Radiation emitted by electrons.

(v.1 March 2010)
(v.2 April 2010)
(v.5.0 June 2015 Added a discussion about conservation of energy)
(v.5.1 September 2019 Small revisions)

This is a preliminary, qualitative sketch of how the aether model interprets the mechanism that gives rise to the radiation emitted by the electron in, for example, the following scenarios:

- Curved electron's trajectories due to magnetic bending; (e.g. circular orbiting of electrons in a uniform magnetic field, synchrotron radiation…).
- Curved electron's trajectories due to a central force; (e.g. electron orbiting a nucleus).
- Electrons decelerated by a target piece of matter; (bremsstrahlung).
- Electrons accelerated or decelerated by uniform electric fields.

It must be supposed that:

(1) The electron is a particle that (as has been explained in other sections of this work) redistributes the aetherinos that collide with it.

(2) The electron's redistribution *is not isotropic* but has instead an axial symmetry with a "Preferred Redistribution Axis" (PRA). See Fig(R-1).

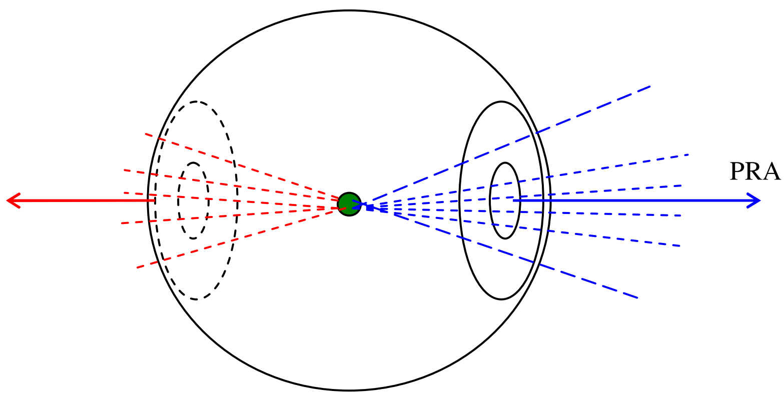

Fig (R-1)

Proposed geometry of the axial *symmetry in the redistribution of aetherinos by an electron.*
(It must not be confused with a geometry of emission of radiation. The aetherinos *are not* radiation, but the features of radiation are implemented by the periodicities in the distribution of aetherinos reaching the detector).

Note_1:
Although the two semi-directions of the PRA are drawn (in most figures of this section) in two different colours it should be supposed that, *at sufficiently large distances from the electron*, the electron's redistribution manifests only an axial rather than a semi axial symmetry (i.e. the redistribution function is the same in all the directions that make a given angle α with "the

equatorial plane" of the electron. The equatorial plane of the electron is an imaginary plane perpendicular to the PRA of the electron and passing by the center of the electron.

The plausible internal structure of the electron has not been modelled.
But since the electron is known to have a magnetic dipole moment, the model is tempted to speculate that the electron consists of a small circular current loop of some “basic matter”. This basic matter that circulates in the loop is what actually collides with the aetherinos and redistributes their speeds. Suppose now that the PRA of the electron is the central axis of the loop; *at small distances* from the loop the redistribution will manifest “chirality” since an observer placed “below” the loop sees a clockwise circulation of the basic matter while an observer placed “above” the loop sees an anticlockwise circulation. The corresponding “chirality” in the electron's redistribution of aetherinos would only be noticeable at short distances from the electron and is what mainstream physics describes as the intrinsic magnetic moment of the electron. But as said above, *at big distances* from the electron, the redistribution of aetherinos is postulated to have an axial symmetry (that singles out the mentioned PRA). This symmetry is consistent with the speculation that the electron’s redistribution is caused by the aetherinos interacting with an hypothetical loop of basic matter and therefore giving rise to a redistribution that, at big distances, will be practically the same at both sides of the loop. This long distance behaviour of the electron’s redistribution is what mainstream physics describes as the *electric field* of the electron (although most texts ignore that the electric field of a *single* electron is not the same in all directions but has an axial symmetry). Finally, what mainstream physics describes as the *weak-force* of the electron can be explained by the model considering that the inherent randomness and fluctuations of an aether of aetherinos must cause fluctuations in its redistribution and hence in the (electric and magnetic) forces in which the electron participates. Furthermore, such fluctuations in the surrounding aether will cause, generally small, random forces on the electron that might sometimes have an important effect in its movement (since the electron has a very small mass).

The *global* redistribution of a numerous group of electrons whose preferred redistribution axis are *randomly* aligned in all directions of space can be considered *isotropic* relative to the group as a whole. This globally isotropic redistribution divided by the number of electrons (average redistribution) is the one whose characteristics have been described in the paper http://www.eterinica.net/redistribs_eterinicas_en.pdf of this work.

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(3) An electron that moves in a *rectilinear reference frame* with constant velocity remains with its *preferred redistribution axis* pointing in some direction, i.e. its PRA does not rotate (except for some small random rotations due to the randomness of the aether).

Note_2:
The model calls “rectilinear frames” those reference frames (that exist by hypothesis) in which the aetherinos move in straight lines at constant speeds. The *inertial* reference frames of mainstream physics in systems *without gravitation* can be considered rectilinear frames. But those reference frames associated with the movement of the "falling bodies" in a gravitation field (that mainstream physics also calls “inertial” frames because the law of inertia holds at least in a “small” space region of them) are **not**, of course, rectilinear frames.

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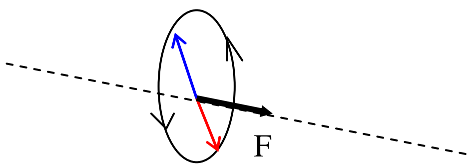
(4) When an electron is bathed by a non zero gradient of aetherino impulses (i.e. when the electron suffers a force) its PRA tends to align perpendicularly to the gradient and to rotate.



