

GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: A

Physics and Space Science



Frictional Heat Generation

Equation of Thermal Radiation

Highlights

Particle in Gravitation Field

Numerical Modeling of Lawsonite

Discovering Thoughts, Inventing Future

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Expanded Field Theory New Axioms, Laws and Consequences

By Dr. Valentina Markova

Bulgarian Academy of Sciences

Abstract- The present study attempts to expand the Classic Field Theory to a more general theory of the field. This more general field theory is named Expanded Field Theory. This new theory contains 2 new axioms and 8 laws. It predicts to include the gravitational field and other unknown and unexplored fields.

As it is well known the Classic Field Theory is described mostly by Theory of Electromagnetic Field. The Electromagnetic Field is described by Maxwell's laws (1864). The Maxwell's laws are certified by a single axiom which claims that the movement of a vector E in a *closed loop* ($\text{div rot } E = 0$) is *evenly* or velocity is constant.

The author replaces this axiom with a new one, according to which the *movement* of a vector E in an *open loop* ($\text{div rot } E \neq 0$) or an open vortex ($\text{div Vor } E \neq 0$) is *unevenly* or velocity is variable. If the vortex is in plane (2D), it is named a cross vortex. If the vortex is in volume (3D), it is named a longitudinal vortex. Something more- each vortex can be decelerating ($\text{div (Vor} E) < 0$) or accelerating ($\text{div (Vor} E) > 0$).

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Expanded Field Theory

New Axioms, Laws and Consequences

Dr. Valentina Markova

Abstract- The present study attempts to expand the Classic Field Theory to a more general theory of the field. This more general field theory is named Expanded Field Theory. This new theory contains 2 new axioms and 8 laws. It predicts to include the gravitational field and other unknown and unexplored fields.

As it is well known the Classic Field Theory is described mostly by Theory of Electromagnetic Field. The Electromagnetic Field is described by Maxwell's laws (1864). The Maxwell's laws are certified by a single axiom which claims that the movement of a vector E in a *closed loop* ($\text{div rot } E = 0$) is *evenly* or velocity is constant.

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After the first axiom are obtained immediately 4 *types of movements*- cross vortex, which can be accelerating or decelerating and longitudinal vortex , which can also be accelerating or decelerating.

The following results are obtained: evenly movement is replaced with unevenly movement (decelerating or accelerating); movement in a closed loop is replaced with movement in an open loop or vortex; a cross vortex in 2D generates a longitudinal vortex in 3D through a special transformation and vice versa- the longitudinal vortex in 3D through another special transformation generates a cross vortex in 2D; the decelerating vortex emits primary vortices to environment, but the accelerating vortex sucks into the same primary vortices from environment; the accelerating longitudinal vortices are attracted to one another, as the faster is inserted into the slower and thus form a funnel- this is the model of gravity funnel.

It should be noted, in particular, the results of the *second axiom*. It claims that two complex (cross- longitudinal) vortex objects in 3D that work in one direction as one complementary pair, are existed simultaneously. This way they are obtained 2 pairs of complementary objects in both directions.

As a final result are received many models with similar shapes and content. For example, the pair in one direction of complex complementary vortex objects is a model of the electron-proton chain, and in the opposite direction is an antiproton-positron chain model.

"We can not solve the problems by using the same way of thinking we used when we created them."

Einstein

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I. INTRODUCTION THE ESSENCE OF AXIOM 1

a) The Classic Axiom

The classic axiom in the Theory of the Electromagnetic Field certifies Maxwell's laws (1864). It postulates that the movement of an electric vector E in a closed loop is evenly:

$$\text{div}(\text{rot } E) = 0, \quad (1)$$

where $(\text{rot } E)$ is the movement of the vector E in a closed loop; $\text{div} (\text{rot } E)$ is the divergence (the variation in increase or decrease) of the vector E during its movement in a closed loop ($\text{rot } E$); the movement of the vector E in a closed loop ($\text{rot } E$) with zero divergence (variation) of the vector E is equivalent to evenly movement or to movement with constant velocity V[1].

The defect of the classic axiom (1) is that it does not describe movements in an open loop or a vortex, or movements with a non-constant or variable velocity V.

b) The New Axiom for rotor

For the purpose of describing a larger range of movements, it is obviously necessary to expand the foundation of service theory. This means that such an axiom must be used which can certify wider set of movements.

The main motivation for altering the classic axiom (1) follows after the need to describe the *causative relationships* in uneven movements in open systems. It turns out that open vortices are the cause of closed vortices, which means that open vortices are more fundamental than closed ones [2].

So it is the necessity to change the existing axiom of the Classic Field Theory for close loop to axioms of Expanded Field Theory for open loops [3].

In order to expand the concepts, the notion (1) of movement of vector E in a closed loop ($\text{div} (\text{rot } E) = 0$) in 2D (Figure 1A, a) is replaced by the notion (2) of movement in an open loop ($\text{div} (\text{rot } E) \neq 0$ in 2D (Figure 1A,b).

The new axiom describes an open loop movement:

$$\text{div} (\text{rot } E) \neq 0,$$

c) The extension of the term of vortex (vor) from Classic Fluid Theory

- Unreal term of vortex: *evenly* vortex (vor) is used in Classic Theory:

The term vortex (vor) is used in fluid dynamics and defined as "an area in fluids, where the flow rotates evenly along a spiral around an axis line, which can be straight or curved" [4]. Fluid movement is uniform (evenly) in 3D. To begin with, we can use this classic definition, having in mind that here the term (vortex, vor) is for a uniform vortex in the classical sense.

Real term of vortex: *unevenly* vortex (Vor) means that the velocity (V) is variable and as a result – the steps are not constant.

For the purposes of the present study the the term must extend to both 3D and 2D and modified for an unevenly vortex or a vortex with uneven movement.

In fact, in nature it does not exist evenly vortex with the constant steps between the rotations. If a movement is evenly, it forms a closed circle rather than an open vortex. There is an unevenly vortex in nature, and because it is uneven it is not centered, but it is eccentric.

Thus the designation of an evenly vortex "vortex, vor" is replaced with a designation for an uneven vortex "Vortex, Vor" with a capital letter.

So the description of an "evenly vortex", that can not exist in nature: $\text{div}(\text{vorE}) > 0$; $\text{div}(\text{vorE}) < 0$ will replace of description of an unevenly (natural) vortex that exists in nature: $\text{div}(\text{VorE}) > 0$; $\text{div}(\text{VorE}) < 0$

Definition: The monotone accelerated or decelerating vortex (VorE) of the vector En is called a natural vortex (vorE) for which:

$$\text{div}(\text{VorE}) > 0; \text{div}(\text{VorE}) < 0.$$

Definition: An unevenly cross vortex (E_{2D}) is an unevenly vortex (E) spinning transversally in a 2D plain.

The cross open vortex in 2D is designated as Vortex E_{2D} or simply V or E_{2D} (Figure 1A, b).

Definition: An unevenly longitudinal vortex (H_{3D}) is an unevenly vortex (H) spinning in the volume of 3D.

The longitudinal open vortex in 3D is designated as Vortex H_{3D} or simply Vor H_{3D} (Figure 1A,d).

Both definitions for natural unevenly vortices ignore the thickness of the vortex itself, be it cross or longitudinal. Differences in geometry reflect the difference in distance between the coils and the diameter of the coils.

d) The New Axiom for rotor and vortex

It exists a vortex $\text{div}(\text{VotE}) \neq 0$ as an open loop ($\text{div}(\text{rotE}) \neq 0$) in 2D or: $\text{div}(\text{VotE}) \neq 0$. 3a.

It exists a vortex $\text{div}(\text{VotH}) \neq 0$ as an open loop ($\text{div}(\text{rotH}) \neq 0$) in 3D or: $\text{div}(\text{VotH}) \neq 0$. 3b

The existence of an open loop means that it can exists a decelerating or an accelerating vortex in 2D:

$$\text{div}(\text{VorE}) < 0; \text{div}(\text{VorE}) > 0; \quad 4a.$$

The existence of an open loop means that it can exists a decelerating or an accelerating vortex in 3D:

$$\text{div}(\text{VorH}) < 0; \text{div}(\text{VorH}) > 0; \quad 4b.$$

Axiom 1. The moving of vector E along an open loop is unevenly $\text{div}(\text{rotE}) \neq 0$, or velocity is variable.

Consequence (of moving in vortex)

- Moving with monotone-decreasing or monotone-increasing velocity becomes along an open vortex:

$\text{div}(\text{VotE}) \neq 0$ for vector E in 2D(in plane) that was named as *cross vortex*, or $\text{div}(\text{VotH}) \neq 0$ for vector H in 3D(in volume) that was named as *longitudinal vortex*. 5.

- The motion of vector E with monotone-decreasing or monotone-increasing velocity is along the open loop in 2D vortex : $\text{div}(\text{VotE}) \neq 0$, for which $\text{div}(\text{VorE}) < 0$; $\text{div}(\text{VorE}) > 0$. The motion of vector H with monotone-decreasing or monotone-increasing velocity is along the open loop in 3D vortex: $\text{div}(\text{VotH}) \neq 0$, for which $\text{div}(\text{VorH}) < 0$; $\text{div}(\text{VorH}) > 0$.

Consequence (of variation of moving):

- The main result of Axiom 1 is that there have been 4 types of vortices: a cross vortex in 2D (E_{2D}) that can be accelerated (E_{2D+}) or decelerated (E_{2D-}) and a longitudinal vortex in 3D (H_{3D}) that can also be accelerated (H_{3D+}) or decelerated (H_{3D-}), (Figure1 A, c, d).
- We immediately received 4 types of movements – cross (3a), which can be accelerated or decelerating(4a) and longitudinal (3b) , which can also be accelerated or decelerating(4b).

Consequence (of visual perception)

It is known that light is spreading crosswise.

- Therefore, the cross vortex will reflect the light rays, and an external observer will perceive the image of the cross vortex.
- But the thread of the longitudinal vortex does not reflect the light. The light crosses the thread of longitudinal vortex, surrounds the thread, and continue its path without reflecting the longitudinal vortex. So it forms diffraction. Therefore, the longitudinal vortex is invisible to an external observer.

The Classic axiom uses the definition of a closed loop ($\text{div}(\text{rot E}) = 0$) (1)[1]. The new Axiom 1 (5) postulates that the movement of vector E in an open loop is always unevenly and uses a new definition (2) with an open loop ($\text{div}(\text{rot E}) \neq 0$) (Figure 1A,b), [2 , ctp 233- 241], [3].

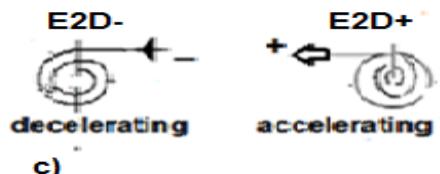
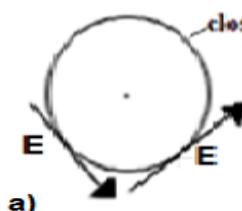
Consequence (vortex turns to a dipole).

The reason is in the acceleration of velocity. For example, in decelerating vortex (Figure 1A, b) $E_1 > E_3$ and the Geometric Center will aim to move to the larger vector E_1 (up). In the same vortex $E_2 > E_4$ and at the

same time the Geometric Center will aim to move to the larger vector E_2 (to the left). Therefore, the Geometric Center will move to a second quadrant or to the Gravity Center.

Classic axiom:

$$\text{div}(\text{rot } \mathbf{E}) = 0 \quad \text{---} \quad \text{div}(\text{rot } \mathbf{E}) \neq 0 \quad \text{---}$$

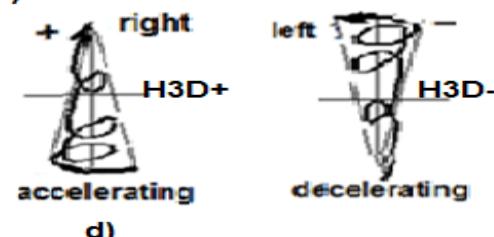
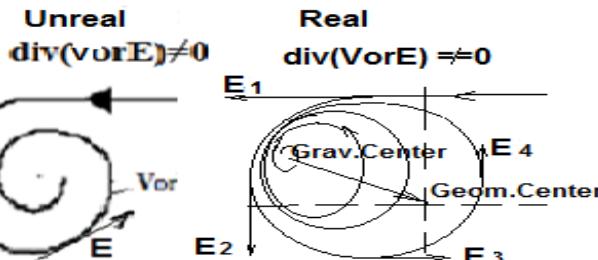


$$\mathbf{E}(\mathbf{V}, \mathbf{A}) \quad \mathbf{E} = \mathbf{V} + i\mathbf{A}$$

(V is reason)

New axiom:

$$\text{Unreal} \quad \text{div}(\text{vor } \mathbf{E}) \neq 0$$



$$\mathbf{E}(\mathbf{V}, \mathbf{A}) \quad \mathbf{E} = \mathbf{A} + i\mathbf{V}$$

(A is reason)

Figure 1A: The classical axiom is replaced by a new axiom

Consequence (of complex vector)

The vector \mathbf{E} is not a simple but complex vector. It contains the velocity (\mathbf{V}) of the real(reason) flow and the amplitude (\mathbf{A}) of the imaginary(result) cross vortices (Figure 1A, e) or the amplitude (\mathbf{A}) of the real(reason) cross vortices and velocity (\mathbf{V}) of the imaginary(result) flow (Figure 1A,g).

II. THE ESSENCE OF AXIOM 2

a) Two directions of pair of complementary objects

The reason is that the vector \mathbf{E} is a complex vector. When $\mathbf{E}_1 = \mathbf{A} + i\mathbf{V}$, the amplitude \mathbf{A} is superimposed and as a result generates a velocity \mathbf{V} (Figure 1B, c). When $\mathbf{E}_2 = \mathbf{V} + i\mathbf{A}$, the velocity \mathbf{V} is transformed as a result of the amplitude \mathbf{A} (Figure 1B, b).

Definition: Pair of complementary objects is such pair of vortices which is generated by complementary vectors $\mathbf{E}_1 = \mathbf{A} + i\mathbf{V}$, $\mathbf{E}_2 = \mathbf{V} + i\mathbf{A}$, and as a result the objects have complementary actions.

If one object pushes (Figure 1B, c), but the other pulls (Figure 1B, b) or inverse, they form a pair of complementary objects. Because of one object pushes (Figure 1B, c), the other- pulls (Figure 1B, b), the both of

them are active generators or they form a pair of active generators in complementary work.

Consequence: The first pair is in straight direction: amplitude (\mathbf{A}) can be the reason but the speed (\mathbf{V}) is the result ($\mathbf{E}_1 = \mathbf{A} + i\mathbf{V}$) (Figure 1B, c) and the velocity (\mathbf{V}) can be the cause and the amplitude (\mathbf{A}) - the result ($\mathbf{E}_2 = \mathbf{V} + i\mathbf{A}$) (Figure 1B, b). The second pair is in the opposite direction: amplitude ($-A$) can be the reason but the speed ($-V$) is the result ($-E_1 = -A - iV$). Or the velocity ($-V$) can be the cause and the amplitude (A) is the result ($-E_2 = -V - iA$) - this situation is not depicted in the figure because it is much less probable.

