillatory in many cases) of some specific matter. (The aetherinos are not considered matter). Examples of such official clocks are the atomic ones, the pendulum ones, those based on the positions of celestial bodies, etc.. With all of them it can be verified that a material body subject (according to official physics) to a constant force acquires a uniformly accelerated movement (at least for speeds u of the body such that $u << c$). According to the model it then also seems reasonable to admit that, being all matter bathed by the aether, the continued collisions with the aetherinos will cause a general and gradual slow down of all the internal and external movements of such matter and in particular of the matter that sustains the clock's mechanisms. Being the "slowing down" a relative concept it must be understood that "matter" suffers the general slow down when measured by an "Ideal clock" (for which the aetherinos move by definition at constant speed). But then it can be expected that *matter will not suffer any general slow down in relation with official clocks since these are themselves made of matter* which from the point of view of the ideal clocks is slowing down at the same rate.

Hereafter 2 different observers will be invoked distinguished by different time standards but sharing the same space standards:

- Ideal Observer IO : Uses Ideal clocks for which the aetherinos move at constant speed (in virtue of a description postulate) in the so called rectilinear reference frames.

- Official Observer OO : Uses Official clocks (the material ones commonly used in experimental physics). For this observer due to the aether drag slow down of all matter, the aetherinos move at ever increasing speeds.

Hereafter letter τ will be used for the variable epoch "read" in the ideal clocks and letter t for that read in official clocks.

Likewise sub index_I (from Ideal) will be used for the speeds and accelerations observed by IO and sub index_F (from oFficial) for those measured by OO.

Although it is not a priori evident at what rate can the official clocks be expected to slow down relative to the ideal ones the following choice seems reasonable in this context:

$$\frac{dt}{d\tau} = e^{-\mu \tau} \qquad [3\text{-}15]$$

where μ is the same constant of Eq [3-11].

It would be unfair in this case to blame the "Tempo rate law" given in Eq [3-15] of being an ad hoc hypothesis of the unwanted type, since, considering that the official clocks are immersed in the "same" aether it can be expected that their mechanism slows down relative to IO at the "same" rate at which a free body does (i.e. according with the law given in Eq [3-11] with the same constant μ).

Inertia.

Since both observers IO and OO share the same space standards, the speeds u_I and u_F that they assign respectively to a given body are related by:

$$u_I \, d\tau = u_F \, dt = dr \qquad [3\text{-}16]$$

Therefore from Eq [3-15]:

$$u_F = u_I \frac{d\tau}{dt} = u_I e^{\mu\tau} \qquad [3\text{-}17]$$

If the body observed is the "free" body (subject only to the aether drag) described above (see Eq [3-11]) then, the official observer assigns to it a speed:

$$u_F = u_I e^{\mu\tau} = u(0) e^{-\mu\tau} e^{\mu\tau} = u(0) \qquad [3\text{-}18]$$

Since u(0) (initial speed of the body at an arbitrarily defined epoch $\tau = 0$) is a constant, Eq [3-18] expresses the property called "**inertia**" of free bodies.

Notice also that the Official Observer sees the aetherinos increase their speed according to Eq[3-17] where u_I stands in this case for the constant IO speed of an aetherino.

Integration of eq [3-15] gives:

$$t = -\frac{1}{\mu} e^{-\mu\tau} + c_1 \qquad [3\text{-}19]$$

Assigning to the constant of integration the value $c_1 = 1/\mu$

$$t = \frac{1}{\mu}(1 - e^{-\mu\tau}) \qquad [3\text{-}20]$$

the description will correspond to the case in which both observers assign the epoch zero to the same given physical event.

An "event" is understood as a distinct position's distribution of a set of elementary objects (aetherinos, Simple particles,...) of the physical world (or model).

NOTE 3-7:

The fact that the time readings (epochs) assigned by each of the two observers to a later (or earlier) event will differ does not alter the fact that the description continues to assume the existence of "Absolute Time" as a valid concept for both observers. I.e.:

If two events are simultaneous for one of the observers (IO or OO) they also are simultaneous for the other.

The time readings of each observer for any given event are related by the function of the type of Eq [3-20] assumed.