Note_3:
Like in mainstream physics, the electron is assumed to have an intrinsic angular momentum and the alignment and rotation of its PRA should be interpreted as the natural way to conserve the angular momentum when the electron suffers a net force (and hence an acceleration). (The details of such alignment reaction of the electron have not been studied yet).

The vector characterizing the *rotation rate* of the "preferred redistribution axis" will be called the *intrinsic rotation vector* (IRV).
Suppose that, during a small time interval dt, the electron's redistribution axis PRA rotates a small angle dθ (i.e. if it was pointing to some space direction $\mathbf{A_1}$ it tilts to point to some new direction $\mathbf{A_2}$). As is common in the description of rotations, the vector (IRV) representing such rotation rate is agreed to be a vector perpendicular to the plane formed by $\mathbf{A_1A_2}$, pointing in the semi-direction of a screw that turns clockwise A_1 over A_2 and with a modulus equal to the time rate dθ/dt (angular speed). See Fig(R-2).

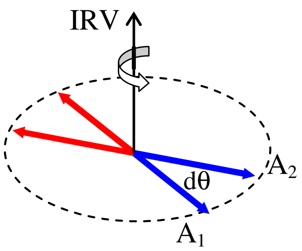


Fig (R-2)

In Fig (R-2), the preferred axis of redistribution of the electron is represented by a segment of a straight line whose two semi directions have been distinguished by different colours. The figure represents such PRA in two different orientations. In changing from the orientation A_1 to the orientation A_2 the PRA performs a rotation. Its rate of rotation is represented by the up-pointing vector IRV.

Note about Polarization.
As will be explained in another section of this work, when the PRA of the electrons oscillate (or rotate) in a plane Π, the emitted disturbance behaves in the same way as what mainstream physics calls “linearly” polarized light in a direction that is coincident with the direction of the IRV vector of the model. In other words, when the PRA of the electrons oscillate (or rotate) in a plane Π, the emitted radiation is plane-polarized in the plane that contains the IRV and the emitter-detector vector. Therefore the so called in mainstream physics “plane of polarization” is *perpendicular* to the plane Π in which the PRA of the emitting electrons oscillate.

Some examples of emission of radiation:

- As is well known, an electron that moves perpendicularly to a uniform magnetic field suffers a force (the Lorentz force) that compels the electron to describe a circle in a plane perpendicular to the magnetic field. Due to the magnetic field, the electron suffers a specific shower of aetherino impulses that forces the "preferred redistribution axis (PRA)" of the electron to rotate in space. The experimental facts about the radiation emitted by the electrons suggest that, when an electron performs such *magnetically-compelled* “circles”, the intrinsic rotation vector (IRV) of the electron aligns itself at all times with the centripetal force; see Fig(R-3b). Furthermore, if the electron travels along the circle at non relativistic speeds, the experimental facts (e.g. the frequency of the radiation equals the orbital frequency) imply that the modulus of the IRV must be equal to *half* the angular speed of rotation of the electron along its circular trajectory (and therefore since the distribution emerging the electron has a maximum at *both* semi-directions of its PRA, an external observer placed far away will see a relative maximum facing him *once* in every orbit of the electron).

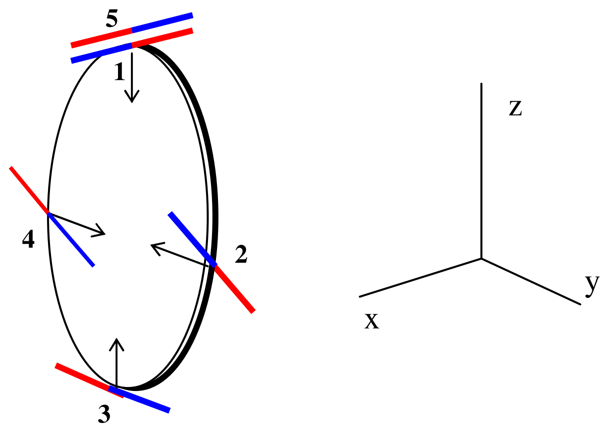


Fig (R-3b)

Fig (R-3b) represents the circular trajectory of an electron in a uniform magnetic field.
The electron goes through the successive positions 1,2,3,4,5,… The trajectory lies in a plane parallel to the plane YZ. The “circularity” of the trajectory is consequence that the electron moves (negative current) perpendicularly to a uniform magnetic field **B** directed along the semi-direction +X.
The arrows represent the orientations of the electron’s intrinsic rotation vector that, as has been said, remains parallel to the centripetal force acting on the electron.
At the orbital position labelled #1 the PRA is aligned with the direction X and is therefore perpendicular to the orbital plane YZ.
During its movement to the orbital position #2 (at which the electron has travelled 1/4 of the circle) the PRA has rotated an angle of 45º in relation to the (moving) direction of the tangent to the circle at the instantaneous position of the electron. At position #2 the electron’s PRA lies therefore in a plane parallel to the XZ plane and is making an angle of 45º with the direction +X and an angle of also 45º with the direction +Z.
In the orbital position #3 (at which the electron has travelled a half of the circle) the PRA has rotated (remaining always perpendicular to the centripetal acceleration) another 45º and is now aligned with the direction Y.
At the position #4 the PRA lies again in a plane parallel to the XZ but is now making an angle of 135º with the direction +X and an angle of also 135º with the direction +Z.

In the position #5 (at which the electron has completed a full circle) the pole of the PRA that at position #1 was facing towards +X is now facing the semidirection –X and is again perpendicular to the orbital plane YZ.