Consequence: Pair of complementary objects ($\mathbf{E}_1 = \mathbf{A} + i\mathbf{V}$, $\mathbf{E}_2 = \mathbf{V} + i\mathbf{A}$) exists at the same time.

Consequence: Pair of complementary objects ($\mathbf{E}_1 = \mathbf{A} + i\mathbf{V}$, $\mathbf{E}_2 = \mathbf{V} + i\mathbf{A}$) is connected by a links - in one direction (1,2,3), and in opposite direction (3,4,1), (Figure 1B, b, c).

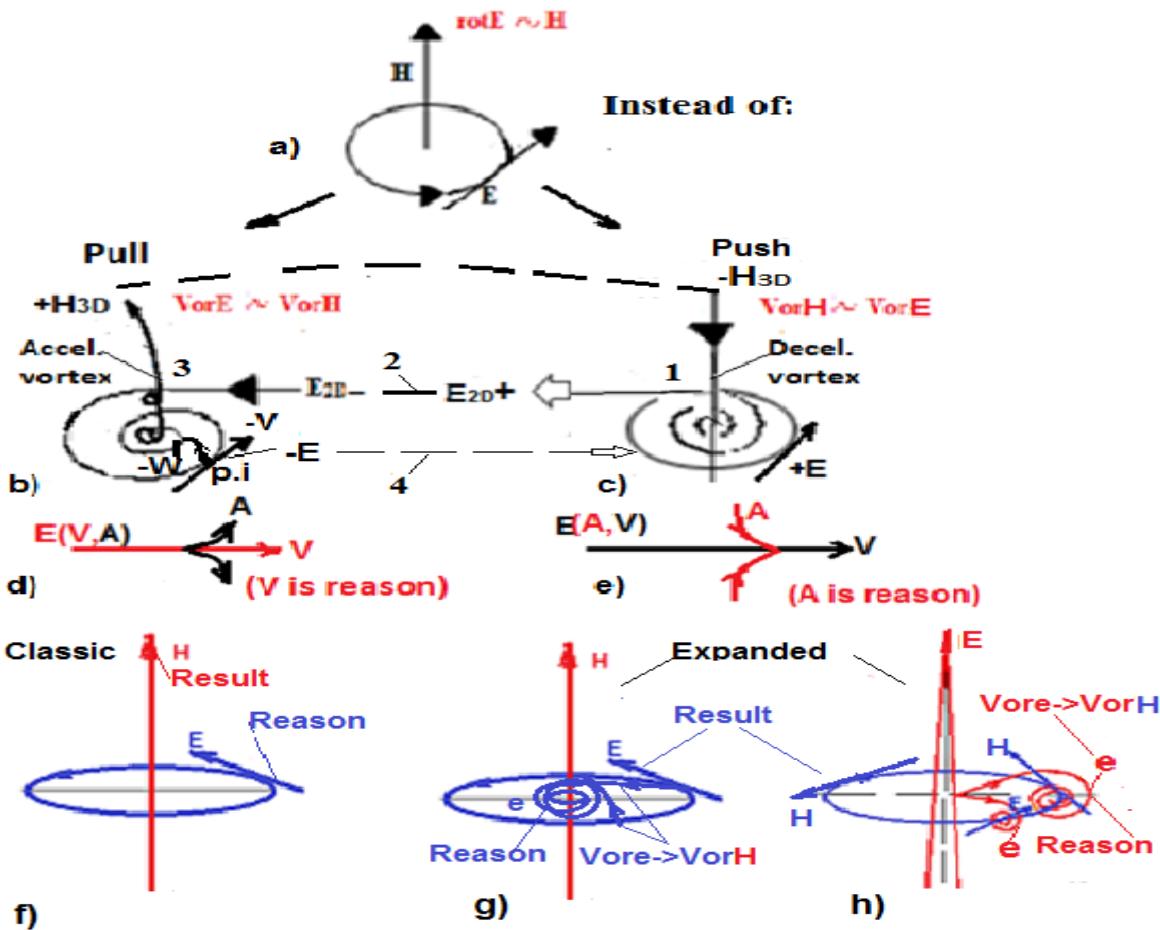


Figure 1B: One pair (in one direction) of complex vortices in 3D

Axiom 2: A pair of complementary vortices forms a system.

As is known from cybernetics, the system is a set of interconnected parts that work together through some process of control. The definition of a system includes simultaneity at unified internal time and bidirectional and also commitment to the exchange of matter and energy.

"A system is called a multitude of objects and relationships between them, which are treated as one. A link can connect two or more objects. It can be information, material or energy. The set of connections defines the structure of the system. The management of an arbitrary system is studied by cybernetics using two approaches... "(Wikipedia).

Consequence: Two pairs of complementary vortices exist simultaneously ,at the same time: one pair in one direction in 2D: $+E_1 = +A + iV$; $+E_2 = +V + iA$ and the complementary pair in opposite direction in 2D:

$$-E_1 = -A - iV; -E_2 = -V - iA. \quad 6.$$

Consequence: A pair of complementary vortices exists at the same time, It is connected by links that exchanges energy and matter.

b) A pair of active generators forms resonance system

Because of one object pushes (Figure1B,c), the other-pulls (Figure1B,b), the both of them are active generators or they form a pair of active generators in complementary mode.

Consequence: In the pair of complementary objects, the both of them form resonance system.

Consequence: In the pair of complementary objects, the both of them are active generators.

For comparison in the Electromagnetic Field, the electrical circuit contains one generator element and one or several passive consumers that only transform energy from one view(kinet.) to the other view (poten.).

III. EXPANDING OF MAXWELL'S LAW

a) The inconvenience of the first Classic Maxwell's Law

According to the classic axiom (1), the first classic law of Maxwell named "the law of electromagnetic induction" is presented as follows:

$$\text{rot } E = -\mu \frac{\partial H}{\partial t}, \quad 7.$$

where (rot E) is the evenly movement of the electric vector E in a closed loop, μ is the coefficient of magnetic

permeability, $\partial H/\partial t$ is the variation of the magnetic vector H in time t [1]. On the one hand, a change in magnetic induction over time ($\partial H / \partial t$) generates an *evenly movement* of the electric vector ($\text{rot } E$). It is named "the law of electromagnetic induction", where the sign "→" means generation:

$$-\mu \frac{\partial H}{\partial t} \rightarrow \text{rot } E. \quad 7a.$$

- On the other hand, an *evenly movement* of the electric vector ($\text{rot } E$) must generate a magnetic induction vector (H) in the center of the closed loop ($\text{rot } E$ is right proportional ~ to H) :

$$\text{rot } E \sim H, \quad 7b.$$

where the sign " ~ " means proportionality.

Consequence (about the sense of the first Classic Maxwell's law):

This presentation of Classic Maxwell's law refers only to *evenly movement* of the electric vector ($\text{rot } E$) that must generate a magnetic induction vector (H) in the center of the closed loop.

b) Expanded Law of Maxwell

- According to the new axiom (2) ($\text{div } (\text{rot } E) \neq 0$) and the new definition of vortex (3) ($\text{div } (\text{Vor } E) \neq 0$), the Expanded Maxwell's Law is modified like this: a cross vortex in 2D ($\text{Vor } E$) of vector (E) continues in the center as an *one single and simple* longitudinal vortex in 3D ($\text{Vor } H$) of vector (H) (Figure 1B, b)
- According to the new axiom (2) Expanded Maxwell's Law states that the cross vortex ($\text{Vor } E$) of vector (E) generates an *one single and simple* longitudinal vortex ($\text{Vor } H$) of vector (H) in the center:

$$(\text{Vor } E)_{2D} = k \cdot (\text{Vor } H)_{3D}, \quad 7c.$$

where ($\text{Vor } E$) is a cross vortex in 2D of vector (E); ($\text{Vor } H$) is an *one single and simple* longitudinal vortex in 3D of vector (H), (k) is an estimator of medium viscosity.

- The direction of the resulting vector (H) is determined by the well known *Right-hand Rule*. If the right hand is facing down and the fingers indicate the direction of the velocity (V) (right), and the thumb indicates the amplitude direction (W) (left), the piercing through the palm will show the upward direction of the vector (H).
- It expands the content of the meanings of movement of vector (E) and vector (H) in the development of laws later. Their main philosophy is affirmed as (E) is the cause vortex, and (H) is the result vortex. So in particular the cross vortex ($\text{Vor } E$) generates in center a longitudinal vortex ($\text{Vor } H$) (7c).

IV. LAWS OF TRANSFORMATION (TRANSFORMATIONS $\Delta 1, \Delta 2$)

- a) *Laws of the transformation of a cross vortex (E_{2D}) into a longitudinal vortex (H_{3D})*

At every (i) point $p(i)$ of a decelerating cross vortex E there are two simultaneous movements: velocity vector ($-V$) and amplitude of the cross vortex ($-W$). The two simultaneous movements (V and W) also exist at all points of longitudinal vortices. The cross vortex (E_{2D}^-) is transformed into a longitudinal vortex (H_{3D}^+). This is accomplished through a specific operator ($\Delta 1$) for cross-longitudinal transformation (Figure 1B, b).

The cross (E_{2D}) and the longitudinal (H_{3D}) vortex are not an original and an image by analogy with the well-known transformations of *Laplace or Fourier*. They are representatives of spaces with qualitatively different structures. Therefore the introduced operator ($\Delta 1$) connects the original in one type (transverse) of space with its image in another type (longitudinal) of space, i.e. the transformation $\Delta 1$ connects two spaces with different qualities.

Law 1: The open cross vortex (E_{2D}) generates (inward or outward) an open longitudinal vortex (H_{3D}) in its center through a cross-longitudinal transformation $\Delta 1$:

$$\Delta 1 \text{ Vor } (E_{2D}) \Rightarrow -\text{Vor } (H_{3D}), \quad 8.$$

where Vor (for Vortex, meaning an *unevenly vortex*) replaces rot (for rotor, meaning closed loop); the cross vortex in 2D (E_{2D}) continues its development in 3D as a longitudinal vortex (H_{3D}) (Figure 1Bb).

While Maxwell's law (7) states that vector E generates vector H , the present law (8) postulates that the cross vortex $\text{Vor } (E_{2D})$ of E in 2D generates a longitudinal vortex $\text{Vor } (H_{3D})$ of H in 3D. The sign (-) for $\text{Vor } (H_{3D})$ 3D means that E_{2D} and H_{3D} have opposite dynamics. For example when $\text{div } (\text{Vor } E_{2D}) < 0$ (is decelerated), $\text{div } (\text{Vor } H_{3D}) > 0$ (is accelerated).

Definition: A *decelerating cross vortex (E_{2D}^-)* is a cross open vortex (E_{2D}) for which $\text{div } (\text{Vor } E_{2D}) < 0$.

Figure 2c shows a decelerating cross vortex (E_{2D}^-) inward.

Definition: A *decelerating longitudinal vortex (H_{3D}^+)* is a longitudinal open vortex (H_{3D}) for which $\text{div } (\text{Vor } H_{3D}) < 0$.

Figure 2d shows a decelerating longitudinal vortex (H_{3D}^+) inward.

Definition: An *accelerating cross vortex (E_{2D}^+)* is a cross open vortex (E_{2D}) for which $\text{div } (\text{Vor } E_{2D}) > 0$.

Figure 2b, d shows an accelerating cross vortex (E_{2D}^+) outward.

Definition: An *accelerating longitudinal vortex (H_{3D}^+)* is a longitudinal open vortex (H_{3D}) for which $\text{div } (\text{Vor } H_{3D}) > 0$.

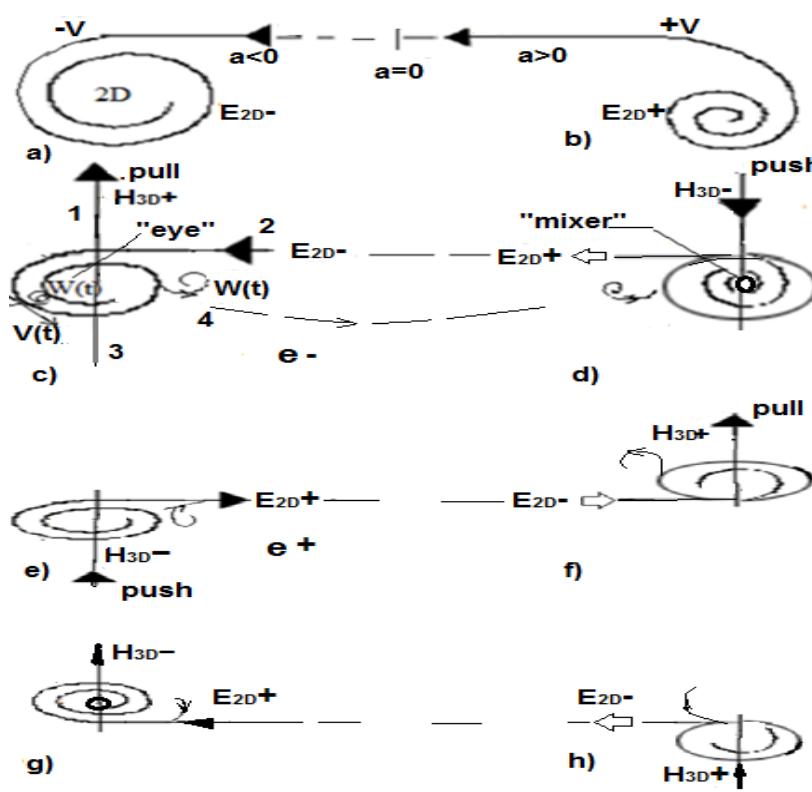


Figure 2: Two Transformation Laws. Options in two complementary complex objects

The present paper describes only the chain of matter: the push-pull chain (Figure 2d - Figure 2c) or inverse pull-push chain (Figure 2f - Figure 2e). The decelerating cross vortex (E_{2D}^-) inward generates an accelerating longitudinal vortex (H_{3D}^+) outward in its center through a physical transformation ($\Delta 1-$) (Figure 2c).

- This transformation ($\Delta 1-$) is achieved through a *phenomenon called full resonance (resonance in amplitude, frequency and phase)*. This type of resonance will be described in detail in further developments and reports.

Consequence: The open decelerating cross vortex ($E_{2D}-in$) generates inward an open accelerating longitudinal vortex (H_{3D}^+out) outward. This action takes place from the center of decelerating cross vortex (E_{2D}^-) through a particular cross-longitudinal transformation $\Delta 1-$:

$$\Delta 1-Vor (E_{2D}-in) \Rightarrow Vor (H_{3D}^+out). \quad 8a.$$

Figure 2c shows this transformation in 3D.

The Consequence (8a) of Law1 corresponds only to the pulling part from inside center (Figure 2c) of the cross vortex pair of objects in 2D (Figure 2c - Figure 2d).

The Consequence (8a) of Law1 describes in 2D the model of electron as the decelerating inward

vortex (dec (e-)) in the chain of proton-electron (Figure 2d - Figure 2c). Every electron (dec(e-)) of this type pulsates in 3D in two modes of: "expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex" (Figure 6A, Figure 6C).