The word "instant" will be reserved for the set of all the events of the physical world that are simultaneous to any given event. Any given event is therefore assigned to the same set of events by both observers.

The concept "instant" is considered an abstraction of "epoch" for all observers. Epoch is the number (i.e. name) assigned to an instant by a given observer.

The description postulates the existence of a classification of events in instants (absolute time) such that any given event belongs to only one instant (set of events). The name of a given instant, epoch, may differ for different observers.

This description (in the sense of organized information from which it is possible to make predictions on the behavior of the physical world) adopts the classic approach of causality: the existence of an event can in principle be deduced, with the use of simple rules (laws), from the information of a complete set of "earlier" events (i.e. from events corresponding to an instant of smaller associated number).

In practice, the physicist, who can not see the aetherinos, can not strictly (but only statistically) determine a complete set of earlier events and therefore he may incorrectly infer violations of causality.

Of course, the description must be consistent with the classification of events and the rules relating them. It must not happen that two contradictory predictions are made by two different observers using complete sets of earlier events.

Newton's second law.

Suppose now that the body is not free but that in addition to the aether drag force there is an external "material" force acting on it. The adjective "material" is used to point out that the force has its origin in some known matter thus distinguishing it from the aether drag force (due to the movement relative to the reference frame in which the aether is considered at rest). The official description of physics does only treat as forces those that have here been called material forces since in that description there is no recognition of the aether drag.

Names F_M and F_D will be used respectively for the two kinds of forces (material and drag) invoked so far in the model.

The generic net force $\mathbf{F}(\tau)$ that appears in Eq [3-8b] can, in this case, from a theoretical point of view, be "separated" in the two kinds of forces assumed to be acting on the body:

$$\mathbf{F} = \mathbf{F}_M + \mathbf{F}_D \qquad [3\text{-}21]$$

Consider the simple case in which the applied material force $\mathbf{F}_M$ acts along the direction defined by the velocity **u** of the body relative to the aether. (The general case in which the direction of the material force differs from that of **u** will be treated below). Then, the modulus of the net force along such direction is simply:

$$F = F_M + F_D \qquad [3\text{-}22]$$

Therefore using Eq [3-8b] and dropping the sub index_c meaning "composite" in that equation and introducing instead the subindex I meaning "as observed by the Ideal observer" :

$$a_I \equiv \frac{du_I}{d\tau} = \frac{Q}{n}(F_M + F_D) \qquad [3\text{-}23]$$

Let x be the direction of $\mathbf{F}_M$ and $\mathbf{F}_D$. Then from the definitions:

$$u_I = \frac{dx}{d\tau} \qquad a_I = \frac{du_I}{d\tau}$$

$$[3\text{-}24]$$

$$u_F = \frac{dx}{dt} \qquad a_F = \frac{du_F}{dt}$$

and admitting the Tempo rate law Eq [3-15] a relation between a_I and a_F can be obtained as follows:

Rewriting eq [3-17]:

$$u_I = u_F e^{-\mu\tau} \qquad [3\text{-}25]$$

the derivation of both members with respect to τ gives:

$$a_I = \frac{du_F}{d\tau} e^{-\mu\tau} - \mu u_F e^{-\mu\tau} = \frac{du_F}{dt}\frac{dt}{d\tau} e^{-\mu\tau} - \mu u_I =$$

$$= a_F e^{-2\mu\tau} - \mu u_I \qquad [3\text{-}26]$$

therefore the acceleration for the official observer OO is given by:

$$a_F = (a_I + \mu u_I)\, e^{2\mu\tau} \qquad [3\text{-}27]$$

and replacing the acceleration a_I (seen by IO) by its value given in Eq [3-23] for the case of a material force F_M acting on the body:

$$a_F = (\frac{Q}{n}(F_M + F_D) + \mu u_I)\, e^{2\mu\tau} \qquad [3\text{-}28]$$

but the aether drag force F_D acting on a composite particle (made of n SPs) can be written (see Eq [3-9]) in terms of μ (= kQ) as:

$$F_D = -\frac{\mu}{Q} n\ u_I \qquad [3\text{-}29]$$

and therefore:

$$a_F = \frac{Q}{n} F_M\ e^{2\mu\tau} \qquad [3\text{-}30]$$

It must now be noticed that an "aetherinical force" is a *defined* concept whose numerical value depends on the type of observer (IO or OO) since it depends on the values that these observers respectively assign to the aetherino's (relative) speeds in their collisions.