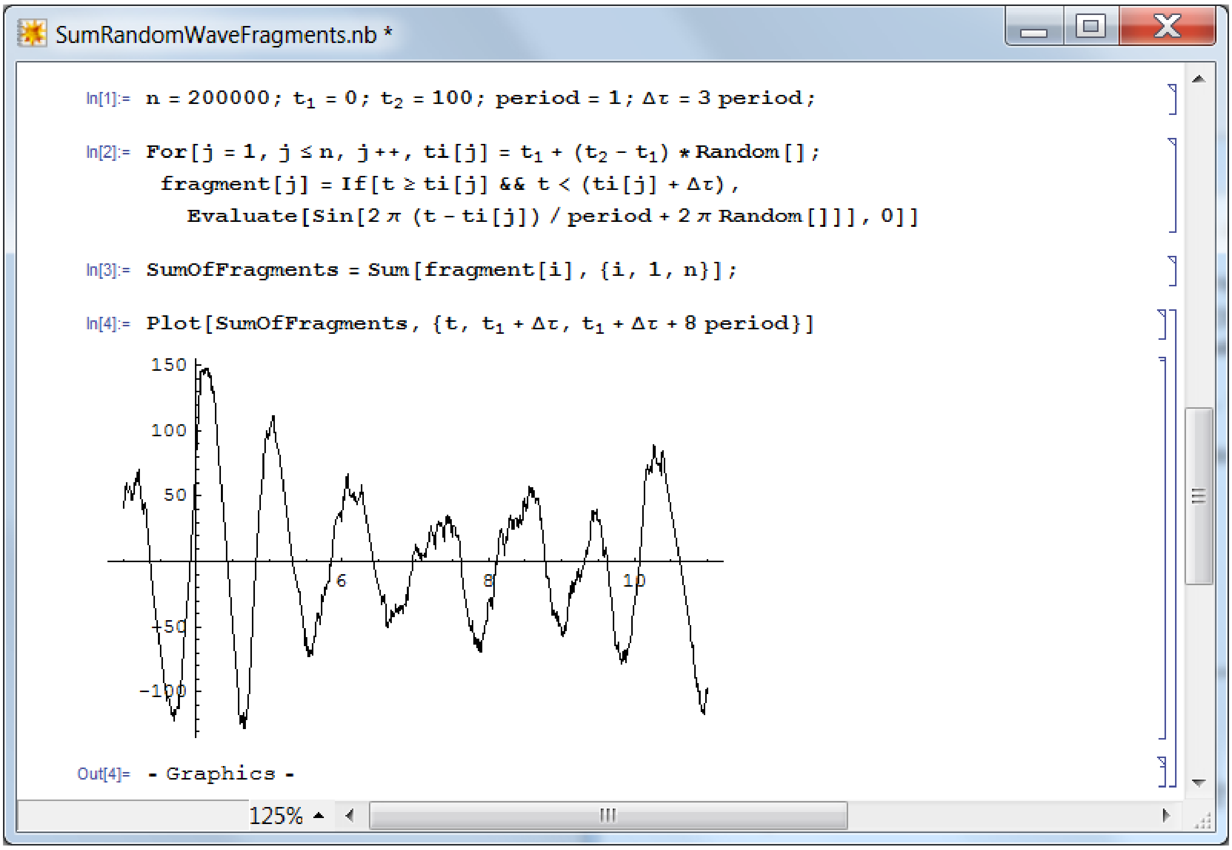
An external observer, like for instance the reader, detects a radiation because he detects a periodically varying aetherino distribution reaching him.

- If the electron travels in curved trajectories *at relativistic speeds* (e.g. in a high energy *synchrotron*) the angle of observation of the electron has a great influence in the frequency of the radiation detected due to the great influence of the Doppler effect in such cases. (Along the "short" arc of the electron's trajectory visible through the radiation window, its velocity makes different angles with the direction of observation. The wide span in frequency of the synchrotron radiation can, for relativistic electrons, be explained by only small variations in such angle).
The experimental fact that the synchrotron radiation is plane polarized in the plane of the trajectory of the electrons is again compatible with the model's description that explains that the radiation is linearly polarized in the direction of the IRV of the electrons (i.e. in the direction perpendicular to the plane in which the *preferred redistribution axis* of the electrons rotate).

The fact that, in a high energy synchrotron, the intensity of radiation is significant only at very small angles above and below the plane of motion (high collimation) can be explained considering that a detector of radiation (whose ultimate elementary detectors are electrons) is mainly sensible to the disturbance carried by aetherinos of relative speed c. But the aetherinos whose speed relative to the detector is close to c have speeds v <<c relative to the emitting electrons. Therefore, in the lab reference frame, in which the emitting electrons move at a speed close to c, the velocity component of the pertinent aetherinos along the direction emitter-detector is much bigger than the velocity component of those aetherinos in the orthogonal directions.

Note_4:
The model of the aether proposed in this work defends that light (and radiation in general) is a *wavelike* disturbance implemented by travelling aetherinos whose distribution of velocities changes periodically in space and time and is therefore a disturbance of the distribution of aetherinos of an undisturbed aether. The apparently corpuscular behaviour of light in some scenarios should be explained by the cooperative effect of the pertinent aetherinos on the target electrons without invoking the controversial concepts of "photon" and "wave collapse". Section 6 of this work gives hints of how to explain some of these phenomena.
The following feature of the emission of synchrotron radiation seems at first sight difficult to explain within a pure wave model of light: How can the electrons emit "a wave" during the short time of their passage in front of a window of the synchrotron? How can the electrons, that when in front of the window all they do is follow a short curved trajectory, cooperate to create at that time a net disturbance with thousands of wave fronts? The proposed explanation is as follows:
When an electron of the synchrotron follows a curved trajectory it is suffering a net *force* (exerted by the bending magnets). As said above, in these circumstances the "preferred redistribution axis" (PRA) of the electron spins with an intrinsic rotation vector (IRV) aligned with the electron's acceleration. Its PRA spins therefore in a plane that is perpendicular to the trajectory plane of the electron. During the short time that an