- If the Consequence (8a) of Law1 generates in 3D a simple and single longitudinal vortex, it would describe the Expanded Maxwell for Electromagnetic Field: ($Vor E_{2D} = k(Vor H)_{3D}$, (7c)).
- If the Consequence (8a) of Law1 generates in 3D a pipe - wrapped vortices from longitudinal vortices inserted into each other, it describes another field with properties inverse to the Electromagnetic Field. It describes the Gravity Field as a Gravity Funnel. Gravity funnel is generated in 3D tube of longitudinal vortices as an longitudinal energy in pulling part outward (Figure 2c) of the pair of complementary objects (Figure 2c - Figure 2d).

Consequence: The open accelerating cross vortex (E_{2D}^+in) generates inward an open decelerating longitudinal vortex (H_{3D}^-out) outward. This action takes place from the center of accelerating cross vortex (E_{2D}^+) through a particular cross-longitudinal transformation $\Delta 1+$:

$$\Delta 1+ Vor (E_{2D}^+in) \Rightarrow Vor (H_{3D}^-out). \quad 8b$$

- The Consequence (8b) of Law1 describes in 2D the model of electron (e-) as the accelerating inward vortex(acc(e-)) (Figure2c) in the chain of proton-electron (Figure 2d - Figure 2c). Every electron (e-) of this type pulsates in 3D in two modes of: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex" (Figure 6A, Figure 6C).

Consequence: The Consequence (8a) and Consequence (8b) describe decelerating (dec(e-)) or accelerating (acc(e-)) cross vortex to inward as two models of electrons(e-)(Figure 6A).

- We immediately obtain 4 type of electrons(e-): (dec(e-)) and (acc(e-)) electrons, which each of them pulsates in two modes: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex " (Figure 6A, Figure 6C).

Consequence: It exists another two consequences (not described in the article), but they describe decelerating or accelerating cross vortices to outward. This is the 2 type of positrons: (dec(e+)) and (acc(e+)) positrons.

- We immediately obtain 4 type of positrons: (dec(e+)) and (acc(e+)) that each of them pulsates in two modes: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex" (Figure 6B, Figure 6C).

b) Laws of the transformation of a longitudinal vortex (H_{3D}) into a cross vortex (E_{2D}).

For the opposite transformation a new operator $\Delta 2$ is introduced to transform a longitudinal (H_{3D}) into a cross (E_{2D}) vortex. The physical nature of this $\Delta 2$ transformation is *quite different* in comparison with $\Delta 1$.

- Generally speaking, the transformations $\Delta 1$ and $\Delta 2$ are orthogonal rather than symmetrical to each other.

Law 2: The open longitudinal vortex (H_{3D}) generates (inward or outward) an open cross vortex (E_{2D}) in its center through a longitudinal-cross transformation $\Delta 2$:

$$\Delta 2 \text{Vor} (H_{3D}) \Rightarrow - \text{Vor} (E_{2D}) \quad 9.$$

Consequence: The open decelerating longitudinal vortex (H_{3D-}) in generates inward an open accelerating cross vortex (E_{2D+}) outward .This action takes place in the center of accelerating cross vortex (E_{2D+}) through a particular longitudinal-cross transformation $\Delta 2$:

$$\Delta 2- \text{Vor} (H_{3D-}) \Rightarrow \text{Vor} (E_{2D+}) \text{out}. \quad 9a.$$

- The Consequence (9a) of Law 2 describes in 2D the model of proton(p+) as the *decelerating outward vortex (acc(p+))* (Figure2d) in the chain of proton-electron (Figure 2d - Figure 2c).

- The Consequence (9a) of Law2 in 3D refers to the pushing part (Figure2 d) of the pair of complementary objects (Figure2c–Figure2d). The transformation $\Delta 2-$ emphasizes that the movement of the longitudinal vortex (H_{3D}) inward is the cause, but the movement of the cross vortex(E_{2D}) outward is the result (Figure 2d).

- When the Consequence (9a) of Law2 are generated by the pipe - wrapped longitudinal vortices, it describes Gravity field. It has the inverse properties to the Electromagnetic Field. This Gravity field exists as a tube from inserted one in another the longitudinal vortices. It forms a Gravity funnel which has a pushing and a pulling ends. In this case the down end of Gravity Funnel (H_{3D-}) has pushing effect because the pushing end of Gravity funnel is attached to the pushing part (Figure2d) of the pair of objects (Figure2c – Figure2d) This end decelerates in 3D direction and generates in 2D plane, perpendicular to 3D, cross vortex from inside to outside as a matter.

Consequence: The open accelerating longitudinal vortex (H_{3D+})in generates inward an open decelerating cross vortex (E_{2D-}) outward in its center through a special longitudinal-cross transformation $\Delta 2+$:

$$\Delta 2+ \text{Vor} (H_{3D+}) \text{in} \Rightarrow \text{Vor} (E_{2D-}) \text{out}. \quad 9b.$$

- The Consequence (9b) of Law2 describes in 2D the model of proton(p+) as the *accelerating outward vortex dec(p+))* (Figure2d) in the chain of proton-electron (Figure 2d - Figure 2c). Every proton (acc(p+)) of this type pulsates in 3D in two modes of: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex" (Figure 6A, Figure 6C).

Consequence: The Consequence (9a) and Consequence (9b) describe decelerating or accelerating cross vortex to outward (Figure 6A).

- We immediately obtain 4 types of proton: (dec(p+)) and (acc(p+)) that each of them pulsates in two modes: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross vortex and extended longitudinal vortex" (Figure 6A, Figure 6C).

Consequence: It exists another two consequences (not described in the article), but they describe decelerating or accelerating cross vortices to inward. This is the 2 models of a antiprotons (dec(p-)) and (acc(p)) (Figure 6B).

- We immediately obtain 4 types of antiproton: (dec(p)) and (acc(p-)) that each of them pulsates in two modes: " expanded cross vortex and a shortened longitudinal vortex" and "shrunken cross

vortex and extended longitudinal vortex" (Figure 6B, Figure 6C).

V. CONCLUSIONS

a) Two type electrons

- The first type of electron(acc(e-)): when the electron is inside a proton-electron system(connected in the atom) has accelerating cross vortex (E2D+) inward that generates a decelerating longitudinal vortex(H3D-) upward.

Therefore, an electron ,bound into an atom (acc(e-)) is strongly linked to a cross component (E2D+) and poorly connected along a longitudinal component (H3D-).

- A second type of electron(dec(e-)): when the electron is free (outside of the atom) has decelerating cross vortex (E2D-) inward, which generates an accelerating longitudinal vortex upward (H3D+). When electron is free (second type (dec(e-)), the decelerating cross vortex (E2D-) is interrupted.

On account of that accelerating longitudinal vortex (H3D+) shoots a fast ingredient, tears in dashes (due to pulsation) and connects to the decelerating longitudinal vortex (H3D-) at input of the proton.

Therefore, the free electron(dec(e-)) is poorly linked in cross component (E2D-) and highly bound to the longitudinal component(H3D+).

Consequence: There is a significant difference in the states of a bound electron (acc(e-)) and a free electron (dec(e-)).

Consequence: Scientists measure the mass of a free electron (dec(e-)) with a *decelerating cross vortex* (E_{2D}-) inward, and can't measure the mass of a connected electron (acc(e-)) with an *accelerating cross vortex* (E_{2D+}) inward.

Consequence: The measured mass of free electrons is much more then the mass of linked in atom inside electrons.

b) Electromagnetic and Gravity field

- If Consequence (8a) of Law 1 generates a simple and single longitudinal vortex, it would refer to the Electromagnetic field.
- If he Consequence (8a) of Law 1 generates a pipe - wrapped vortices from accelerating longitudinal vortices inserted into each other, it really generates accelerating Gravity Funnel.
- If the Consequence (9a) of Law 2 is generated by a pipe - wrapped vortices from decelerating longitudinal vortices inserted into each other, it refers to the decelerating Gravity Funnel.
- The new extended meaning of the term" Complementarity" is when the two parts are generating and they act anti-phase - one push and the other pulls.

- The two transformations $\Delta 1$ (Law1) and $\Delta 2$ (Law2) are not symmetrical but rather form pairs of objects that complement each other in their action .So they form a pairs of complementary objects or they are mutually orthogonal.
- The two vortices in the described above vortex pairs (Figure 2c - Figure 2d) play the role of generators (!) - one push (Figure 2d), the other -pulls (Figure 2c). Obviously in described above chain (Figure 2c - Figure 2d) there is not the consumer. Therefore this chain has not energy losses. It is well known that in every Electromagnetic chain has generator and one or more consumers. That's why Electromagnetic chain has energy losses.
- Both transformations, $\Delta 1$ (Law1) and $\Delta 2$ (Law2), are not regulated by external regulator or external parameters. Therefore the processes are regulated only by internal laws and are not determined by outside parameters.

VI. LAW OF NONPARAMETRIC MOVEMENT OF THE VORTEX

Obviously the processes of acceleration and deceleration of the longitudinal vortex is a nonparametric process. Processes of accelerating and decelerating longitudinal vortices manifest both quantitative and qualitative changes [5].This mechanism of amplification is known in cybernetics as *Positive Feedback*.

Law 3: Accelerating and decelerating of the main vortex is going by internal logic as a nonparametric process through Positive Feedback.

- The Law 3 shows that velocity V_i increases by redistribution with cross vortices. There is also redistribution of mass The mass of the cross vortices is added in portions (quanta) with acceleration to the initial mass of the longitudinal vortex with velocity V_i and thus accelerates it more and more(Figure 3a).
- The accelerating longitudinal vortex *sucks in* more cross vortices from outside that accelerate further the longitudinal vortex with velocity V_i and so on. Thus the longitudinal vortex at output(V_i) increases its velocity and acceleration which returns at input. The reason is that it suck in more cross vortices and increases of the acceleration and mass to the entrance (Figure 3a).
- This process runs *avalanche* until it reaches a saturation level where the acceleration becomes maximum (a_{max}) for a time slice ($t_0 - t_n$),(Figure 3b).

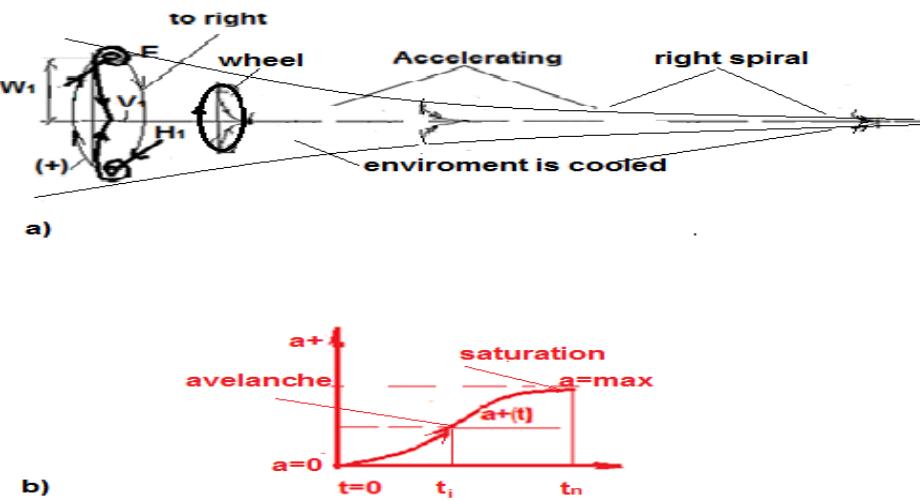


Figure 3: Positive Feedback

- When, for example, an accelerating longitudinal vortex sucks in with acceleration the cross vortex, then in start moment ($t=0$) its first derivative is minimum: $a=0$. However the accelerated absorption of the cross vortex increase and when in the end moment($t=t_n$) the positive acceleration of the cross vortex becomes maximum: $a_{\max} >> 0$. The mass of this cross vortex is added to the longitudinal vortex accelerating it further (Figure 3b).
- It is an example of the avalanche process. In the next cycle the accelerated longitudinal vortex again sucks in a portion (quantum) of the cross vortex and so on. Through Positive Feedback the level of saturation constantly increases, the time interval needed for saturation becomes longer, etc.
- Positive Feedback turns the described above avalanche process from an amplifier to a generator procces.
- It is well known that in Classic Mechanic the simultaneous operation of two independent vectors is equal to the sum of these vectors.
- According to Law 3, the transforming one vector (V) into a vortex (W) and vice versa is a nonparametric process. Transformation is done by internal laws but not by setting parameters from outside.
- The nonparametric transformation of two variables $V(t)$ and $W(t)$ is mathematically described by the product $V(t) \cdot W(t)$ of these variables.

Consequence: The Positive Feedback in a longitudinal vortex turns the process of amplification to a process of generation. The Positive Feedback can be a base for constructing an energy generator.

- Probably this generative effect of the Positive Feedback was used by Nikola Tesla in the construction of the electronic block for his electro mobile. The original engine worked in generator mode and needed a battery only at start up.

VII. LAW OF THE CONSTANT POWER OF THE VORTEX

As we saw above there are two qualitatively different movements at each (i) point p (i) of the decelerating vortex E: longitudinal vector velocity (V) and cross vortex with amplitude (W) (Figure 1B, b).

The reason of that is the vector E is not a simple vector but it is a complex vector (Figure 1B,d).