Nevertheless, in this work, when referring to *aetherinical* forces (either material or drag) it must always be understood that their values refer to the Ideal Observer since the model takes advantage calculating such forces for this observer for which the aetherinos move at constant speed.

Then, since all matter is slowing down for the Ideal observer IO it seems reasonable to suppose that *the IO aetherinical material force* F_M, of a given invariable setup of the experimenter, *also decreases with time* at some rate related with that with which matter slows down for IO. That seems plausible thinking that matter is a source of aetherinical forces by virtue of the redistribution of the incident aetherino's velocities that take place at the collisions with the particles of matter, and it can be expected that the "rate of the redistribution" is directly related to the rate at which IO observes the internal movement of matter and therefore to the rate at which IO observes the evolution of the official material clocks. A proposition is being made to assign time varying "aetherinical forces" to constant "official forces" (i.e. to situations in which official Physics would say that a constant force is being applied).

But the example of redistribution studied in Annex D (see Note D2 in that Annex) suggests that the aetherinical material force should be considered proportional to the square of the mean internal IO speed w of the component Simple particles of the bodies producing the material force. Hence if the "model of material force" expressed in Eq [D-11] is assumed, when adding the consistent supposition that the internal IO speeds w of the responsible matter decrease (for IO) at the same rate of slow down of matter in the dragging aether (and of the slow down of the (material) official clocks), the IO time evolution of any OO constant material force is given by:

$$F_M(\tau) \cong k_0\, w^2(\tau) = k_0 (w(0)\, e^{-\mu\tau})^2 = k_0 w^2(0) e^{-2\mu\tau} = F_M(0)\, e^{-2\mu\tau} \qquad [3\text{-}31]$$

therefore according to Eq [3-30] the acceleration $\mathbf{a_F}$ measured by the official observer on a body subject to what he would call a constant force takes the form:

$$a_F = \frac{Q}{n} F_M(\tau)\ e^{2\mu\tau} = \frac{Q}{n} F_M(0)\ e^{-2\mu\tau}\, e^{2\mu\tau} = \frac{Q}{n} F_M(0) \qquad [3\text{-}32]$$

which is the sketch of Newton's second law.

NOTE 3-7b

- The $F_M(0)$ of Eq[3-32] is the aetherinical material force that would be acting on the body at the epoch τ=0 supposing an identical configuration to the present one, i.e supposing that at τ=0 the body suffering the force was also moving through the aether at IO speed u_I and was in presence of the same material bodies placed at the same distance and with the same IO relative speeds to those producing the aetherinical force $F_M(\tau)$ considered in the above calculus of a_F.

If the aetherinical material force suffered by the body *in the given configuration* is measured instead of at the epoch τ (also called t by OO) at a different epoch τ_2 (called t_2 by OO), then IO would assign to it a different value because of the different internal speeds w in this epoch, but OO will still assign to it the same value $F_M(0)$. I.e., *for a given configuration*, the material force assigned by the Official Observer OO does not depend on the epoch (t, t_2,... etc) of observation.

- The preceding assertions implicitly assume that the epoch t = τ = 0 is a well defined epoch (related to some physical event) in which both observers synchronized their clocks. But this synchronization could have been done at an earlier or later epoch (simultaneous to a different physical event) and it can be asked if this earlier or later synchronization would affect the value of the aetherinical force assigned by IO at the *new* epoch t = τ = 0 (and hence assigned by OO at any epoch). The answer is ***no*** considering that the natural way for the model to define a synchronization of the IO and OO clocks is the following:

1) in simultaneity with some given event of the physical world, IO and OO set their clocks to read τ = 0 and t = 0 respectively.