electron is in front of the radiation window, its PRA will rotate say θ radians. As explained below, this angle θ needs not amount to many wave cycles (1 wave cycle = 2π radians).
Suppose to simplify that the intensity of the electron's redistribution (Fig R-1) varies with the angle that the direction of emergence of the aetherinos makes with the equatorial plane of the electron (perpendicular to its PRA) according to a *sine* function; (this is a deliberately vague example of redistribution, the details not being important in this context). Each electron "i" of the bunch will appear behind the window with its PRA making some particular random angle α(i) with the direction to the observer and will disappear from the window with a new angle α(i)+θ. Each electron contributes to the "total" disturbance with just a small *fragment of a sinusoidal wave* of "angular width" θ and random phase. (The so called synchrotron's radiation is the total disturbance received by the observer as a consequence of the passage of a whole bunch of electrons in front of the radiation window). Let Δt be the total time during which the bunch of electrons is passing in front of the window (i.e. if the first electron of the bunch appears at the window at t_1 and the last disappears from in front of the window at t_2 then $\Delta t = t_2 - t_1$). Each electron of the bunch will appear in front of the window at some particular random epoch t(i) (such that $t_1 \leq t(i) < t_2$) and since all the electrons of the bunch have the same speed they will all spend the same time Δτ to cross the arc of trajectory in which they are visible at the window. Therefore the i^{th} electron disappears from behind the window at the epoch t(i)+ Δτ. It can be seen in a computer simulation that *the sum of a big number of fragments of sinusoidal waves* of equal frequency, random phase, random start t(i) and equal duration Δτ *is a "fair" approximation of a sinusoidal wave,* of the same frequency to that of the fragments, provided that the number "n" of electrons of the bunch is n >> Δt/Δτ. The following screenshot of an evaluation done with Wolfram's *Mathematica* shows an example of that assertion:



The frequency of the sinusoidal wave from which the fragments are cut is equal to the modulus of the IRV but the Doppler must be applied to it due to the fact that the electrons are travelling at high speed towards the observer.

- When an electron performs an “orbit” acted instead by a central force, e.g. when it orbits a nucleus due to its electric attraction force, the electron does not always radiate (like for instance in the so called “stable orbits”). This case of *stable orbits* can be modeled supposing that in these “orbits” the PRA of the electron remains aligned at all times in the same spatial direction (e.g. perpendicularly to the orbital plane). An observer placed at a distance much bigger than the average radius of the electron’s orbit and looking at the electron will always see the same angle between the direction of observation and the PRA of the electron and will therefore not detect any periodically varying aetherino distribution (radiation).

Note_5:
Due to the different velocities of the electron *relative to the observer* in the different positions of its orbit, there will be positions (e.g. close to the orbital plane of the pertinent electron) from which an exterior observer should actually notice a weak periodic variation of the distribution of aetherinos arriving from such electron. (But if it is supposed that, in the stable orbits, (1) the electrons keep their PRA perpendicular to the orbit and that (2) the electron's redistribution of aetherinos is small at the electron's equator, then this radiation should be very weak).

- When an electron falls “freely” in a gravitation field (i.e. the only force acting on the electron is that of gravitation), mainstream Physics asserts that it does not radiate because in such scenario the electron must be considered a particle with no acceleration relative to an “inertial” reference frame. (According to Einstein’s Equivalence Principle a gravitational falling frame is also considered an “inertial” reference frame. There is still nevertheless, due to lack of conclusive experiments, some controversy about such non-radiation predicted by mainstream physics and more generally about the conditions in which the electric charges emit radiation).
According instead to the aetherino’s model, *a free falling electron does radiate* because it is suffering the non zero gradient of aetherino impulses that implements the gravitation force. If this radiation has not been experimentally observed it is plausibly because, in the scenarios accessible to its direct observation, the gravitation force is too weak and hence the radiation is expected to be of very low intensity and of very small frequency.

Note_7:
In the present context the name *falling reference frame* will be given to any locally-restricted reference frame devoid of acceleration relative to some *neighbour reference piece of matter of small mass which is immersed in a gravitation field* (but that otherwise does not suffer any other external force). By "locally restricted" it is meant that the assertions about the behaviour of bodies relative to the *falling reference frame* have validity in only a *small* region of space in the neighbourhood of the reference piece of matter. (In that small region the gravitation field is supposed to be uniform).
According to the aether model, the gravitation force is just a *normal* aetherinical force (aetherinical impulse by unit time) that, like any other force, accelerates the material

bodies relative to the rectilinear frames. The fact that, relative to the “falling” gravitational frames, the bodies have an inertial behaviour (i.e. Newton’s 1st and 2nd law hold) does not give these reference frames the status of “rectilinear frames” but is just considered a trivial consequence of the fact that the aetherino-implemented forces satisfy, by its very nature, the superposition principle. For example, a body that in addition to a gravitation force $\mathbf{F}_G$ suffers another force $\mathbf{F}$ (for example an electric force) will according to the model (and according to Newton’s mechanics) experience an acceleration $\mathbf{a}$ given by $\mathbf{a} = (\mathbf{F}_G+\mathbf{F})/m$ (where m is the mass of the body). But since the gravitation force $\mathbf{F}_G$ that a given body suffers in a gravitation field is proportional to its mass, it can be written as $\mathbf{F}_G= (\mathbf{a}_G \, . \, m)$ where $\mathbf{a}_G$ is a constant (with the dimension of acceleration) that only depends on the variables responsible of the gravitational field (aether features and distribution of external matter) and therefore the acceleration acquired by the body can be rewritten as $\mathbf{a} = (\mathbf{F}_G+\mathbf{F})/m = \mathbf{a}_G + \mathbf{F}/m$. But $\mathbf{a}_G$ is also the acceleration that all the falling bodies acquire in such local gravitation field relative to the rectilinear frames (because gravitation is just a normal force that the aether model shows that produces an acceleration = force/mass) Therefore the acceleration of the body *relative to the falling reference frame* is $\mathbf{a} - a_G$ that is equal to $\mathbf{F}/m$ and therefore such falling frame meets the requirements to be called an *inertial* reference frame since, relative to it, any applied force F satisfies Newton’s 2nd law.