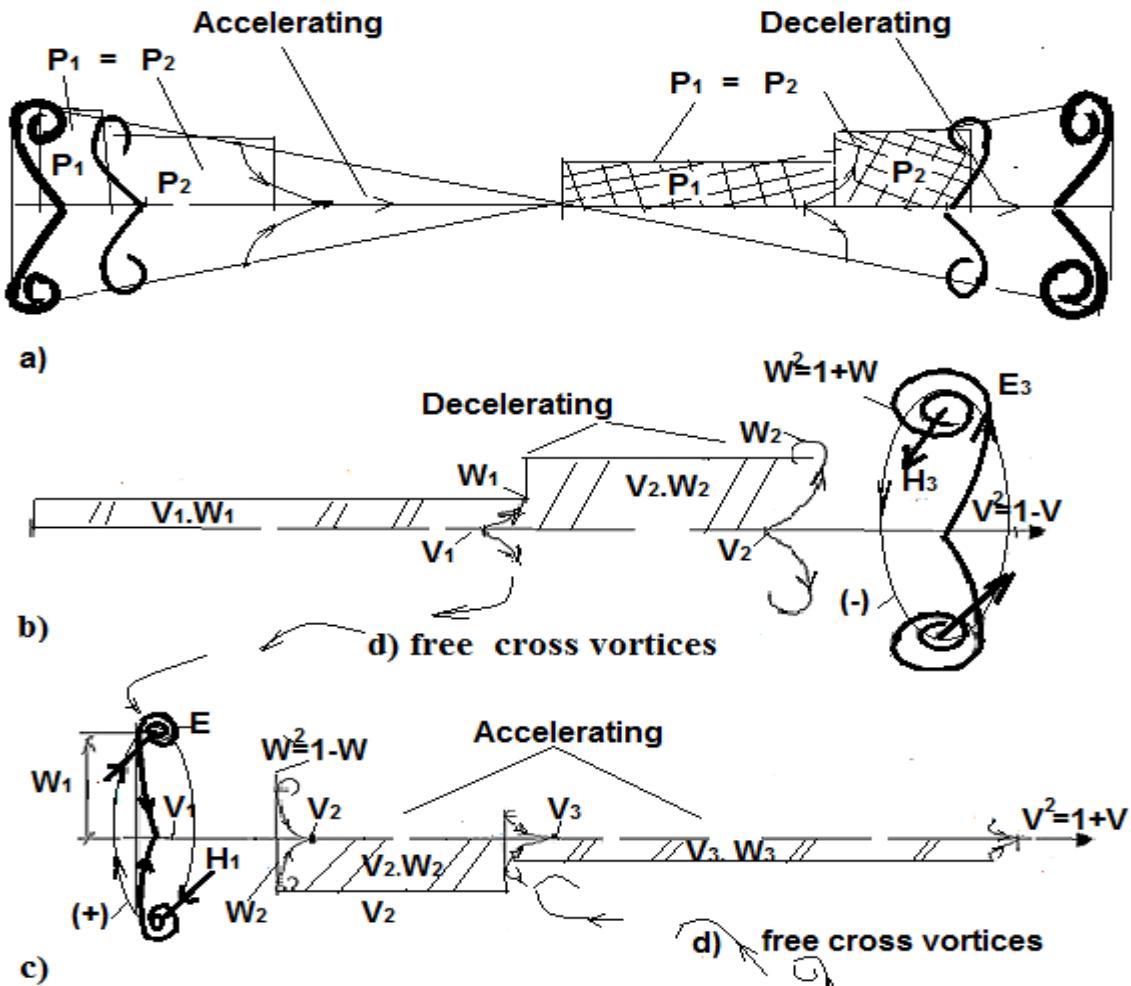


Figure 4: A system of accelerating and decelerating vortices

We have seen that at each (i) point of the vortex E there is simultaneously a vector velocity (V) in 1D and vortex pressure (W) in 2D (Figure 1B,d).

- In the case of the decelerating longitudinal vortex the velocity decreases (V-), while the amplitude of the cross vortices increases (W+) in such a way that their product (V-).(W+) remains constant all along the longitudinal vortex. The product (V-).(W+) is proportional to the power(P-) of the decelerating longitudinal vortex. (Figure 4a, b).
- In the case of the accelerating longitudinal vortex the velocity increases (V+), while the amplitude of the cross vortices decreases (W-) in such a way that their product (V+).(W-) remains constant all along the longitudinal vortex. The product (V+).(W-) is proportional to the power (P+) of the accelerating longitudinal vortex(Figure 4a,c).

Law 4: For an uneven (accelerating or decelerating) vortex the product between current velocity (Vi) of longitudinal movement on one and the same current

line and current amplitude (Wi) of its perpendicular cross vortices is a constant in every (i) step:

$$(Vi).(Wi)=\text{const.} \quad 10.$$

where $i = 0 \div \infty$ is current point from step to step; the product $(Vi).(Wi)$ is proportional to the current power(P_i) of the uneven vortex .

Consequence: The simultaneous operation of two mutually - dependent vectors is equal to the product of these variables (in Expanded Field Theory) while the simultaneous operation of two independent vectors is equal to the sum of these variables (in Classic Mechanic).

Consequence: The product $(Vi).(Wi)$ is proportional to the current power (P_i) of the uneven vortex in current (i) step. The current power (P_i) of the uneven vortex is a constant in every (i) step:

$$-P_i=V_i.W_i, \quad 10a.$$

Consequence: The Total energy (Eo) in Expanded Field Theory is equal to the product of Kinetic energy -Ek(Vi) and Potential energy Ep(Wi) :

$$- \quad Eo = Ek(Vi) \cdot Ep(Wi), \quad 10b.$$

Consequence: At a decelerating vortex vector velocity (V) is transformed according to *internal law* (10) into the amplitude of the cross vortex (W) (Figure 4a, b).

Consequence: At a accelerating vortex vector velocity (V) is transformed according to *internal law* (10) into the amplitude of the cross vortex (W) (Figure 4a, c).

VIII. LAWS OF THE VELOCITY OF THE LONGITUDINAL VORTEX (V) AND THE AMPLITUDE OF THE CROSS VORTICES (W)

We saw in the previous point (p.6) that at a decelerating vortex vector velocity (V) is transformed according to *internal law* into the amplitude of the cross vortex (W) (Figure 4a,b). More precisely- the reduction in speed (V) is transformed into an increase in the amplitude(W) of cross vortices.

Law 5: The deceleration vortex in 2D is described with a system of 2 equations in which: longitudinal velocity (V) decreases in (n) portions (ψ^n) times; the amplitude (W) increases in (n) portions (ψ^n) times:

$$\begin{aligned} IV^2 &= V_0(1-V), & 11. \\ IW^2 &= W_0(1+W), \end{aligned}$$

where v_n, w_n n are periodic roots with period n ; v_n, w_n are *mutual orthogonal* that fulfill the requirement for orthogonality: $v_n \cdot w_n = V_0 \cdot w_0$, $v_n \cdot \omega_n = V_0 \cdot W_0$; $n = 0 \div \infty$; the roots v_n, w_n are expressed as: $v_n = (1/\psi^n) \cdot V_0$, $\omega_n = \psi^n \cdot W_0$; linear velocity V_0 is the starting value of V_n , amplitude of cross vortex W_0 is the starting value of ω_n ; ψ is a proportional that fulfills the requirement: $\psi-1/\psi = 1$.

Consequence: The deceleration vortex in 3D is described with a *system of 4 equations* in which: longitudinal velocity (V) decreases in (n) portions (ψ^n) times; the angular velocity (w) , the amplitude (W) and the number (N) of cross vortices increase in (n) portions (ψ^n) times:

$$\begin{aligned} IV^2 &= V_0(1-V), & 11a. \\ IW^2 &= W_0(1+W), \\ Iw^2 &= w_0(1+w) \\ IN^2 &= N_0(1+N) \end{aligned}$$

where v_n, w_n are periodic roots with period n ; v_n, w_n are *mutual orthogonal* that fulfill the requirement for orthogonality: $v_n \cdot w_n = V_0 \cdot w_0$, $v_n \cdot \omega_n = V_0 \cdot W_0$; $n = 0 \div \infty$; the roots v_n, w_n and ω_n and n_n are expressed as: $v_n = (1/\psi^n) \cdot V_0$, $\omega_n = \psi^n \cdot W_0$; $w_n = \psi^n \cdot W_0$, $[n_n] = \psi^n \cdot N_0$; linear

velocity V_0 is the starting value of V_n , amplitude of cross vortex W_0 is the starting value of ω_n , angular velocity w_0 is starting value of w_n , number N_0 is starting value of n_n , $[n_n]$ is the closest integer; ψ is a proportional that fulfills the requirement: $\psi-1/\psi = 1$.

It is noteworthy that: When starting number $N_0 = 1$ the number n_n is calculated with the row: 1; 1.62; 2.62; 4.25; 6.88, 11.15; 18.07; 29.28; 47.43, ... The closest integer $[n_n]$ form row: 1,2,3,4,7,11,18,29,47,.. For comparison, *Fibonacci's order* is: 0,1,1,2,3,5,8,13,18,21,34,... Obviously there is a similarity between the two rows at the beginning. But finally (after 18th) the number $[n_n]$ rises sharply (29>21, 47>34,...) compared to the order of Fibonacci.

Consequence: A decelerating vortex(E_{2D}) with a velocity vector (V) emits to the environment decelerating vortices with increasing amplitude (W) (because of sign + in second equation of system 11,11a).

- The amplitude (W) increases in perpendicular direction to the velocity vector(V).
- In decelerating longitudinal vortex, the amplitude (W) increases only if it is directed from the inside to the outside, ie. if the decelerating vortex emits outward cross vortices with increasing amplitude (W) (Figure 4b).
- According to the Law1(8) and Rule of the Right Hand, the decelerating cross vortex (E) generates at the center to outside (to left) a longitudinal vortex (H). So at every n point forms left rotating wheel perpendicular to the velocity (V).
- Therefore, the decelerating longitudinal vortex in 3D forms left rotating spiral (left- counterclockwise when observer watches against the movement) (Figure 4b).

Consequence: Decelerating longitudinal vortices rotate counterclockwise (-)(Figure 4b).

Consequence: Because of increasing of the amplitude (W) the angular velocity (w) and the number of cross vortices (N) it forms decelerating, thickening and expanding left rotating Funnel in which: W_{max} ; w_{max} ; N_{max}

Consequence: Two or more decelerating longitudinal vortices repel each other. The reason is due to the emission of cross vortices from center to outside.

Law 6: The acceleration vortex in 2D is described with a system of 2 equations in which: longitudinal velocity (V) increases in (n) portions (ψ^n) times; the amplitude (W) decreases in (n) portions (ψ^n) times:

$$\begin{aligned} IV^2 &= V_0(1+V), & 12. \\ IW^2 &= W_0(1-W), \end{aligned}$$

where v_n, w_n are n periodic roots with period n ; v_n, w_n are *mutual orthogonal* that fulfill the requirement for orthogonality: $v_n \cdot w_n = V_0 \cdot w_0$, $v_n \cdot \omega_n = V_0 \cdot W_0$; $n = 0 \div \infty$;

the roots v_n , w_n are expressed as: $v_n = (\psi^n) \cdot V_0$, $\omega_n = (1/\psi^n) \cdot W_0$; linear velocity V_0 is the starting value of V_n , amplitude of cross vortex W_0 is the starting value of ω_n ; ψ is a proportional that fulfills the requirement: $\psi-1/\psi = 1$.

Consequence: The acceleration vortex in 3D is described with a system of 4 equations in which: longitudinal velocity (V) increases in (n) portions (ψ^n) times, the angular velocity (w), the amplitude (W) and the number (N) of cross vortices decrease in (n) portions (ψ^{-n}) times:

$$\begin{aligned} IV^2 &= V_0(1+V), & 12a. \\ IW^2 &= W_0(1-W), \\ Iw^2 &= w_0(1+w) \\ IN^2 &= N_0(1+N) \end{aligned}$$

where v_n , w_n , n are periodic roots with period n ; v_n , w_n are mutual orthogonal that fulfill the requirement for orthogonality: $v_n \cdot w_n = V_0 \cdot w_0$, $v_n \cdot \omega_n = V_0 \cdot W_0$; $n = 0 \div \infty$; the roots v_n , w_n and ω_n and n_n are expressed as: $v_n = (\psi^n) \cdot V_0$, $\omega_n = (1/\psi^n) \cdot W_0$, $w_n = (1/\psi^n) \cdot w_0$, $n_n = (1/\psi^n) \cdot N_0$; linear velocity V_0 is the starting value of V_n , amplitude of cross vortex W_0 is the starting value of ω_n , angular velocity w_0 is starting value of w_n , number N_0 is starting value of n_n ; ψ is a proportional that fulfills the requirement: $\psi-1/\psi = 1$.

- The first positive root of the first equation (12a) is: $v_1 = \psi \cdot V_0 = 1, 62 \cdot V_0$. The periodic roots of the first equation (12a) are obtained from the expression: $v^n = V_0 \cdot (v^{n-1} + v^{n-2})$.
- The first positive root of the second equation (12b) is: $w_1 = (1/\psi) \cdot W_0 = 0,62 \cdot W_0$. The periodic roots of the second equation (12a) are obtained from the expression: $w^{n-2} = W_0 \cdot (w^{n-1} - w^{n-2})$.

Consequence: When velocity (V) increases, the amplitude (W) decreases so that at each step (n_i) (according to Consequence of Law 4) the product (V_i). (W_i) is a constant (Figure 4a). For an accelerating longitudinal vortex, the amplitude (W) decreases only if it is directed from the outside to inside, ie. if the accelerating vortex sucks in cross vortices with decreasing amplitude (W) (Figure 4c).

Consequence: It exists an expanded sense of the simultaneous action of equations from each of systems (11) and (12). They portray a qualitatively new, specific and combined movement in the form of a system:

- The system expresses the joint action of two movements - longitudinal and transverse vortex;
- This system is mutually orthogonal; the direction of velocity of the longitudinal vortex V is perpendicular to the direction of the amplitude W of the transverse vortices and, respectively, to the direction in which the transverse vortices

- This system is open (not closed) ie. the system contains: a closed inner part - the longitudinal vortex, and an open outer part - the cross vortices.
- Exactly the openness of the system of two mutually orthogonal, simultaneous and cooperative movements is the cause of the exchange of cross vortices (inward or outward) with the environment.

Consequence: An accelerating vortex (E_{2D+}) with a velocity vector (V) sucks in accelerating vortices with decreasing amplitude (W) in perpendicular direction (because of sign – in second equation of system 12, 12a).

According to the Consequence 8b of Law1 the accelerated cross vortex(E_{2D+}) generates (sucking) to its center a longitudinal vortex(H_{3D}) from the outside to inside(to the right). At each point(n_i) a right rotating wheel is formed. The spiral vortex in 3D is formed as a right rotating spiral (Figure 4c).

Therefore, the acceleration vortex will twist to the right – clockwise (+), viewed against the movement (Figure 4c).

Consequence: Accelerating longitudinal vortices wind clockwise(+) (Figure 4c).

Consequence: Because of the amplitude(W), angular velocity (w) and the number of cross vortices(N) decreases it forms accelerating, stretching, narrowing, right rotating Funnel in which: W_{min} , w_{min} , N_{min}

Consequence: Accelerating longitudinal vortices form a tube like: the vortex is inserted at the center with the maximum lineal speed, the minimum number of coils and the minimum distance, the slower vortex is with more coils and a longer way along the spiral and the vortex at the periphery is winding with a minimum lineal speed, maximum number of coils and a maximum spiral path. Because of acceleration this tube turns to the so called *Gravity Funnel*.

Consequence: Two or several accelerating longitudinal vortices, due to the suction of cross vortices, are attracted.

IX. LAWS OF CONTINUITY

In Euclidean geometry has an axiom that postulates that only one straight line passes through two points. The Axiom 2 for two complementary objects resemble an axiom in Euclidean geometry. But in essence Axiom 1 and Axiom 2 are physical, rather than geometrical. Instead of points as geometric objects there is a pair of vortices with different dynamics as physical objects: the both of them are generators-one pulls, the other pushes(Figure 2c, d).

Provisionally vortices can be classified as primary (W) and secondary (E) uneven vortices. The primary uneven vortices are micro cross vortices (W) (Figure 5c, d). The secondary uneven vortices are

macro cross vortices (E) (Figure 2c,d). The primary cross vortices exist as a free form or free cross vortices. They are also called as "free energy" (Figure 5 c,d).

Definition: Primary vortices are emitted to the environment or sucked in from environment by the secondary (main) vortex.

a) *Law of continuity in a closed loop in 2D*

According Law 5 (11) decelerating cross vortex (E2D-) emits decelerating primary cross vortices in perpendicular direction (Figure 5b).