2) OO defines the unit of time interval (e.g. the "second") in relation with some physical phenomenon observed by it (e.g. the duration t_f-t_i of a given number n of vibrations of a given atom) and informs to IO (at this epoch t = τ = 0) of the beginning and end of this unit time interval. With this information IO selects an aetherino that travels a unit distance (in a given rectilinear Euclidean frame) during that time interval to be his clock. In the future IO determines its time readings to be the distance readings of this particular aetherino (and forgets about OO).

Suppose now the existence of two groups of physicists independently describing the forces acting on a given body in the present epoch. The first group synchronizes their IO and OO clocks setting t=τ=0 at the epoch of a given physical event. The second group synchronizes their IO and OO clocks setting t=τ=0 at the epoch of a *later* (and hence *different*) physical event. The first group assigns an epoch τ_1 (and t_1) to the present. The second group assigns to the present the epoch τ_2 (and t_2) and of course it will be $\tau_1 > \tau_2$ (as well as $t_1 > t_2$). It is asked: will the material force $F_{M1}(0)$ (converted to the epoch zero) of the first group be greater than the $F_{M2}(0)$ of the second group due to the fact that for the first group the epoch zero is further in the past than that of the second group? The answer is again ***no*** in spite of the fact that the further back in the past the stronger the IO material forces of any given configuration (due to having suffered less slow down of their internal speed w the SPs of the interacting bodies). The explanation is that due to the above method of setting clocks, the first group of physicists are assigning to the present epoch *weaker* aetherinical forces to be acting on the common body. This is due to the fact that this first group of physicists are assigning slower speeds to all the aetherinos than the speeds assigned by the second group to the same aetherinos. This is due to the fact that the aetherino chosen as IO clock by the first group is faster (for all observers and at all epochs) than the IO aetherino-clock of the second group because the first had to advance the same unit distance than the second during the nominally the same but really shorter time interval of the n atomic vibrations of the OO clock. And finally this is due to the fact that at the earlier epoch of synchronization of the first group the atoms had faster internal speeds due to the gradual IO slow down of all material bodies. (It must also be remembered that the value assigned to an aetherinical force depends on the value of the elementary impulses and these depend on the values assigned to the relative speeds of the colliding aetherinos).

NOTE 3-8

A common subject of discussion and confusion in Physics is whether to consider Newton's second law "*F=m a*" as the primary definition of force, as an experimental law or as the primary definition of (inertial) mass.

The "*F=m a* <=> definition of force" point of view must assume that the mass m of the body is known by independent ways. Then, for example, pulling the body with an elastic spring at different accelerations and "drawing marks" at the elongations acquired by the spring, this spring can be considered as a calibrated dynamometer with which to measure other forces (for instance magnetic or electric ones). But this "definition" point of view seems a very risky one. It would be unacceptable to find a posteriori that two parallel dynamometers indicating each a force F=1 are unable to equilibrate the pulling of a third dynamometer indicating a force F=2. Of course, it could be argued "the dynamometers are not well calibrated " (i.e. our definition of force is inadequate) because we have not taken into account that the mass m of the body used in the definition varies with its speed. But unless the concept of mass was universally agreed and independently understood, no one would agree how to relate the mass of a body with its speed (or why not with its acceleration, temperature, density, chemical composition, etc). Saying, "well, let's look how the mass varies recalibrating ad hoc the dynamometers until they are able to pass the later equilibrium of forces tests" would just be cheating and introducing confusion in Physics. (A possible independent definition of mass that at first sight looks promising to be used in a later F=m.a definition of force is based on predefining the momentum of a particle as its mass times its velocity and then postulating the conservation of momentum in particle collisions. The study of the emerging velocities of the particles in elastic collisions could then be used to determine their masses and their speed dependence. But high speed mass determinations using this method can only be done in practice with microscopic particles. When later wanting to evaluate a force using the definition F=m.a one should be aware that the m used in the equation has really been independently determined in a direct or indirect way with (for example) the momentum paradigm and not using m=F/a in another experiment because this would add to a circular reasoning and the force determination would be unjustified).