- When an electron is fired into a piece of matter it suffers a deceleration during which it is known to emit radiation (Bremsstrahlung). The deceleration is supposed to be caused by the non zero electric forces of the pertinent nuclei and electrons of the target that dominate at short distances (since the cancellation of positive and negative electric charges is only effective at long distances from the target). On the *average,* the force causing the deceleration of the electron acts along the opposite semi-direction to that of the initial velocity of the projectile electrons. This stopping force corresponds, according to the model, to a gradient of aetherino impulses along the direction of the force. The thesis is again that, due to this gradient, the PRA of the electron is forced to rotate with its IRV aligned with the force and in such a way that the modulus of the IRV increases when the modulus of the force (and hence of the electron's deceleration) increases. This alignment "explains" that (for non-relativistic electrons of speed v<<c) an external observer detects radiation mainly along the directions perpendicular to that of the average deceleration (or close to them). See Fig[R-4].

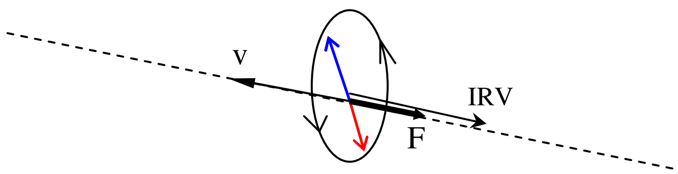


Fig [R-4]

Fig [R-4] represents an electron being forced to decelerate with an average force "**F**" that is parallel and opposite to its velocity "v". The same aetherinical force that produces the electron's deceleration is considered responsible of feeding a rotation on the electron's PRA whose rotation vector IRV is parallel to "**F**".

Note_8:

As is well known, the maximum radiation frequency ν_m (called the cut-off frequency) observed in the Bremsstrahlung is related with the kinetic energy E_{kin} of the projectile electrons by:

(N8-1) $E_{kin} = h \nu_m$

where h is Planck's constant (and where the small work function energy of the target material has been neglected compared with the normally much bigger E_{kin}).

Mainstream physics interprets that the relation (N8-1) means that the full kinetic energy of the projectile electron is converted into a single photon.

The experimental relation (N8-1) invites the aether model to postulate that, in general, when an electron suffers a net force F it emits a radiation of frequency ν given by:

(N8-2) $\nu = (L_M F)^{1/2}$

where L_M is a constant with the dimension $M^{-1} L^{-1}$

The hypothesis (N8-2) would be consistent with the following sketch interpretation of the cut-off feature of the Bremsstrahlung:

The bombarded electrons would emit a radiation of maximum frequency ν_m because, as explained below, in the process of being stopped by the target material they would suffer electric forces that never exceed a maximum intensity F_m.

In the more common cases, the incoming electron is gradually stopped by the electric forces of the target electrons and nuclei near to which it passes. But there will exist special cases in which the incident electron is suddenly and completely stopped by only the repulsion force of a single target electron with which it frontally collides. The maximum force F_m that the projectile electron is able to suffer corresponds therefore to the Coulomb force when it reaches its closer distance to the target electron.

Let d_0 be this closest distance between the projectile electron and the target electron. Therefore (in MKS units):

(N8-3) $F_m = 1/(4 \pi \varepsilon_0) e^2 / d_0^2$

Such minimum distance d_0 can be estimated considering that when the projectile electron comes to rest at the target it has converted all its initial kinetic energy E_{kin} into the Coulomb potential energy associated with the system that it makes with the target electron. This potential energy is:

(N8-4) $E_{Pot} = 1/(4 \pi \varepsilon_0) e^2 / d_0$

and therefore equating $E_{Pot} = E_{kin}$ and introducing the experimental relation $E_{kin} = h \nu_m$

(N8-5) $h \nu_m = E_{kin} = E_{Pot} = 1/(4 \pi \varepsilon_0) e^2/d_0 = e/(4 \pi \varepsilon_0)^{1/2} \; 1/(4 \pi \varepsilon_0)^{1/2} e/d_0 =$

$= e/(4 \pi \varepsilon_0)^{1/2} \; F_m^{1/2}$

and therefore

(N8-6) $\nu_m = (e^2 /(4 \pi \varepsilon_0 h^2) \; F_m)^{1/2}$

which is the relation (N8-2) proposed for the frequency emitted by an electron when suffering a force F_m and where:

(N8-7) $L_M = e^2 /(4 \pi \varepsilon_0 h^2)$

Parenthesis: Review of some basic features of the model.

It has been proposed in the article redistribs_eterinicas_en.pdf of this work that the redistribution of aetherinos by ordinary elementary particles with electric charge can be described with the aid of the following hypothesis:

- There are *two* types of matter (type-p and type-n matter) characterized by the specific way in which they affect and are affected by the aetherinos that collide with them.

- There are *two* types of aetherinos that will be called *p* and *n*.

- There are two types of interactions of the aetherinos with an elementary particle made of a specific type of matter: "Impulsion interactions" and "Switch interactions".
In the "impulsion interactions" the aetherino gives impulse to the elementary particle with which it collides (i.e. it changes the velocity of the collided particle).
In the "switch interactions" the aetherino changes its type (i.e. from *n* to *p* or vice versa) but does not give impulse to the collided particle. This "change of type" of the aetherino does not take place in the former "impulsion interactions".

The type of interaction that takes place depends on the type of matter of the elementary particle and on the type of aetherino involved in the collision, as follows:

Impulsion interactions:
- The n-type aetherinos are able to make "impulsion interactions" with particles of n-type matter (but not of p-type matter). In these interactions a n-aetherino gives impulse (momentum) to the particle with which it interacts. Similarly:

- The p-type aetherinos are able to make "impulsion interactions" with particles of p-type matter (but not of n-type matter). In these interactions a p-aetherino gives impulse to the particle with which it interacts.