- In general the primary micro vortices are derivatives of the main secondary macro vortices.
- Since cross vortex objects are physical particle, they must fulfill the main Physical Law of continuity cycle of movement matter and energy.
- *The Axiom 2 contains within itself the question of the link in the opposite direction which closes the full circle (loop) of cross vortices in 2D (6).*

- In order to fulfill the fundamental law of continuity, the feedback must pass through empty space (feedback 2D). It contains elementary primary cross vortices generated and emitted by the secondary decelerating cross vortex (Figure 5c) and consumed and sucked in by the secondary accelerating cross vortex (Figure 5d). This feedback is closed through the so called "empty space". The feedback is in inverse direction to the direction of the main cross vortices.
- Therefore, in order to satisfy this fundamental law in physics, apparently this space cannot be "empty", as we often call it. The imaginary space is filled with primary cross vortices.
- The primary cross vortices are copies of the secondary cross vortices but at a much smaller scale.

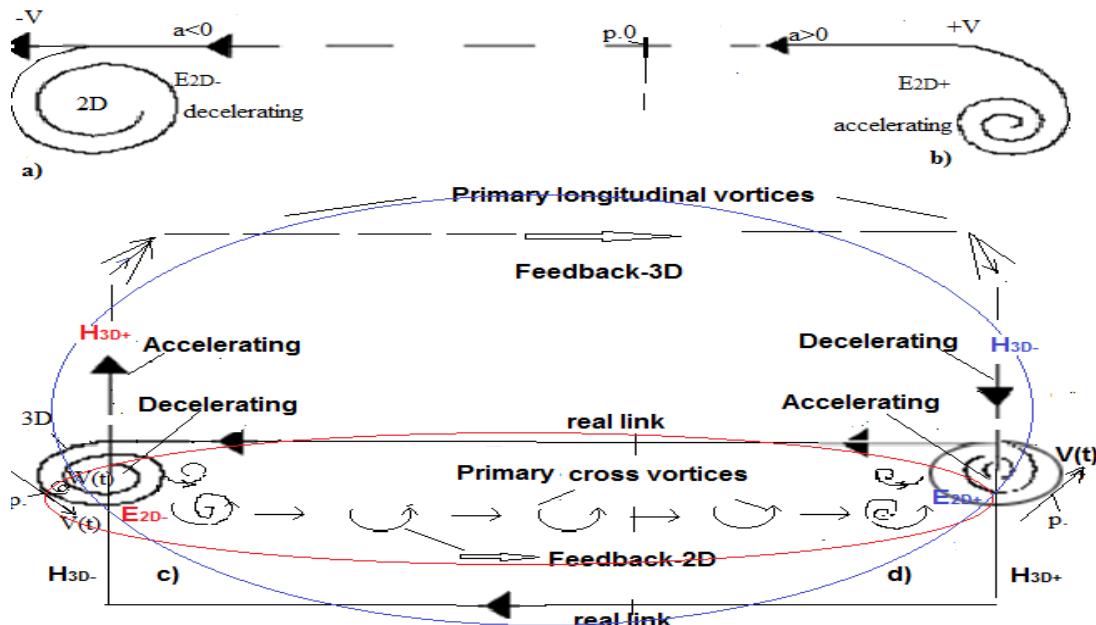


Figure 5: System of one pair of complementary vortices

Law 7: A pair of open cross objects forms a closed loop in 2D by feedback of primary cross vortices. This pair conducts energy through the real connection: (Figure 5d - Figure 5c), (E2D+ - E2D-) and conducts matter through the back link: (Figure 5c - Figure 5d), (E2D-E2D+) or through the feedback 2D.

The reason for the emission of primary elementary cross vortices is the deceleration of the main longitudinal vortex (E2D-) (Figure 4b, Figure 5c).

But their movement in the space between the two vortex objects in 2D is due to the sucking action of the accelerating main longitudinal vortex (E2D+) (the second vortex in the pair) (Figure 4c, Figure 5d).

b) *Law of continuity in a closed loop in 3D*

In order to fulfill the fundamental law of physics the feedback of the main longitudinal vortices in 3D must close through the space (feedback 3D). It contains elementary primary longitudinal vortices, generated and consumed by the main secondary longitudinal vortices.

- This imaginary space is filled with primary longitudinal vortices resembling copies of the secondary longitudinal vortices but at a much smaller scale. All longitudinal vortices (primary and secondary) create a new type of field that contributes to our knowledge of the field as a form of matter.

- The real link (Figure 5d - Figure 5c) of the chain in 3D conducts real pulsating energy ($H3D+$) \div ($H3D-$).

The back link (Figure 5c- Figure 5d) of the 3D chain conducts pulsating matter as a pulsating, longitudinal primary vortices .

- Because of that the objects of complementary pair include both cross and longitudinal vortices, connected internally with reason-result transformations, either ($\Delta 1$) or ($\Delta 2$), they are called complex vortex objects.

Definition: A complex vortex object is an object that contains a cross and a longitudinal vortex connected internally by reason-result transformations, either ($\Delta 1$) or ($\Delta 2$).

Law 8: A pair of open complex vortex objects forms a closed loop in 3D by feedback of primary longitudinal vortices , so that the objects conducts energy through the real connection: (Figure 5d - Figure 5c) and conducts matter through the back link: (Figure 5c -Figure 5d) or through the feedback 3D.

- This pair conducts energy through the real connection and conducts matter through the imaginary link, so that the primary elementary longitudinal vortices form the feedback link in 3D (Figure 5c - Figure 5d).
- The reason for their movement in the space between the pair of vortex objects in 3D is the sucking action of the entrance of secondary longitudinal funnel that has a decelerating exit ($H3D-$) (Figure 2d),(Figure 5d).
- The reason for generation of primary longitudinal vortices
- Is the pulsating accelerated longitudinal vortex ($H3D+$). The pulsating accelerated longitudinal vortex($H3D+$) make dashes in the form of primary longitudinal vortices. As these longitudinal vortices are highly accelerated they attract, suck and form longitudinal packets as a micro funnels [6]. They move in the opposite direction as a feedback in 3D.

Consequence: The reason for the emission of primary elementary longitudinal vortices is that the secondary longitudinal vortex tears in dashes by high frequency pulses ($H3D+$)(Figure 5c).

- The real links in 2D and 3D are simple, but the imaginary links in 2D (feedback 2D) and 3D (feedback 3D) are most likely multi ciphered. Feedback (2D and 3D) connects a pair of complementary vortex objects (Figure 5 c, d).
- Let us consider the nature of the link in the opposite direction that closes the full circle (loop) of main longitudinal vortices in 3D, perpendicular to the circle (loop) in 2D.

Consequence: (of continuity in two mutually perpendicular closed loops in 2D and 3D).

Two complex vortex objects are connected with *mutually perpendicular closed loops in 2D and 3D*. The closed loop: $\{E2D(+)\div E2D(-)\} \div \{(feedback(2D) (Figure 5d,c.)\}$ is perpendicular to the closed loop: $\{H3D(-) \div H3D(+)\} \div \{(feedback (3D)\}$, (Figure 5c,d).

IX. CONCLUSIONS

a) The extension of the classical main axiom

The extension of the classical Maxwell's axiom led to a new Axiom1 that certifies open or non-uniform vortices. As a result, the decelerated and accelerated longitudinal vortices were obtained. Their acceleration realizes forces as in the direction of the plain of a cross vortex and as in the perpendicular direction of the plain (in volume) in longitudinal vortex .The accelerating longitudinal vortices attract each other because of sucking in(out to in) the cross vortices.

- So the accelerating longitudinal vortices form a pipe in which the fastest vortex is in the center, and the slowest vortex is in the periphery. Due to the acceleration, this tube becomes a funnel called Gravity Funnel The Gravity Funnel has two ends-one end in repulsion mode and other end in suction mode.
- The introduction of Axiom2 certifies the presence of complementary pairs of complex objects. Both objects in a pair are complex cross-longitudinal vortices that operate in generator mode .If one work in pulling mode, the other work in pushing mode. They describe complementary relations between the complex vortex objects, which include the gravitational impact of both types.

b) Two tips of electrons

- The first type of electron (acc(e-)): when the electron is inside a proton-electron system(connected in the atom) has accelerating cross vortex ($E2D+$) inward that generates a decelerating longitudinal vortex ($H3D-$) upward.

Therefore, an electron, bound into an atom (acc (e-)) is strongly linked to a cross component ($E2D+$) and poorly connected along a longitudinal component ($H3D-$).

- A second type of electron (dec (e-)): when the electron is free (outside of the atom) has decelerating cross vortex ($E2D-$) inward, which generates an accelerating longitudinal vortex upward ($H3D+$). When electron is free (second type (dec (e-)), the decelerating cross vortex ($E2D-$) is interrupted.

On account of that accelerating longitudinal vortex ($H3D+$) shoots a fast ingredient, tears in dashes (due to pulsation) and connects to the decelerating longitudinal vortex ($H3D-$) at input of the proton.

Therefore, the free electron (dec (e-)) is poorly linked in cross component (E_{2D-}) and highly bound to the longitudinal component (H_{3D+}).

Consequence: There is a significant difference in the states of a bound electron (acc (e-)) and a free electron (dec (e-)).

Consequence: Scientists measure the mass of a free electron (dec (e-)) with a *decelerating cross vortex* (E_{2D-}) inward, and can't measure the mass of a connected electron (acc (e-)) with an *accelerating cross vortex* (E_{2D+}) inward.

Consequence: At the similar logic there are two tips of protons as well. Therefore there are 2 tips electrons and 2 tips protons. Therefore there are 2 tips positrons and 2 tips antiprotons too.

c) *Electromagnetic and Gravity field*

- If Consequence of Law 1 generates a simple and single longitudinal vortex, it would refer to the Electromagnetic field.
- If the Consequence of Law 1 generates a pipe - wrapped vortices from accelerating longitudinal vortices inserted into each other, it really generates accelerating Gravity Funnel
- If the Consequence of Law 2 is generated by a pipe-wrapped vortices from decelerating longitudinal vortices inserted into each other, it refers to the decelerating Gravity Funnel.
- The new extended meaning of the term "Complementarity" is when the two parts are generating and they act anti-phase - one push and the other pulls.
- The two transformations $\Delta 1$ (Law1) and $\Delta 2$ (Law2) are not symmetrical but rather form pairs of objects that complement each other in their action .So they form a pairs of complementary objects or they are mutually orthogonal.
- The two vortices in the described above vortex pairs (Figure 2c - Figure 2d) play the role of generators (!) - one push (Figure 2d), the other -pulls (Figure 2c). Obviously in described above chain (Figure 2c - Figure 2d) there is not the consumer. Therefore this chain has not energy losses. It is well known that in every Electromagnetic chain has generator and one or more consumers. That's why Electromagnetic chain has energy losses.
- Both transformations, $\Delta 1$ (Law1) and $\Delta 2$ (Law2), are not regulated by external regulator or external parameters. Therefore the processes are regulated only by internal laws and are not determined by outside parameters.

d) *Description of complex design of complementary pairs*

- The *decelerating vortex(1)* is similar to a toroid. Vector of eccentricity (p.F-p.O) decomposes along

x-axis and y-axis. The x-axis is pulling him to the accelerating vortex(2). The y-axis rotates decelerating vortex(1) around the accelerating vortex(2). Simultaneously primary cross vortices(3) rotates the decelerating vortex(1) around Gravity center p.F.(second quadrant).

- The accelerating vortex (2) is similar to a very tight ball. Vector of eccentricity (p.F-p.O) is much smaller than that one of decelerating vortex (1). The number of cross coils in accelerating (2) is much more than of decelerating vortex (1) and because this number determine much more mass of substance for accelerating vortex (2): $m2 > > m1$
- In center (green) it has an accelerating longitudinal vortex(4) from down to up (direction of internal gravity wave).
- In middle (red) because of resistance it has an decelerating longitudinal vortex that form *internal "Back wave"* (direction of external gravity wave).



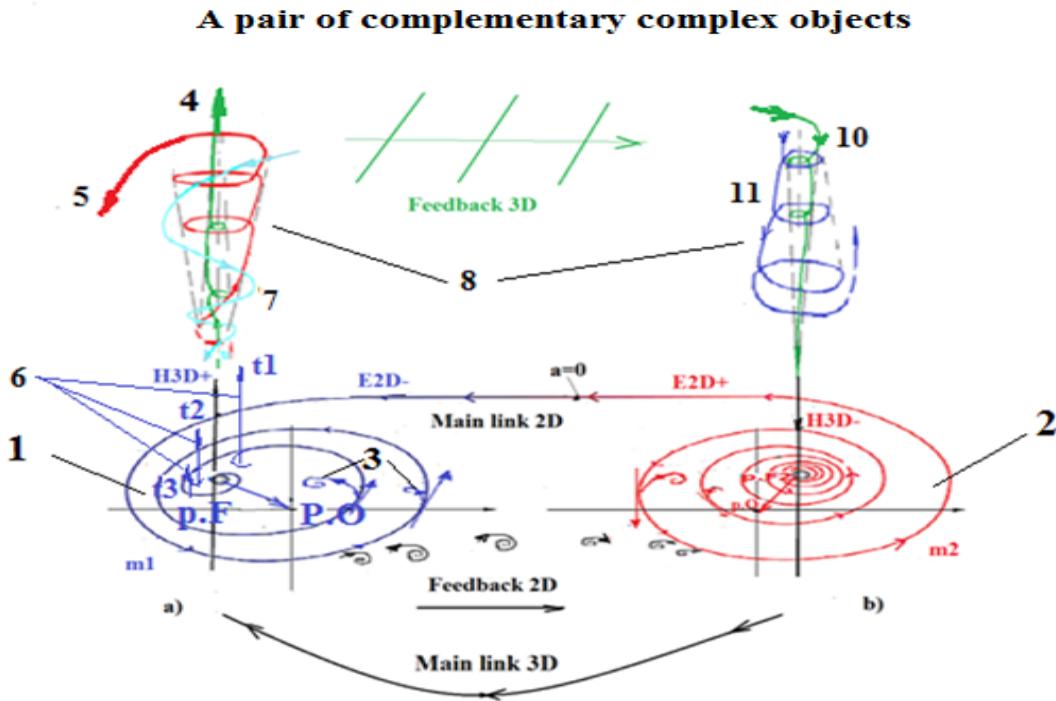


Figure 6: Complex design of complementary pairs

- At periphery (light green) because of internal cross vortices (5) there is a reduction in the lengths of longitudinal vortices (6), corresponding to the decreasing development time ($t_1 > t_2 > t_3 >$). They form external "Back wave" (7) (direction of internal magnetic wave).
- Longitudinal vortices (8) are invisible. They don't have mass as a substance. They exist alone or in a package such as a pipe or funnel (9). When the pipe (funnel) is not active, the energy inside the package exists as a standing wave. When it enters into denser environment of primary free cross vortices the funnel becomes active and it acts as a mixer. At the center (10) it turns to right, but at periphery (11) it turns to left.

e) *Visibility*

i. *Visible*

Particle (1) is visible as an empty toroid. It is a model of the electron or one of internal planets.

- Particle (2) is visible as a very tight ball. It is a model of proton or (the respective to one) bulk resonator inside the sun.

ii. *Invisible*

- Main link in 2D is total invisible. Because of the thread of link form diffraction to the light waves, this link does not reflect light waves and it is invisible. It is a model of so called "Black energy"
- Feedback in 2D is invisible. Because of *primary cross vortices* emitted from decelerating particle (1)

to accelerating particle (2) are commensurable with waves of light, they do not reflect the waves of light. They are the model of so called "Black matter".