The "*F=m a* <=> experimental law" point of view, that will consist in measuring accelerations, must assume that there exist independent methods to know at all times *both* the value of the force and of the mass involved in the experiments. The determination of the force can depend for example on some defining independent law (for example related with electricity or magnetism or with elasticity, etc). The determination of the mass can be based on gravitation (comparing weights with a balance at the Earth's surface) but since these type of measurements do not study the dependence of mass with velocity the *m* values deduced in the weighing are the only ones allowed to be introduced in the equation a=F/m to check its validity. Then, according to the high energy accelerators F=m.a would not be a valid law for high speeds of the particles if *m* has been determined by gravity methods. If instead the masses used in the experiment have been determined with the momentum conservation method then it would turn out that F=m.a is a valid experimental law. This seems to be the point of view of mainstream relativistic Physics. But it is believed that mass determinations based on momentum determinations with high energy collision experiments are not as reliable as they should considering the complications introduced by the appearance of photons or other particles transporting a part of the momentum and even worst the ad hoc invocation of neutrinos done by some authors.

A third point of view is to consider *F=m a* as the definition of (inertial) mass. Applying an independently known force F to a free body it will always suffer an acceleration (this acceleration could happen to be zero or , why not, negative but those will still be values of an acceleration). Once accepted m=F/a as a definition of mass then F=m.a could also be called (as is general practice) "an experimental law" but of an axiomatic and therefore not very illuminating kind. The high energy accelerators indicate that if the masses of the particles are defined by m=F/a then these masses increase with speed. *Assuming* that the equations of the electromagnetic *forces* exerted by the ground based apparatus on particles moving at very high speed relative to them should be considered *correct*, then the masses increase according to the well known relativistic relation (in which the masses tend to Infinity as the particle's speeds tend to c). The problem is that official physics lacks a defined concept of force of general application in all its fields. The expression of the electric (or the magnetic) force is not a really independent definition of force as the third point of view requires but is somehow a law dependent in a not explicit way on a previous assumption of F=m.a as a definition of force, falling therefore in ambiguity.

If, for example, the aetherinical *definition* of force could be transported and applied in a satisfactory way to most areas of physics, then m=F/a could provide a more secure definition of inertial mass (see [4-32] below). Even more, if it could be considered that the model is able to describe the concept of mass and its speed dependence in a convincing way, then it could be said that Newton's second law is a "relation" explained by the model.

Shrinking distribution.

Up to now it has been implicitly supposed that the aetherino's velocity distribution (e.g. the canonical distribution) is the same at all epochs for the Ideal Observer. This implies that such distribution varies in time for the Official Observer. (Remember that the aetherinos constantly increase their speed for this observer and that it has been assumed that there exists neither sinks nor sources of aetherinos. Notice also that the total number of aetherinos contained at any given "instant" in a given domain of "vacuum" (aether) is the same for both observers).

But a distribution that varies in time for OO seems at first sight unable to account for the experimental evidence concerning the time invariance of the universal constants of physics. Therefore it is considered necessary to question the above supposition and study a description based on the new *supposition that the aetherinos velocity distribution of any given undisturbed region does not change significantly in time for the Official Observer OO*. Therefore when viewed by IO the distribution must "shrink" (or cool) in time.

It continues to be assumed that the speed of each traveling aetherino is constant in time for the Ideal Observer IO but not for OO.

The new supposition can perhaps be justified admitting that when the aetherinos collide with matter they reemerge with speeds smaller, on the average, than the incident ones. This redistribution process should occur at an “adequate” rate to compensate the ever increasing speed of the aetherinos (between collisions) observed by OO.

It is not yet clear if it must be supposed that our area of the Universe, where the time invariance of the physical constants has been determined, must be surrounded by matter in a very restrictive way to maintain a rate of "cooling" redistributing collisions capable to explain the stability of the aetherino's distribution observed by OO. On the other hand the rate of the redistribution process depends on the rhythm of matter in a feedback process. Furthermore, the distribution observed in our vicinity has only in a very small proportion been affected by collisions with local matter since other facts force to suppose that most aetherinos can traverse massive blocks of matter with very small chance of suffering collisions. Hence most of the aetherinos in our neighborhood have traveled long distances, from deep space (/time) without being redistributed. The distribution of the aetherino speeds observed by IO at the Earth's position must depend on the cosmological model of the Universe which is far from being agreed.