- The cross sections of the (ordinary) elementary particles to Impulsion interactions with its corresponding type of aetherinos are *by hypothesis* given by the function [R-1] :

[R-1] $$\sigma_I[v_R] = a_I \ \mathrm{Exp}[-b_I \ v_R{}^2]$$

where:
v_R is the speed of the incident aetherino relative to the particle
a_I is a constant specific of the particle
b_I is a constant common to all ordinary elementary particles.

As usual in physics, a collision "cross section" is a physical magnitude with the dimension of area that is proportional to the probability that the interacting particles (in this case an aetherino and an elementary particle) make an *effective* collision. In this case, such probability depends on the speed v_R of the aetherino *relative* to the particle.

In the impulsion-interactions, when an aetherino (of the appropriate impulsion-type) collides with a material particle it gives to this particle an *elementary aetherinical "impulse"* that by definition is equal to

[R-2] $\mathbf{i}_1 = h_1 \mathbf{v_R}$

where $\mathbf{v_R}$ is the velocity of the aetherino *relative to the particle* and h_1 is a positive universal constant

As explained before in this work, the so called *aetherinical impulse* is just an *auxiliary concept* with which to define the *aetherinical force* as the net aetherinical impulse by unit time suffered by a material particle.

The velocity change suffered by an elementary particle in an "*impulsion interaction*" is by hypothesis:

[R-3] $\Delta\mathbf{v} = \mathbf{i}_1 / \mu_P = h_1 / \mu_P \; \mathbf{v_R}$

where μ_P is a positive constant specific of the particle.

Switch interactions:

In these *switch* interactions the aetherinos suffer a change from on type to the other. More precisely:

- The n-type aetherinos suffer *switch* interactions when they collide with p-type matter (but not with n-type matter). In these interactions the n-type aetherinos are transformed into p-type aetherinos.

- The p-type aetherinos suffer *switch* interactions when they collide with n-type matter (but with p-type matter). In these interactions the p-type aetherinos are transformed into n-type aetherinos.

- The cross sections of the (ordinary) elementary particles to Switch interactions with its corresponding type of aetherinos are *by hypothesis* given by the function [R-5] :

[R-5] $\sigma_S[v_R] = a_S \; \mathrm{Exp}[-b_S \; v_R{}^2]$

where:

v_R is the speed of the incident aetherino relative to the particle
a_S is a constant specific of the particle
b_S is a constant common to all ordinary elementary particles.

Note: Additional assumptions of these *switch* (*non-impulsion)* interactions would be that: (a) the particle does not suffer any velocity change; and (b) the interacting aetherino neither suffers a velocity change (but only a type-change). (Nevertheless the description could also (and might also need to) assume that in these non-impulsion (switch) interactions both the particle and the aetherino do also suffer a small velocity change but much smaller than the respective velocity changes of the impulsion interactions).

Notice that both cross sections σ_I and σ_S are, by hypothesis, described by the same function. Furthermore, it will be assumed (not only for simplicity reasons but also so as to predict for example that the force exerted by a neutral atom on a charged particle is equal to the force that the particle exerts on the atom) that the constants of b_S and b_I both cross sections are equal (i.e. $b_S = b_I$) and that, for a given particle, its constants a_S and a_I are aslo equal (i.e. $a_S= a_I$).

<u>Some *conservation of energy* considerations.</u>

Many physicists consider that mainstream physics is presently unable to reconcile the two following facts:

(1) When two electrically charged particles interact they exert electromagnetic forces on each other that change the kinetic energies of the particles and the potential energy of the system in such a way that the sum of the kinetic energies of the particles and the potential energy of the system is conserved. This conservation of kinetic plus potential energy is a consequence of assuming that the accelerations suffered by the interacting particles is governed by the laws of mechanics (approximately Newtonian for slowly moving particles or, more rigorously, by those of Special Relativity).

(2) The electrically charged particles emit radiation when they suffer an acceleration (relative to an inertial reference frame).

Since that radiation implies that some energy is added to the system then the consequence of the two above assumptions is that mainstream physics is unable to explain the conservation of energy in closed systems made by charged interacting particles.

The author believes that the expressions of the “electrodynamic” force between charged particles proposed by the EVE model of the aether gives some clues to solve the energy dilemma of mainstream electrodynamics.
Consider for example the force that, according to the model, exerts a charged particle A on another charged particle B that moves relative to the first at a speed u along the straight line AB that joins both charges (and that therefore is called a *frontal* force). Suppose that A remains at all epochs at rest in the inertial reference frame of description (e.g. because $m_A >> m_B$ or because an experimental arrangement is made in which there is another 3rd charge B’, equal to B, that due also to the interaction with A, moves at all epochs in symmetry (of center A) with the movement of B). The frontal force between two charges has been calculated by the model in other sections of this work. For example in the paper *redistribs_eterinicas_en.pdf* it is shown (see Fig[R-22]) a plot of such central force:

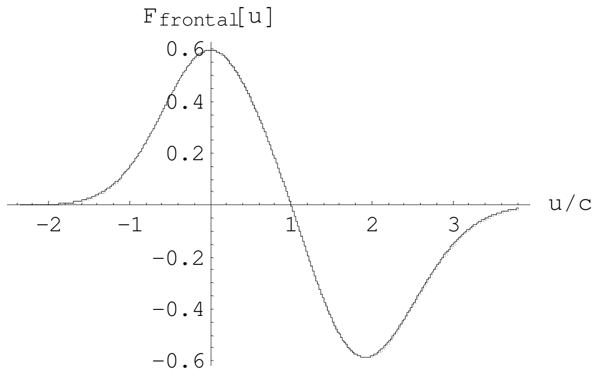


Fig [R-22]
Electric force exerted by a charge A on another charge B that moves directly away (u>0) or towards (u<0) the former at a relative speed u.