- Main link in 3D is total invisible too, because of the thread of link form diffraction to the light waves too.
- Feedback in 3D is invisible too. Because of *primary longitudinal vortices* emitted from accelerating longitudinal funnel (4) of decelerating particle (1) to the decelerating funnel (10) of accelerating particle (2) are proportional to diameter with waves of light, they do not reflect the waves of light.

iii. *Conclusion*

We see that there are many more invisible objects (95%) and very few actually (only two) visible objects (5%).

f) *Model of Fractal structures*

- The complementary pairs of elementary particles: dec(e-), p+. It shows the model of (free electron) - proton link or the model of Earth-Sun link.
- The complementary pairs of elementary particles: acc(e-), p+. It shows the model of (bound electron) - proton link or it shows the model of Venus-Sun link.
- The complementary pairs of elementary particles: e+, p-. It shows the model of positron-antiproton.

g) *Some explanation of view and work of cross vortex objects*

- The acceleration (positive or negative) is the reason for the eccentricity of the cross vortex objects (Axiom1, Law 1), (Figure 1b).

- Two complementary pairs work counter-phase as generators(Axiom 2, Law 1, Law 2) (Figure 2c).
- The center of Gravity(p.F) is in different quadrants : in first quadrant is center in accelerating cross vortex (2), but in second- is center in decelerating cross vortex (1)(Law 5, Law 6), (Figure 6).
- h) Some explanation of particle charge as direction and size of the acceleration
 - The direction (inward or outward)of cross vortex determines the charge (negative or positive) of cross objects. When direction is from out to in (1) - the "charge" is negative(E2D-)). When direction is from in to out (2) - the "charge" is positive (E2D+)(Figure 6).
 - The stationary mode describes creation of objects, but pulsating mode explains their work in time and pulsating and transmitting transverse waves at the speed of light.
 - It explains the cause for mass increasing of an elementary particle, described in *Theory of Relativity* of Einstein and confirmed by the experiment. For example an electron that moves at the speed of light, increases its mass (Law5, Law 6). The reason is in structure of electron as an vortex from outside to inside(1, Figure 6). When electron is not connected to the proton, it is in free form. The cross vortex of electron sucks inward the free primary vortices. The higher the speed - the more primary vortices are sucked in and are glued to the electron.
- i) Some explanation of longitudinal vortex
 - Explanation why according to the Law 6, a longitudinal vortex, because of maximum velocity and minimum amplitude, is moving in minimum time. But a longitudinal vortex, because of minimum velocity and maximum amplitude, is moving in maximum time.
 - Explanation why accelerating longitudinal vortices, because of suck in the cross vortices outside-inward, are attracted each other and form Gravity Funnel.
 - In Gravity Funnel distance(S) along the accelerating spiral is inverse proportional to the velocity(V). In Electromagnetic Field the distance(S) is right proportional to the velocity (V)[3].
- j) Some explanation of Gravity field
 - Gravity field participates in a stationary structure in the tube (at the entrance or at the exit) of Gravity funnel that generates the cross part of object. Gravity field participates and in a pulsating structure as a wrap around the object.
 - Gravity funnel consists by accelerating longitudinal vortices inserted one in another. It has one push end and one pull end. It attracts in both directions - along the axis of the funnel and perpendicular to the axis. The Gravity funnel has an accelerating central axis and decelerating periphery (due to the

resistance on border surface) (Law 1, Law 2 and Consequences). Then It returns back and envelops the cross object.

- In the pulsating mode, the cross vortex of object is stretched and collapsed and the longitudinal funnel is extended and shortened. Thus, a gravitational pulsating envelope is generated around the object and so on.

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Kinematics and Dynamics of a Particle in Gravitation Field

By Dubrovskiy I

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Keywords: general theory of relativity, metric tensor, hypersurface, Riemannian geometry, geodesic line, gravitational field, equations of motion.

GJSFR-A Classification: DDC Code: 530.1 LCC Code: QC6



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I. INTRODUCTION

Despite its long history and the work of outstanding physicists, the general theory of relativity still contains a number of fundamental contradictions and unresolved issues. Attention is drawn to them in the monograph [1] in the chapters on the General Theory of Relativity (GR), which "is perhaps the most beautiful of all existing physical theories." In this work, we will show that all these problems are removed if, from the very beginning, changes are made to the mathematical definition of the properties of space, in which the GR is described. As a sign that this is not a four-dimensional space, all of whose axes are mathematically the same, let's call it "space (3 + 1)".

II. GEOMETRY OF SPACE (3 + 1)

The tasks of GR mechanics can be divided into several levels: the cosmos as a whole, a galaxy, a binary star, and the last one is a point particle in a gravitational field, the scale of which is much larger than the size of the particle, and the particle's own field is much weaker than the external one. So you can consider a planet in the field of a star and a small body in the field of a planet. At each level, it can be assumed that the gravitational field is created by an object of a higher level and it can be considered stationary in those periods of time that are considered. Particle kinematics - the simplest problem of mechanics - describes the inertial world line of a point particle in the absence of any external force. For this, the differential geometry of

the four-dimensional space-time is used, which takes into account the difference in the properties of time and space. The main features of this type of space follow from the formulation of the physical problem [1], but then the geometry is constructed purely mathematically. Consider the four-dimensional Euclidean space as the initial concept for describing the physical space-time. In some coordinate system, given by the starting point and four non-collinear axes, each point in space corresponds to four numbers (x^0, x^1, x^2, x^3) that are the coordinates of this point. To use the apparatus of differential geometry, it is necessary to pass to curvilinear coordinates. To do this, we introduce four linearly independent continuous differentiable functions $x^i = f_i(x^0, x^1, x^2, x^3)$. This coordinate transformation must be reversible and differentiable. At each point M of space, four coordinate lines intersect. They are determined by a change in one of the coordinates with fixed values of the other three corresponding to the point M . The tangents to these lines are linearly independent and form a local frame. Any vector drawn from the point M can be decomposed with respect to this frame. Now the same Euclidean space is described in curvilinear coordinates. The transition to curvilinear coordinates is unambiguous and reversible. This is due to the fact that the Euclidean space is affine. In addition, in the geometry of the physical space-time, three spatial coordinates must be equivalent, and the time coordinate must differ in special properties. Therefore, we will call such a space not four-dimensional, but the space (3 + 1). Special Theory of Relativity (SR) is not described in four-dimensional Euclidean space, but in (3+1) Minkowski space, which is called "index one pseudo-Euclidean space". In this space, the time coordinate is a purely imaginary number. This made it possible to simply describe all the differences between the mechanics of the SR and classical mechanics. But with such a choice of one of the coordinate axes, the transition to curvilinear coordinates described above would lead to the fact that all coordinates x^i become complex numbers and the selection of the time coordinate disappears.

The properties of the space (3+1) can be described by the properties of the metric tensor of this space. This possibility has long been used in describing the kinematics of the GR, but in well-known monographs

on this theory, the description of the properties of the metric tensor is not presented systematically.

A multidimensional space is called metric if the scalar product of vectors $(\mathbf{A} \cdot \mathbf{B}) = G_{ik} A^i B^k$ is defined in it. Here \mathbf{A}, \mathbf{B} are the vectors plotted from one point in space, A^i, B^k – their components in the local frame of this point, G_{ik} – are the components of the symmetric tensor. (Hereinafter, the usual rule of summation over repeated indices is adopted. Indexes denoted in Latin letters take the values 0, 1, 2, 3; indexes denoted in Greek letters take the values 1, 2, 3). The metric tensor $\|\mathbf{G}\|$ is a rank 4 symmetric non-singular matrix whose components generally depend on the coordinates. Like any real symmetric non-singular matrix, the metric tensor at each point in space can be reduced to a diagonal form, that is, there is such a real non-singular matrix $\|\mathbf{D}\|$ that the matrix $\|\mathbf{D}\|^{-1} \cdot \|\mathbf{G}\| \cdot \|\mathbf{D}\| = \|\bar{\mathbf{G}}\|$ is diagonal (this is indicated by a bar over the matrix character). If the components of the metric tensor depend on the coordinates, then its diagonal components also depend on the coordinates.

The matrix can also be reduced to a diagonal form by introducing a rectilinear orthogonal coordinate system at the selected point, which is called Galilean. Such a transformation reveals properties that are important for what follows. At the origin, located at a chosen point in space, generally speaking, inhomogeneous, the metric tensor will be exactly diagonal, as in the case of an algebraic transformation of the matrix but for small deviations from the origin, the off-diagonal components will be of the second order of smallness in deviations. If the space is Euclidean, then the metric tensor does not depend on the coordinates and can be reduced to a diagonal form by introducing Galilean coordinates throughout the space.

The matrix $\|\mathbf{D}\|$ or orientation of the Galilean coordinates frame can be chosen in an infinite number of ways. In this case, the metric tensor of the space (3+1) SR always has the form [see [1] formula (6.5)]:

$$\|\mathbf{G}_0\| = \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{vmatrix}. \quad (2.1)$$

Further we will denote the metric tensor $\|\mathbf{G}\|$ and its components \mathbf{g}_{ij} .

Let us describe the difference in the physical meaning of the zero row and the remaining three rows of the metric tensor matrix. The theory should describe not the trajectory of a particle in three-dimensional space,

but the world line in four-dimensional space-time (3+1). General view of the world line:

$$s \{ x^0 = ct, x^1(t), x^2(t), x^3(t) \}. \quad (2.2)$$

Here t – time, a continuously changing parameter $dt > 0$, x^0 – a coordinate proportional to time with the coefficient c – of the electromagnetic wave velocity in vacuum, the remaining variables $x^\alpha(t)$ are coordinates of a point in a certain system of curvilinear coordinates in a curved three-dimensional space.

The metric tensor of a homogeneous space (3+1) in Galilean coordinates $\|\bar{\mathbf{G}}_0\|$ is defined by the equality

$$\mathbf{g}_{ij} = \delta_{ij} (2\delta_{i0} - 1). \quad (2.3)$$

Let us establish the rule that if the matrix is diagonal, then the rows whose diagonal element is positive are located in the upper part of the matrix. This rule was introduced in the monograph [1] and is called the signature. In the described case, the diagonal element is positive in the top row, and are negative in the remaining rows. This defines an important property of the space: a sequence of signs in an invariant quadratic form that describe the curve arc differential:

$$ds^2 = (dx^0)^2 - (dx^1)^2 - (dx^2)^2 - (dx^3)^2. \quad (2.4)$$

The main axiom of the GR: in a gravitational field, it is possible to bring the metric tensor to a diagonal form only locally at each point in space. This geometry is called Riemannian geometry. The fundamental Einstein equation relates the curvature of space to the distribution and movement of mass in space. We consider a stationary gravitational field. Therefore, the energy-momentum tensor does not depend on time, and the zero value of the indices does not make sense. The geometry of three-dimensional space is determined by the Einstein equations, in which the indices take only the values 1, 2, 3.

$$\mathbf{R}_{\alpha\beta} - \frac{1}{2} \mathbf{g}_{\alpha\beta} R = \frac{8\pi k}{c^4} \mathbf{T}_{\alpha\beta}. \quad (2.5)$$

Here the constant k is the gravitational constant, $\mathbf{T}_{\alpha\beta}$ are components of the energy-momentum tensor of the mass that creates the gravitational field, the Ricci tensor $\|\mathbf{R}\|$ and its convolution R (scalar curvature) are expressed in terms of the metric tensor of three-dimensional space and its derivatives with respect to coordinates. If the space is flat, then the Ricci tensor is identically equal to zero.

Then, obviously, the energy-momentum tensor is also equal to zero. The converse is also true: if the energy-momentum tensor is identically equal to zero, then the space is flat, i.e., Euclidean.

Einstein's equations define the matrix of the metric tensor of the three-dimensional Riemannian space $\|\mathbf{g}_{\mu\nu}(\mathbf{r})\|$, components of this matrix are functions of the point at which the metric is defined. The metric space tensor (3+1) can be represented by a cellular matrix

$$\|\mathbf{G}\| = \begin{vmatrix} \mathbf{g}_{00}(\mathbf{r}) & \mathbf{g}_{0\alpha} \equiv 0 \\ \mathbf{g}_{\alpha 0} \equiv 0 & \|\mathbf{g}_{\mu\nu}(\mathbf{r})\| \end{vmatrix}. \quad (2.6)$$

This matrix must be cell-diagonal. This means that three-dimensional space is a hypersurface in four-dimensional space on which a Riemannian metric is defined.

This definition of the metric tensor in (3+1) space is the main new mathematical proposition in this paper. Further, we will show that if it is accepted, the entire further theory of the motion of a particle in a gravitational field is built logically sequentially. All the problems noted but not resolved in the monograph [1] disappear, and the limiting transition to the special theory of relativity becomes clear. In [1] the metric tensor of three-dimensional space was also introduced, but it was obtained as a result of a thought experiment, which is incorrect for geometry. As a result the formula expressing its components in terms of the components of the metric tensor of the four-dimensional space is incorrect. The identity $\mathbf{g}_{0\alpha} \equiv 0$ means that all

components in this row and column, except for the diagonal one, are equal to zero; $\mathbf{g}_{00} = \mathbf{g}(\mathbf{r})$ is a scalar function of spatial coordinates. The coordinate \mathbf{r} is a three-dimensional space vector; in contrast to 4-vectors, we will denote them by small letters.

Let's move on to Galilean coordinates at a fixed spatial point \mathbf{r} and reduce to diagonal form the matrix $\|\mathbf{G}(\mathbf{r})\|$. To reduce to diagonal form a cell matrix of the fourth rank, it is necessary to reduce to diagonal form only the matrix of the third rank $\|\mathbf{g}_{\mu\nu}(\mathbf{r})\|$. The metric tensor of three-dimensional space defines by Einstein's equation (2.5) for three-dimensional space. This is a matrix of the third rank with components $\mathbf{g}_{\alpha\beta}$. The characteristic equation of such a matrix is the equation of the third degree. Therefore, it has one, two or three real roots. The components of the metric tensor $\|\mathbf{g}_{\mu\nu}(\mathbf{r})\|$ reduced to a diagonal form in Galilean coordinates must be equal to each other. The metric tensor of a three-dimensional space, reduced to a diagonal form at a point \mathbf{r} , should have the form:

$$\|\mathbf{g}_{\mu\nu}(\mathbf{r})\| = g(\mathbf{r}) \begin{vmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{vmatrix}, \quad (2.7)$$

where $g(\mathbf{r})$ is a real function of spatial coordinates. That is the real root of the cubic characteristic equation of the matrix $\|\mathbf{g}_{\mu\nu}(\mathbf{r})\|$:

$$y^3 - ay^2 + by - c = 0$$

$$a = \mathbf{g}_{11} + \mathbf{g}_{22} + \mathbf{g}_{33}, \quad b = \left[\mathbf{g}_{12}^2 + \mathbf{g}_{13}^2 + \mathbf{g}_{23}^2 - \mathbf{g}_{11}\mathbf{g}_{22} - \mathbf{g}_{33}\mathbf{g}_{22} - \mathbf{g}_{33}\mathbf{g}_{11} \right]. \quad (2.8)$$

$$c = \mathbf{g}_{11}\mathbf{g}_{22}\mathbf{g}_{33} - \left[\mathbf{g}_{11}\mathbf{g}_{23}^2 + \mathbf{g}_{22}\mathbf{g}_{13}^2 + \mathbf{g}_{33}\mathbf{g}_{21}^2 \right] + 2\mathbf{g}_{12}\mathbf{g}_{23}\mathbf{g}_{31}$$

If there are two or three such roots, then one can choose a single value based on physical considerations. For example, if space should tend to flatten as it moves away from a certain point or area, then the function $g(\mathbf{r})$ should tend to unity. The function $g(\mathbf{r})$ must be positive. The equation $g(\mathbf{r})=0$ defines a surface in space separating the accessible $g(\mathbf{r})>0$ and inaccessible $g(\mathbf{r})<0$ regions of space, and the inaccessible region must be limited if the mass that creates the energy-momentum tensor that determines the gravitational field in Einstein's equations occupies some limited volume. For example,

in the case of spherical symmetry the function $g(\mathbf{r})$ must be proportional to $(r-r_0)/r$, where r_0 is the radius of the Schwarzschild sphere.