Alternately, an expanding aether, where the so called "local" inertial reference frames fly apart from each other, could perhaps account by itself for the cooling (i.e. *shrinking*) of the distribution that IO must observe.

The aetherino's speed canonical distribution that is being used in this work was expressed in [1-47] as:

$$\rho_0(v) = N_0\, v^2\, e^{-\alpha v^2}$$

This distribution reaches its maximum for $V_M = 1/(\alpha)^{1/2}$. In terms of V_M an equivalent expression for that distribution is:

$$\rho_0(v) = \frac{N}{V_M^{\,3}} v^2 e^{-(\frac{v}{V_M})^2} \qquad [3\text{-}33]$$

which has the property that the total number of aetherinos in unit volume is constant :

$$\int_0^{\infty} \rho_0(v)\,dv = N\frac{\sqrt{\pi}}{4} \qquad \text{(does not depend on } V_M \text{)}$$

(the constant N has the dimensions L^{-3})

Therefore [3-33] seems an appropriate expression to describe a shrinking distribution in a model with no sources nor sinks of aetherinos. It apparently suffices to replace in [3-33]

$$V_M = V_M(0)\,e^{-\mu\tau} \qquad [3\text{-}34]$$

to account for a distribution that does no appear to change for OO (whose clocks slow down at the same rate).

NOTE:

The considerations of Section 6 about a possible interpretation of the constancy of the speed of light suggest that the canonical distribution to account for most facts should be of the simple exponential type:

$$\rho_S(v) = N_0\, v^2 e^{-\alpha v} \qquad [3\text{-}33a]$$

rather than of the Maxwell-Boltzmann type.

A more convenient form to write this distribution is:

$$\rho_S(v) = \frac{N}{V_M^{\,3}} v^2 e^{-\frac{\mathbf{2\,v}}{\mathbf{V_M}}} \qquad [3\text{-}33c]$$

where V_M is the speed for which the distribution reaches its maximum. Again [3-33c] has the property that the total number of aetherinos in unit volume is N/4 and therefore not dependent on V_M .

NOTE 3-9: The last paragraph is not a strict interpretation of what might be expected. If the canonical distribution is shrinking according to Eq [3-34] then a material body will suffer an aether drag force that is no longer time independent and therefore is not of the type $F_{DRAG} = - k\,u$ calculated in section 2. But if the F_{DRAG} is no longer of that type, the slow down of material bodies (seen by IO) will no longer be of the type $u(0)e^{-\mu\tau}$ calculated in [3-11] and therefore a shrinking given by [3-34] will no longer be "coupled" with the revised slow down rate of material particles.

If a shrinking aetherino distribution needs to be introduced to explain other facts, then, first, to be consistent with other ideas proposed in this model (like the justification of material forces by the aetherino speeds redistribution at the sources) the elementary impulse defined in Eq [1-1b] must be redefined as:

$$\mathbf{i}_1 = q\,\mathbf{v}_r \,\frac{\dfrac{v_r}{V_M}}{1+\left(\dfrac{v_r}{V_M}\right)^2} \qquad [3\text{-}36]$$

and interpreted like a transfer of an impulse q $\mathbf{v}_r$ occurring with a ("shrinking coupled") probability given by:

$$\text{Prob}\,(v_r) = \frac{v_r/V_M}{1+(v_r/V_M)^2} \qquad [3\text{-}37]$$

With the new definition of elementary impulse given in [3-36] and using the expression [3-33] for the canonical distribution a calculus has been made for the aether drag force following the same steps of section 2 (see Eq [2-9]). It can be seen that a rough approximation for u << V_M of the drag force on a SP in a shrinking aether distribution is:

$$F_{DRAG} \cong -0.29\, q\sigma\, N\, V_M\, u \qquad (u << V_M) \qquad [3\text{-}38]$$

where $V_M = V_M(\tau)$ is the speed (as seen by IO) for which the aetherino distribution reaches its maximum and u is the speed of the SP relative to the aether.