Defining for the present purposes that a repulsion force is *positive* (while an attraction force is negative), the figure [R-22] corresponds to the case in which both electric charges A and B are of the same sign.

When the charges A and B are of opposite sign the model predicts that the frontal force $F_{frontal}[u]$ is just the negative of the force shown in Fig[R-22]
(i.e. in the case of two particles of opposite electric charge the frontal force is again equal to zero at u=c (i.e. when B moves away from A at a relative speed c) and tends asymptotically to zero as B *approaches* A at increasing relative speeds (including those in which $|u| > c$)).

The evaluation of the force $F_{frontal}[u]$, done according to the assumptions of the model, also show that for any given speed $|u|<c$ the force *is always slightly bigger* when B approaches A (u<0) than when B moves away from A. (It is of course assumed that in both cases the distance between A and B is the same because, for a given relative velocity u, the force $F_{frontal}[u]$ decreases with the distance in proportion to the inverse square of the distance).

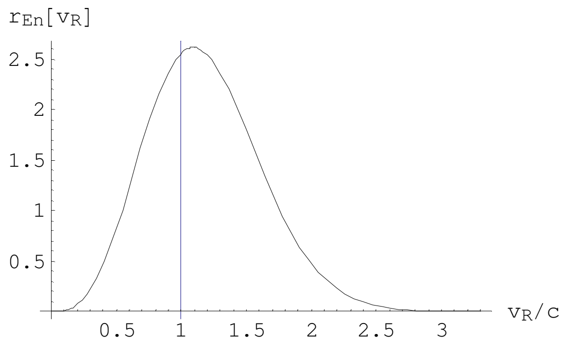
The following two scenarios can then be analyzed:
1^{st} – Suppose that A and B are **charges of equal sign**. Let B be at the initial epoch t_0 at rest at a "small" distance d_0 from A. Due to the repulsion force exerted by A the particle B will accelerate away from A. At a later epoch t the particle B will be at a distance *d* from A and will have acquired a speed u_{Bd} (along the semi direction AB). Such speed u_{Bd} can be calculated from the knowledge of the frontal force $F_{frontal}[u]$ of the model and the use of Newton's second law. Suppose that this epoch t is late enough so that at the distance *d* the force that A exerts on B is negligible (i.e. the speed u_{Bd} does no longer increase noticeably). Suppose that the velocity of B is then reversed so that it begins to approach A at the same initial speed u_{Bd} (In this scenario in which, due to the big separation *d*, the force F_{AB} can be neglected, all theoretical approaches (whatever expressions of the kinetic and of the potential energy of a particle they adopt in their description) will agree that the total *energy* (kinetic + potential) of B has not been changed by the fact of reversing its velocity (maintaining its *speed* relative to A). As B approaches A it will suffer the repulsion force $F_{frontal}[u]$ exerted by A and the speed of B will gradually slow down. At some given epoch t_1 and some distance d_1 from A the particle B will come to a stop. The intuition suggests that, since for any given distance and any given relative speed the force $F_{frontal}[u]$ is stronger when B approaches A than

when B recedes from A, then the distance d_1 at which B will come to a stop will be bigger than the distance d_0 defined above. The calculus confirms such intuition. Therefore, whatever expressions of the potential and kinetic energies are adopted by the description, one must conclude (according to the model) that the particle B has lost energy because in both reference epochs t_0 and t_1 its kinetic energy is zero while in the epoch t_1 its potential energy is smaller than at the earlier epoch t_0. The model can therefore assume in a natural way that such missing mechanical energy is actually in the system in the form of radiation emitted by B due to the accelerations that it has suffered in both (recede and approach) journeys.

2nd – Suppose that A and B are **charges of opposite sign**. Let A me made in this case by two identical, small, particles A_1 and A_2 that are located very close to one another but leaving a small gap in between through which B can pass. A_1 and A_2 remain at all epochs at rest (in the reference frame of description). Let B be at the initial epoch t_0 at rest at a big distance d_0 from A. Due to the attraction force exerted by A, the particle B will accelerate *towards* A. At some later epoch t_1 the particle B will traverse A (through the gap between A_1 and A_2) with a "high" speed and begin to move away from A (at the other "side" of A). Due to the attraction exerted by A, the particle B will decelerate and eventually stop at the epoch t_2 at some distance d_2 from A. The intuition suggests now that, since for any given distance and any given relative speed the force $F_{frontal}[u]$ is stronger when B approaches A than when B recedes from A, then the distance d_2 at which B will come to a stop will be bigger than the distance d_0 at which it started to approach A from the other side. But in this case the calculus shows that intuition fails. The calculus (step by step numerical evaluations of the position and velocity of B acted by the frontal force $F_{frontal}[u]$ of the model and the use of Newton's second law) shows that the distance d_2 at which B comes to a stop (or more precisely reverses its velocity) is *smaller* than the distance d_0 at which it started to approach A from the other side. This result implies again that the particle B has lost energy because in both reference epochs t_0 and t_2 its kinetic energy is zero while in the epoch t_2 its potential energy is smaller than at the earlier epoch t_0. The model can therefore assume in a natural way that such missing mechanical energy is actually in the system in the form of radiation emitted by B due to the accelerations that it has suffered in both (recede and approach) journeys.

Anisotropy of the redistributions of the electron (and some other elementary particles)

The impulsion and the switch cross sections [R-1] and [R-5] are considered average cross sections when averaging over all the directions of space relative to the particle. In the paper *redistribs_eterinicas_en.pdf* it is shown that, when considering the distribution of aetherino speeds of the aether bathing an electron (or more generally a non-neutral elementary particle), such average switch cross section gives rise to a redistribution of the type:



Fig[R-10]

In arbitrary units, average **redistribution** of n-type aetherinos created by an electron at rest in the aether.
(v_R is the speed of the aetherinos relative to the electron),
(taking a_S=1, b_S=1.255/c^2 , V_M=10^{10} c, N_0=10^{32}). See Eq[R-9].