Let $\mathbf{g}_{00}(\mathbf{r})=g(\mathbf{r})$. Let us emphasize that this condition is necessary for the cell matrix to be proportional to the metric tensor (2.3). Then formula (2.6) can be represented as:

$$\|\mathbf{G}\| = \begin{vmatrix} g(\mathbf{r}) & \mathbf{g}_{0\alpha} \equiv 0 \\ \mathbf{g}_{0\alpha} \equiv 0 & \|\mathbf{G}_s\| \end{vmatrix} \equiv g(\mathbf{r}) \begin{vmatrix} 1 & \mathbf{g}_{0\alpha} \equiv 0 \\ \mathbf{g}_{0\alpha} \equiv 0 & \|\mathbf{G}_s\|/g(\mathbf{r}) \end{vmatrix}. \quad (2.9)$$

Total metric space tensor (3+1) in Galilean coordinates at each point \mathbf{r} :

$$\|\mathbf{G}\| = g(\mathbf{r}) \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{vmatrix}. \quad (2.10)$$

We will not present differential geometry. It is described in sufficient detail in the monograph [1]: §83,

$$ds = dt \sqrt{c^2 - (v^1)^2 + (v^2)^2 + (v^3)^2} = cdt \sqrt{1 - |\mathbf{v}|^2/c^2}; v^\alpha = \frac{dx^\alpha}{dt};$$

$$U^i = dx^i/ds; U^0 = c \frac{dt}{ds} = \frac{1}{\sqrt{1 - |\mathbf{v}|^2/c^2}}, U^\alpha = \frac{v^\alpha}{c \sqrt{1 - |\mathbf{v}|^2/c^2}}, |\mathbf{U}|^2 = 1. \quad (2.11)$$

The general definition of a geodesic line is a line whose tangents are parallel at any point. In addition, the length of the tangent segment, given at one, arbitrarily chosen point, is preserved in the Riemannian space. Through any point in space in any direction it is possible to draw a geodesic and only one. In different sources, you can find different definitions of the equations of a geodesic line. Usually they are represented as the equality to zero of the sum of the derivative of the corresponding component of the vector \mathbf{U} along the length of the arc and the term proportional to the connection coefficient, which is determined by a linear combination of the derivatives of the metric tensor with respect to the coordinates.

For our purposes, it is more convenient to use the form of differential equations of a geodesic line presented in the monograph [2]:

$$\frac{dU_i}{ds} - \frac{1}{2} \frac{\partial g_{kl}}{\partial x^i} U^k U^l = 0. \quad (2.12)$$

Since we know the diagonal form of the matrix in this equality, using this, we get:

$$\frac{dU_i}{ds} = \frac{\partial g(\mathbf{r})}{\partial x^i} |\mathbf{U}|^2 = \frac{\partial g(\mathbf{r})}{\partial x^i}. \quad (2.13)$$

§85, §86. We give only some definitions and formulas necessary for further presentation.

The space (3+1) is a special case of a four-dimensional space with a metric tensor defined by us. Therefore, general concepts and formulas can be used, taking into account formula (2.9). The curve in the space (3+1) is generally given in the form $s[x^0 = ct, x^1(t), x^2(t), x^3(t)]$. The tangent vector to this curve \mathbf{U} is defined by the equations (see [1, §7]):

III. KINEMATICS AND DYNAMICS OF A PARTICLE IN SPACE (3+1)

The main task of mechanics in the macrocosm is to determine the world lines of particles in various conditions. In pseudo-Euclidean space, in the absence of forces, it is always a straight line, determined by the initial conditions: the starting point and the velocity vector. This is formulated in Newton's first law - the law of inertia: "A particle maintains a state of rest or uniform, rectilinear motion until an external force acts on it." In the Riemannian space in this law, only the words "... uniform, rectilinear ..." should be replaced by "... movement at a constant speed." In Euclidean space, these expressions are equivalent, the velocity vector can be moved along a straight line. In a Riemannian space, the parallel translation of a tangent vector from a certain starting point occurs along a geodesic line.

Let us pass in equations (2.13) from geometric quantities to physical ones, that is, observable, measurable and having dimensions. This is a system of four equations that differ only in the index value. But in the space (3+1), the equation for the time axis ($i=0$) has some differences due to the fact that the function $g(\mathbf{r}(t))$ depends on time only through the dependence of coordinates on time, i.e. due to the motion of the particle. Then we get:

$$\frac{dU_0}{ds} = \frac{\partial g}{\partial x^\alpha} \frac{v^\alpha}{c} (U^0)^2 - 3 \frac{\partial g}{\partial x^\alpha} \frac{v^\alpha}{c} (U^\mu)^2 = \frac{\partial g}{\partial x^\alpha} \frac{v^\alpha}{c} |U|^2 = \frac{\partial g}{\partial x^\alpha} \frac{v^\alpha}{c}$$

$$\frac{dU_\alpha}{ds} = -\frac{\partial g}{\partial x^\alpha} (U^0)^2 + 3 \frac{\partial g}{\partial x^\alpha} (U^\mu)^2 = -\frac{\partial g}{\partial x^\alpha} |U|^2 = -\frac{\partial g}{\partial x^\alpha} \quad (3.1)$$

On the right side of the equalities, we pass to differentiation with respect to time using formulas (2.11).

We obtain equations expressed in terms of coordinates and time:

$$\text{a) } \frac{dU_0}{ds} = \frac{d}{dt} \left(\frac{1}{\sqrt{c^2 - \mathbf{v}^2}} \right) = 0 = \frac{\partial g}{\partial x^\alpha} \frac{v^\alpha}{c}$$

$$\text{b) } \frac{dU^\alpha}{ds} = \frac{d}{dt} \left(\frac{v^\alpha}{c\sqrt{1 - \mathbf{v}^2/c^2}} \right) = \frac{1}{c\sqrt{1 - \mathbf{v}^2/c^2}} \frac{dv^\alpha}{dt} = -\frac{\partial g}{\partial x^\alpha}. \quad (3.2)$$

$$\text{c) } \frac{d}{dt} \left(\frac{\mathbf{E}(\mathbf{v}^2)}{c} \right) = 0, \quad \frac{dp^\alpha}{dt} = -\frac{\partial(mcg)}{\partial x^\alpha},$$

Here, as in formulas (2.11), $v^\alpha = dx^\alpha/dt$ - spatial velocity, $\mathbf{E}(\mathbf{v}^2)$ is a kinetic energy. If we multiply the equations by mc , where m is the mass of the particle, then the function $mcg(\mathbf{r})$ plays the role of a potential. Then it follows from equations a) and b) that in three-dimensional space the gravitational force is perpendicular to the velocity. Therefore, this potential affects the form of the trajectory, but does not change the velocity modulus, that is, the kinetic energy. This is a well-known natural phenomenon: under the influence of gravity, planets move in closed orbits without changing their kinetic energy. In our theory, this happened due to the fact that it was accepted $\mathbf{g}_{00}(\mathbf{r}) = g(\mathbf{r})$.

Equations expressed in terms of impulses are written in line c). As is known (see [1]), kinetic energy can be expressed in terms of spatial impulses and rest energy. This function is called the Hamiltonian function

$H = c\sqrt{m^2c^2 + \mathbf{p}^2}$ and the equation for the zero momentum component is:

$$\frac{d}{dt} H = 0. \quad (3.3)$$

This is the law of conservation of energy in a gravitational field. The remaining three equations describe Newton's second law: acceleration is proportional to the acting force.

The monograph [3] formulates the rules for projecting a Riemannian space onto a flat one. With this transformation, the geodesic line becomes a straight

line. This is obvious, since the defining property of a geodesic is the constancy of direction. Then the opposite is also possible: the transformation of a straight line into a geodesic. These transformations open up the possibility of transition to another frame of reference through Lorentz transformations.

In the monograph [1] in the footnote to § 85: "It can be shown that by a suitable choice of the coordinate system it is possible to achieve the vanishing of all connection coefficients not only at one point, but also throughout the given world line." (The proof of this statement can be found in P. K. Rashevsky's book "Riemannian Geometry and Tensor Analysis". Nauka, (1964), §91)". The solution of the above specific problem is a special case of the theorem proved in the monograph [3], therefore, using this theorem, one can consider the problem of the combined action of gravitational and electromagnetic fields.

IV. CONCLUSION

The equations of motion of a particle in a gravitational field are obtained by sequentially taking into account the position that the physical four-dimensional space is a distinguished time axis and a three-dimensional hypersurface, the metric tensor of which is determined by the Einstein equations. This approach removes all the problems and contradictions noted in the monograph [1], and the resulting equations adequately describe, for example, the curvilinear motion of planets without energy loss.

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Equilibrium Equation of Thermal Radiation of Earth and Solution

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Abstract- The Earth is isolate on its orbit motion around the Sun. The thermal radiation on Earth determines climate warmer or colder. By Kirchhoff's law, the thermal radian on Earth must be in an equilibrium state. Which equivalents to an optimum problem. This paper establishes an equilibrium equation of thermal radiation of Earth, transmits it to an optimum problem, and proves that the equilibrium of thermal radiation of Earth is an indifferent equilibrium, neither stable, nor un-stable, based on the Stefan- Boltzmann law and the emissivity formula. The result means that the climate neither getting warmer and warmer, nor getting colder and colder.

Keywords: *thermal radiation, kirchhoff's law, stefan-boltzmann law, plank's law, optimization theory.*

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Equilibrium Equation of Thermal Radiation of Earth and Solution

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I. INTRODUCTION

Climate change is one of the focus topics in the world[1]. On the one hand, NASA scientists (NASA 2009)[2] found that fast-flowing Glaciers and thin Greenland and Antarctic ice sheets are accelerating. Which shows that the earth is being warming. On the other hand, cold wave, heavy snowfall, freeing temperature, with new-record sweeping Europe, North America, and East Asia have been reported in srtcles[3,4], news reports[5]. These reports query the earth warming.

Which one is correct? Or both are in-correct/correct?

What is the criterion for judging the climate of Earth to be warmer or colder?

II. THE CRITERION FOR JUDGING THE CLIMATE OF EARTH TO BE WARMER OR COLDER

Here, the "(Average) Earth's radian temperature T" is used as the criterion for judging the climate to be warmer or colder, based on reflecting the global factors of Earth's climate. It differs from that criteria based on local factors, such as local Glaciers, local temperature, local snowfall, etc. Where T is unknown, to be determined by the thermal radian equilibrium equation of Earth.

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III. ENERGY EXCHANGING OF EARTH

The Earth is isolate on its orbit motion around the Sun. The energy exchanging of Earth through Thermal radiation. The thermal radiation on Earth determines climate warmer or colder.

A body emits radiation at a given temperature and frequency exactly as well as absorbs the same radiation. This was proved by Kirchhoff.

By Kirchhoff's law[6], the absorption of thermal radiation on Earth is equal to its emission. That means that the thermal radiation on Earth must be in an equilibrium state.

IV. THE STUDY ON THERMAL EQUILIBRIUM IS TRANSFERRED TO THE STUDY OF OPTIMUM PROBLEM

The study on equilibrium state in mechanics often take placed to the study of some Principles, e.g., the Generalized Principles of Variation was used to mechanics [7]; the Principle of Minimum Potential Energy [8] was used to study static mantle density distribution, etc. Here, the study on the thermal radiation equilibrium of Earth is transferred to the study of an optimum problem.

V. CONSTRUCTION THE THERMAL RADIAN EQUILIBRIUM EQUATION OF EARTH

$$T = F(T) = (\min/\max)_{Tp}(T). \quad (1)$$

a) By Plank's law^[9], the emissivity ϵ is the function of (λ, T) ,

$$\epsilon = \epsilon(\lambda, T) = \frac{2hc^2}{\lambda^5} \frac{1}{e^{(hc/\lambda kT)} - 1}, \quad (2)$$

Where λ =electromagnetic wavelenght,

h =Plank's constant,

c =speed of light,

k =Boltzmann' sconstant,

T =temperature of the radiator.

For total wavelengths, improper integrating of (2) from 0 to infinity of radiation, we have

$$\epsilon(\Sigma \lambda, T) = \int_0^{\infty} \epsilon(\lambda, T) d\lambda = \epsilon(T), \quad (3)$$

Where the emissivity is the function only of T.

b) *The Stefan-Boltzmann Law (S-B law)*

There are many articles introducing S-B law^[10], etc. The S-B law, formulated by J. Stefan (1879) based on experiment and derived by L. Boltzmann (1884) based on thermal dynamic. It states that the total radiant heat power emitted from a surface is proportional to the fourth power of its absolute temperature.

The S-B law gives:

$$p = \sigma \varepsilon T^4, \quad (4)$$

Where $p=p(T)$ =the net radiant power per unit surface area of radiator.

σ =Stefan's constant, $\sigma = 5.6703 \times 10^{-8}$, watt/m²K⁴, K=absolute temperature,

T= temperature of radiator,

$\varepsilon = \varepsilon(T)$ =emissivity.

c) *Construction the thermal radian equilibrium equation of Earth* $T = F(T) = (\min/\max)_T p(T)$.

Let $p=p(T)$ be an object functional of an optimum (min or max), then, the variation problem becomes:

$$F = F(T) = (\min/\max)_T p(T), \quad (5)$$

Where $F = F[SB(T), \varepsilon(T)] = F(T)$ is a functional. SB is the S-B law. Satisfying (4)

d) *The necessary condition of the thermal radiation of Earth laying on an equilibrium state*

The thermal radiation laying on equilibrium, by (6), it must be:

$$\frac{dF}{dT} = \sigma \left[\frac{d\varepsilon}{dT} T^4 + \varepsilon \frac{dT^4}{dT} \right] = 0, \quad (6)$$

(6) is the necessary condition of an equilibrium state. The point at equilibrium is called a stationary point. (6) is expressed:

$$\frac{d\varepsilon}{\varepsilon} = -\frac{dT^4}{T^4}, \quad (7)$$

Integrating both sides of (7), we have

$$\int \frac{d\varepsilon}{\varepsilon} = \ln \varepsilon = - \int \frac{dT^4}{T^4} - \ln C = -\ln C(T)^4 = \ln C(T)^{-4}, \quad (8)$$

$$\varepsilon = \varepsilon(T) = C(T)^{-4}, \quad (9)$$

Where the integral constant C can be determined by the known condition between ε and T, that is: $\varepsilon=1$ (black body), $T=0^\circ K$ (black body), then, $C=1$ Then, we have

$$0 \leq \varepsilon = (T)^{-4} \leq 1, \quad (10)$$

(10) is called "emissivity formula".