Supposing for example that the distribution shrinks according to [3-34], and applying Eq[3-8b] for the acceleration produced by an aetherinical force (with n=1 for a single SP):

$$\mathbf{a} \equiv \frac{\mathbf{du}}{d\tau} \cong Q\,F_D(\tau) = -Q\,0.29\,q\,\sigma N\,V_M(0)\;e^{-\mu\tau}\,u \qquad (u << V_M) \qquad [3\text{-}39]$$

Calling $0.29\,Q\,q\,\sigma\,N\,V_M(0) = k\,\mu$ and integrating the differential equation [3-39]:

$$u(\tau) = u(0)\,e^{-k(1-e^{-\mu\tau})} \qquad [3\text{-}40]$$

would be the slow down law for a "free" particle in an aether shrinking according to [3-34] <u>if</u> it where the case that Eq [3-38] was the exact expression of the drag force and not only an approximation for u << V_M.

It can be seen in this example, that as advanced above, u(τ) is no longer of the type $u(0)e^{-\mu\tau}$ and therefore it decreases in time at a different rate than the arbitrarily postulated shrinking given in [3-34].

It is nevertheless interesting to remark that if there is no shrinking (i.e. the aetherino distribution does not change in time for IO) the only drag slow down law that is able to explain without contradiction the inertia observed by OO in <u>all</u> "free" material bodies is u(τ)=u(0).Exp[-μτ] but if a shrinking is admitted (and therefore an epoch dependent aether) any law of the type u(τ)=u(0).f(τ) for the IO drag slow down of material bodies can in principle be imagined to take place and also show able to predict the inertia of all speed bodies observed by OO using the same reasoning as above. (f(τ) is a generic function of τ like for example that of Eq[3-40]).

(The reason why, in the case of a constant aether, u(τ)=u(0).Exp[-μτ] has been said to be the only valid slow down law is that in this case the slow down rate of all bodies must be constant at all epochs and the exponential function is the only one with such a property. But if the aether is admitted to change with time then this changing aether can be blamed for the epoch dependence of the slow down rate).

But if a shrinking distribution is admitted and the free bodies can slow down according to a law different from u(τ)=u(0).Exp[-μτ] without contradictions, then there is a priori no point in defining an elementary impulse $\mathbf{i}_1$ as complicated as the one given in Eq [1-1b] because there is no need anymore to obtain an aether drag force of the type $F_{DRAG} = - k\ u$.   A simpler definition like:

$\mathbf{i_1} = q\ \mathbf{v_r}$ [3-41]

should instead be the natural election.

In the case of a non shrinking aether the model has yet to calculate and predict which of the now called "universal" constants would change with time and at what rate and check the predictions with the experimental facts. It seems premature to attack this problem now. Nevertheless some descriptive considerations suggest that the model will better find its way admitting a shrinking aetherino distribution:

- First, a slow down law of the non shrinking type like $u(\tau)=u(0).Exp[-\mu\tau]$ predicts that a body slowing down with that law can only travel a limited distance:

$s = \int_0^\infty u(\tau)\, d\tau = \frac{u(0)}{\mu}$ which is likely to present some difficulties even if μ happens to be very small. (A slow down according for example to Eq [3-40] predicts instead an infinite advance as τ tends to Infinity).

- Second, *any* slow down law of the general type $u(\tau)=u(0).f(\tau)$ (and not necessarily $u(\tau)=u(0).Exp[-\mu\tau]$) is able to predict not only inertia but also Newton's 2nd law, simply adding the supposition $dt/d\tau = f(\tau)$ for the OO clocks behavior and following the same steps of the above section called "Newton's second law". (It has been checked that if the material force has its source in a redistributing matter according with the ideas of Annex D, then, if the internal speed w of the source slows down at the same rate as the speed V_M of the distribution maximum, the aetherinical force produced on a target particle is still at all epochs proportional to $w^2(\tau)$ as is needed to predict Newton's second law).

Newton's third law.

It is well known that in the Theory of Relativity the force $\mathbf{F_{BA}}$ suffered at a given time t by a body A due to the action of a body B is in general *not* equal and opposite to the force $\mathbf{F_{AB}}$ suffered at the same time t by the body B due to the action of body A. I.e. Newton's action and reaction equality law is no longer valid. The reason is the finite non zero time taken by the forces to propagate between A and B , since physical actions travel at a finite speed not bigger than c and the fact that in general there is a relative displacement of A and B during the time of propagation of the forces.