(That would be the average redistribution of a lot of electrons randomly oriented in space).

But some physical facts like the "constancy of the speed of light" which is interpreted by the model as meaning that the speed of light is c *relative to the specific elementary detector* (generally an electron) that receives the radiation (but not necessarily relative to the reference frame of description) need some further hypothesis about the anisotropy of the redistribution and the impulsion cross section of any given electron. For instance, many physical facts about light seem to fit if it is supposed that:

- Both the impulsion and the switch cross sections of the electron have a very sharp resonance, centred at the speed c (relative to the electron), in the directions that are quasi perpendicular to the PRA (preferred redistribution axis) (i.e. in the equator of the electron).
- The fact that the switch cross section of the electron is very sharp for those aetherinos of relative speed equal (or close) to c that reach it along equatorial directions has the consequence that *the redistribution* of the electron has that same anisotropy (i.e. the n-type aetherinos that emerge in excess include a wide range of speeds along its polar (high latitude) directions but a very narrow redistribution of speeds (affecting mainly those aetherinos of speeds close to c) along its equatorial directions.
- When the electron suffers a gradient of aetherino impulses (like for example the oscillating gradient of aetherinos that implements the radiation along its line of propagation) then the electron orients its equator to face the direction of the gradient (i.e. sets its PRA perpendicularly to the gradient) and rotates (or oscillates) its PRA as explained above (i.e. aligning its PRA perpendicular to the gradient of impulses). This rotation (or oscillation) of its PRA, whether induced by the incoming radiation or by the non-oscillating gradient of a more general aetherinical force, has the consequence that the electron "throws" periodically in space along its rotating polar directions a big number of aetherinos with a wide distribution of speeds (i.e. the electron radiates). And again, the target electrons reached by such flow of aetherinos modulated in a wide spread of speeds (radiation) will react more strongly to those flows transported by aetherinos of speed c relative to those target electron-detectors.

- The case of non relativistic electrons accelerated by a uniform electric field (e.g. electrons travelling between two plates of opposite charge) can also be pictured by Fig[R-4] in which the radiation emitted by the electrons has its maximum along the directions perpendicular to the electric force (and hence to the acceleration of the electrons).

- When electrons move alternately up and down a rectilinear conductor wire (e.g. in a radio antenna) in response to an applied potential difference whose semi-direction is changed with a given frequency ν, it will happen that the IRV (intrinsic rotation vector) of the conducting electrons will also change its semi-direction with the same frequency ν. In many cases the PRA of the electrons will only rotate small fractions of 2π during a period $1/\nu$ of the applied potential and it can be expected that the *dominant* frequency of the emitted radiation will also be ν and in this case will not be conditioned by the acceleration of the electrons due to the oscillating force.

- When a "free" electron is radiated by an external source of radiation (e.g. in the Compton effect) it is "pushed" along the semi-direction of the incoming radiation until it quickly acquires a limit speed v_L that (as explained in another section of this work) depends on the frequency ν_E of the emitted radiation. The speed v_L is actually an *average* speed since the radiation that keeps arriving to the target electron increases and decreases such speed with a frequency ν_D which is the Doppler shifted frequency detected by the electron flying away from the source of radiation at the average speed v_L. The electron behaves then similarly to the antenna described in the above paragraph and emits a secondary radiation. This secondary radiation is observed at the lab detectors at frequencies that depend strongly on the angle of observation since now the Doppler effect of the fast moving electron plays an important role.

- When a constant electric field is applied to a neutrally charged body its electrons rearrange their positions and speeds within the body and quickly stabilize in states in which they suffer a null average electric force because, in those arrangements, the electric force of the external electric field is cancelled by the electric forces of the neighbour charges. Therefore the body will not radiate since its charges suffer no net force.

Similarly, no radiation is expected from a material body *resting* in the surface of the Earth since here again the charged particles of the body suffer electric forces from the neighbour particles that cancel the gravitation force that they also suffer.

The assertion of the preceding paragraph is only true assuming that the Earth itself has no acceleration relative to the rectilinear reference frames. But strictly speaking, the Earth is orbiting the Sun and has therefore a small acceleration relative to the rectilinear frames. This implies that the Earth is suffering a net force (since in the model all acceleration relative to the rectilinear frames implies the existence of a net force). The electrons forming part of the Earth will therefore also be suffering their small share of such gravitational force of the Sun and will radiate (though it can be expected that this "gravitation radiation" will be very weak and totally obscured by the standard thermal radiation of matter).

Similarly, any neutrally charged body being accelerated (relative to the rectilinear frames) by an external force (e.g. a bullet departing a cannon or entering a target) will have its electrons suffering their share of that force (gradient of aetherino impulses) and are expected to radiate.

(Another issue that does not yet seem settled in mainstream physics is whether the radiation of the accelerated protons interferes destructively and cancels the radiation of their neighbour electrons thus justifying that the radiation of neutral bulk accelerated matter has not been observed. According to the aether model, the protons cannot cancel the radiation from the electrons since, for any given acceleration, the protons radiate with much smaller power than the electrons. This (unclear) prediction will be studied in another paper).

Many ordinary macroscopic emitters of radiation are made of electrically neutral matter. In these emitters it can be considered that for each electron, including those that are radiating, there is a randomly aligned proton whose aetherinical redistribution must be accounted for since it also reaches the detector. The *non radiating* electrons have their axes randomly aligned in space and therefore their average redistribution cancels approximately when adding to it the average redistribution of a corresponding proton. But from a *radiating electron*, whose axis oscillates or rotates, emerges a redistribution that is no longer cancelled *at all times* by that of a neighbour proton. Therefore to describe the disturbance received by a distant detector, the average redistribution of a proton must be accounted for together with the oscillating redistribution of each emitting electron.

to be revised when possible

See also http://www.eterinica.net/redistribs_eterinicas_en.pdf

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