The same is true in the aetherino model for the forces between two bodies since here the interaction is also transmitted at a finite speed, that of the weighted average speed of the aetherinos traveling from one body to the other.

4 - MASS AND REVISION OF NEWTON'S LAWS.

Section 3 can be considered just a simplified approach to introduce the main features of the model related to Newton's laws. But a deeper description of the concept of mass of a body requires to take into consideration : (1) the speed of the internal constituents of the body (relative to the body as a whole) and (2) the absolute speed of the body relative to the aether. The effects of these will be better analyzed using the expressions of the new dynamics shown in Section 12.

The above "sketch" of Newton's 2^{nd} law (Eq[3-32]) suggests that the concept of mass is represented in the model simply by n/Q. I.e. except for the constant $1/Q$ the mass of a body would be given simply by the number n of its Simple Particles. Pre relativistic 19^{th} century Physics would pose no objections to such simple interpretation of the concept of mass. But orthodox modern physics has established that:

1- Newton's 2^{nd} law is only an approximation for small (non relativistic) speeds of the body suffering the force. More precisely: a constant force does not produce a constant acceleration on a body but as the body increases its speed its acceleration starts to decrease. For high speeds of the body suffering the force, it can still be written

F=M.a but keeping in mind that *M*, the so called “relativistic mass” (in the terminology of the early relativists) is a magnitude that increases with the speed of the body.
2- The "rest mass" of a body increases with its *internal* energy (i.e. $\Delta E = \Delta m\, c^2$).

Note: In older versions of this work an additional supposition was added to the above hypothesis B. Such supposition that was called Hypothesis B-2 said: *The macroscopic "effectivity" of the velocity increment acquired (according to hypothesis B) by a SP due to an aetherino collision is inversely proportional to the mean number of aetherino collisions per unit time suffered by the SP*. It was introduced because old computer simulations showed that the effect of a specific aetherinical material force (implemented by a precise number of collisions per unit time by aetherinos of specific direction and relative velocity) on a Simple particle depended also on the characteristics of the environment aether (global density of aetherinos, velocity distribution, etc) surrounding the SP previously to the addition of the material force. Furthermore it was reasoned in the older versions of the model that it seemed reasonable to make such correction in the calculus of the acceleration (of the SP due to a constant aetherinical force) to account for the fact that, the sooner the SP receives the next aetherino collision the smaller will be the long term influence of the earlier one, and this should affect the macroscopic (observable) acceleration of the particle. But recently, the computer simulations have been repeated with more reasonable suppositions and routines and those characteristics of the environment aether do no longer seem to affect the acceleration suffered by the SP due to the specific collisions that implement the material force being studied.

NOTE 4-3:

If the inertial-mass concept can be considered "explained" by the model, then, in what respects to its dimensional analysis, the situation can be considered similar to that of the kinetic theory of gases explaining the concept of temperature as a mean kinetic energy. No new basic dimension is needed for temperature since the dimension of this magnitude is derived from its theory and therefore from the other basic dimensions (L,M,T). This idea could be applied to the "explained" concept of mass with the consequence that M should no longer be considered a fundamental magnitude of physics (leaving thus only L and T).

It can for example be assumed that an aetherinical impulse has the dimension of speed ($L\,T^{-1}$) and therefore that the constant h_1 of its definition $i_1 = h_1\, v_R$ is a dimensionless magnitude. That would imply, see [3-1] and [3-2], that the constant Q is also a dimensionless magnitude and therefore that "mass", see [3-32], must also be considered a dimensionless magnitude. But it is also believed that should this suggestion be taken seriously it would introduce in present physics more confusion than clarity.

NOTE 4-4:

Once again it must be said that the calculations done in this work only pretend to give a hint on the descriptive possibilities of the model but do not claim to make exact quantitative predictions. As will be shown in Section 12, the inertial mass of a body varies with its absolute speed and that implies that a revision must be made of the magnitudes (energy, momentum,...) whose conservation is predicted by the model (in the interactions between particles of matter or in the interactions between matter and radiation). The theory of Relativity had to introduce a similar revision when it stated that the laws of Newton where no longer valid for high speeds.

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