Substituting (10) and (4) into (5), we have:

$$F(T) = \sigma = \text{constant}, \quad (11)$$

That means operator F maps T into a constant. Or, F independents to temperature T. That is already shown in (6), the necessary condition of the thermal radiation of Earth laying on an equilibrium state.

e) *The sufficient condition of the thermal radiation equilibrium of Earth to be an extreme point*

According to optimization theory[11], the sufficient condition of an equilibrium state reaching to its extreme point depends on the sign of its higher order derivatives. By(4) and (10), we have

$$\frac{d\varepsilon}{dT} = -4T^{-5}, \quad (12)$$

$$\frac{d^2\varepsilon}{dT^2} = 20T^{-6}, \quad (13)$$

By (4), we have

$$\frac{d^2F}{dT^2} = \sigma \left[\frac{d\varepsilon^2}{dT} T^4 + 2 \frac{d\varepsilon}{dT} (4T^3) + 12\varepsilon T^2 \right], \quad (14)$$

Substituting (10), (12), (13) into (14), we have

$$\frac{d^2F}{dT^2} = \sigma T^{-2} [20 - 32 + 12] = 0, \quad (15)$$

Similarly, we have

$$\frac{d^n F}{dT^n} = 0, \quad (n = 1, 2, \dots, \infty) \quad (16)$$

According to the third rule (p. 232 of [11]), (16) shows that no extreme point exists. The equilibrium is an indifferent equilibrium, neither stable, nor um-stable. The indifferent equilibrium holds for arbitrary temperature T.

VI. DISCUSSION

Q=question, A=answer,

Q1: There are many factors, influent climate of Earth, such as: Forest fire, heat energy emitted from inside of the Earth via earthquake [12- 16], and volcano, and human activity caused density of CO₂ increasing, etc. Do these factors causing the Earth's radian temperature T going up?

A1: Do not worry about that. If the emissivity ε changing and causing T increasing, then, by the S-B law, more heat energy. With four power shall emitted to the space and keeps T unchanged.

Q2: You works on relating problem ?

A2: 1, On Atmosphere, Book [17]. and papers [18 – 22,25].

2, On Earthquake [12].

Features: Earthquake and Earth self-rotation are two problems, it is linked by conservation law of energy.

Highlights:

- Energy release of Earthquake proportions to square of velocity of Earth rotation;
- Earthquake happens in pulse-mode, the releasing energy storages in fasten rotation of Earth. Once the velocity of rotation of Earth returned to normal, the storage energy transfers to kinetic energy and disaster happening. People should get out from dangerous zone before the rotating velocity returned to normal.

3, On Earth Science[8 23 24],

Highlight of series studies on “static mantle density distribution 1, equation, 2, solution, 3, application”:

- Why the Tibet-Qinghai high-land rising up? Why earthquakes happen frequently at the belt (about 35° of south & north latitudes)? The study of three papers found that the static mantle density distributes in “X-types”, where the un-continuity of masses locates at the turning point of “X” (about 35° of south & north latitudes). Earthquakes happen frequently at this belt and the Tibet-Qinghai high-land raising up can be viewed as supporting to the study.

VII. CONCLUSION

The thermal radian equilibrium equation of Earth is an indifferent equilibrium, neither stable, nor un-stable. Any temperature T satisfies the necessary condition, while does not satisfy the sufficient condition of an extreme point. Therefore, It has no unit solution T .

Data Availability Statement: all data are cited from open publications.

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Numerical Modeling of Lawsonite Thin Film as Radiative Cooling Minerals for Harvesting Dew

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Keywords: condensation, radiative cooling, lawsonite, harvesting dew, dew yield.

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M. Benlattar ^a & R. Adhiri ^a

Abstract- Radiative cooling is the phenomenon responsible for dew formation on plants. Harvesting humidity from the air has two different pathways: fog and dew, but harvesting dew have not been sufficiently exploited. In this paper, we describe the resources for radiative cooling as well as lawsonite mineral for exploiting this natural phenomenon. Further, this paper describes the development of dew harvesting systems for use in the semi-arid mirleftsouth Morocco. Numerical simulations using the energy balance equation were performed. Harvesting dew can be used as a renewable complementary source of water both for drinking and agriculture in specific arid or semi- arid areas. In order to form global estimates of dew collection potential via a dew formation model, we combined meteorological parameters with radiative properties of a specific collector sheet (natural lawsonite, $\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2 \bullet \text{H}_2\text{O}$ deposited on glass) to enhance the dew yield. The daily yields show that significant amounts of dew water can be collected.

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I. INTRODUCTION

Since 1905, scientists has tried to collect dew to obtain water, using the so-called Ziboldcondensers [1-3]. Recently, many studies concerning natural condensation of water vapor are oriented towards agriculture (plants and animals), the source of drinking water and the study of the soil cooling[4-8]. Dew is a type of precipitation where water molecules droplets form on the ground, which is usually not explicitly considered in hydrologic cycle, because the amounts are small. However, in semiarid and arid regions harvesting dew can reach or even exceed all other forms of precipitation for extended periods or indeed a whole year. Water scarcity well becomes especially severe in many countries of Africa (South Morocco, Senegal, Mali, etc). One possible solution lies in alternative water sources, such as nocturnal radiative cooling. Dew formation is the result of nocturnal radiation. Practically, Dew is a natural phenomenon that occurs under particular meteorological conditions and on a dew plate condenser with high radiative cooling properties specially designed for this purpose. Dew forms when the temperature of a surface (collector sheet

or dew condenser) cools below the dew point temperature (T_d) of the surrounding air so that water vapor contained in this air condenses on the collector sheets. The cooling effect of a collector sheet is caused by a radiation loss. The importance of water vapor as a reservoir of heat can be seen by comparing the daily temperature ranges of a semi-arid environment to that of a humid area. Semi-arid and humid environments may heat up in the same manner during the day but, due to the relative absence of water molecules and dioxide the carbon to absorb and hold the heat energy, the semi-arid region cools down much more at night than the humid region. How much it cools down depends on the meteorological data.

We attempt to create an efficient and cheap dew plate condenser has not yet been exploited. In this modeling study we focus on the harvesting dew onto lawsonite radiant mineral as a dew condenser, and investigate the potential for its collection. The planar dew condenser was set at an angle of 30° with respect to horizontal. Numerical simulations using the energy balance equation to identify the meteorological factors which determine the degree of cooling, and to assess their effect on harvesting dew were performed. These meteorological parameters were found to be ambient temperature (T_{amb}), cloud cover (N), wind speed (V_w), soil heat flux (G), and relative humidity (Hr). The temperature of the collector sheets (T_s) dew forms on is also important. The impact of water vapor on soil is important in arid or semi-arid environments.

a) Sample description and characterization

Lawsonite, $\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2 \bullet \text{H}_2\text{O}$, is one of the key mineral used as an indicator of high-P and low-Z metamorphic environments like blueschists-facies metabasalts and metagreywackes[9-10]. Lawsonite can occur as isolated needle-like crystals, aggregates displaying a radiating pattern, or as tabular crystals. The structure, which contains both discretehydroxyl groups (OH) and H_2O molecule, was first solved by Wickman [11]. In addition to Si_2O_7 groups, lawsonite contain also the SiO_4 unit. At ambient conditions, lawsonite is orthorhombic with space group $Ccmm D_{2h}^{16}$ and the following designation of crystallographic axes has been adopted: $a = 8.795 \text{ \AA}$, $b = 5.847 \text{ \AA}$, $c = 13.142 \text{ \AA}$. The structure consists of chains of edge sharing Al-O octahedra and which are linked by Si_2O_7 groups. The non-centred primitive unit cell (spectroscopic cell) is half

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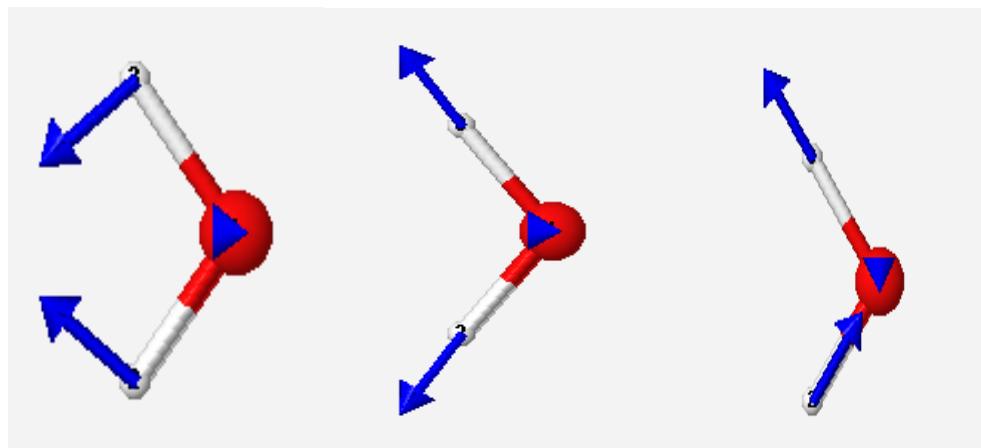
as large and contains 38 atoms; hence, there are a total of 114 vibration modes at the centre of the Brillouin zone[12-13].A knowledge of atomic positions and

symmetries leads to the following irreducible presentation of the 114 modes:

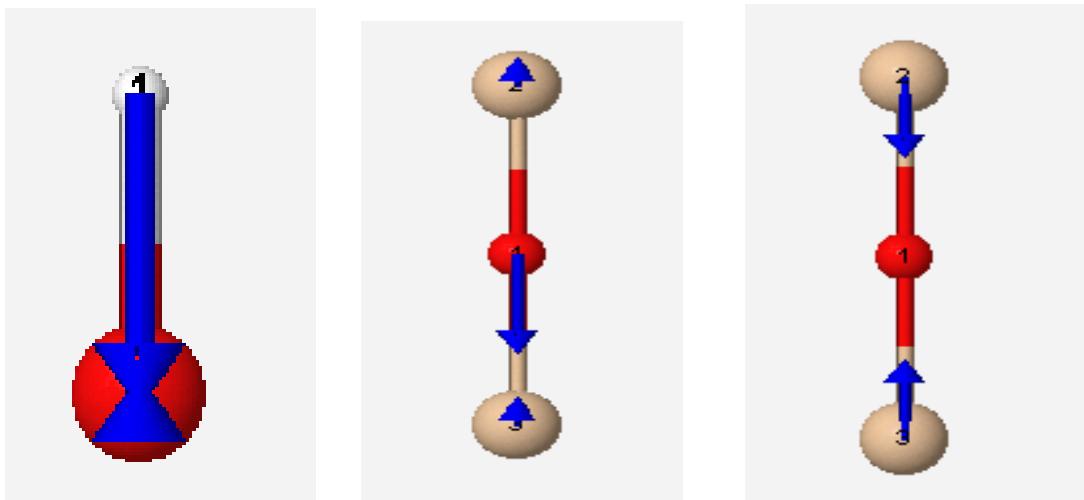
$$\Gamma_{RR} = 16A_g + 11B_{1g} + 16B_{2g} + 8B_{3g} \text{ (Raman active = 51 modes)} + 11A_u \text{ (inactive)} \\ + 18B_{1u} + 13B_{2u} + 18B_{3u} \text{ (IR active = 49 modes)} + 1B_{1u} + 1B_{2u} + 1B_{3u} \text{ (acoustic)} \quad (1)$$

It is assumed that the Si_2O_7 polyhedra, OH and H_2O groups are preserved as distinct structural units. The site symmetry of both Si_2O_7 and water molecules H_2O within lawsonite is m (C_{2v}) and that of hydroxyl groups OH is m (C_s). Labotka and Rossman [12] have assigned the bands of the vibrations of OH and H_2O in

lawsonite. The stretching motions of Si_2O_7 polyhedra were assigned by Hofmeister et al [13].The stretching vibrations of one Si_2O_7 unit can be divided into the vibrations of SiO_3 and the vibrations of Si-O-Si bridges[14].



Bending of water δ (H_2O) Stretching symmetric $\nu_s(\text{H}_2\text{O})$ Stretching antisymmetric ν_{as} (H_2O)



Stretching $\nu(\text{OH})$ Stretching antisymmetric ν_{as} (Si-O-Si) Stretching symmetric ν_s (Si-O-SiIIISiSi)
 Stretching symmetric in plan ν_s Stretching antisymmetric in plan ν_{as}
 Stretching antisymmetric out of plan ν'_{as}

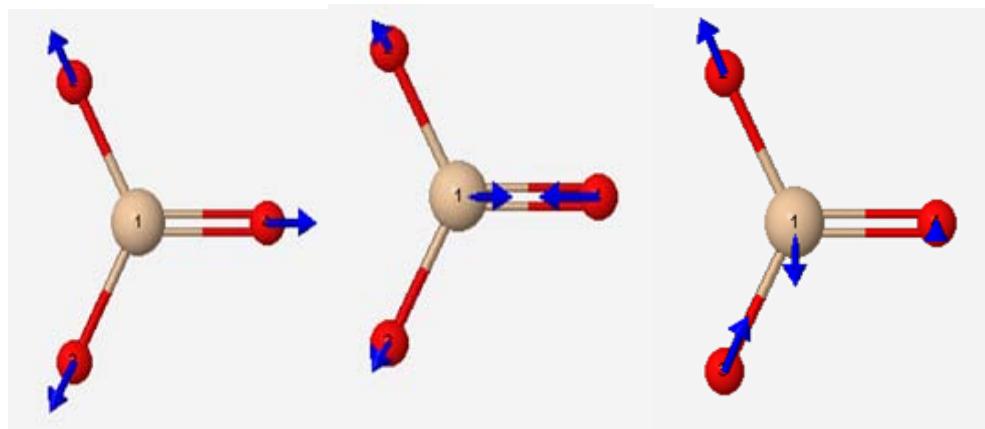


Fig. 1: Lawsonite vibrational modes stretching (vibration of OH, H₂O and Si₂O₇) calculated by PM3 semi-empirical method

As shown in Fig. 1, we have presented the different vibrational modes stretching of natural lawsonite calculated by PM3 semi-empirical method. At most wavelengths, the atmospheric downward radiation is fairly similar to the energy flux emitted by a soil at the ambient temperature. However, this is not true for wavelengths between 769 and 1250 cm⁻¹ (8-13 μ m) where the atmosphere is partly transparent provided that the humidity is low. The transmittance in the wavelength region 769-1250 cm⁻¹, the "atmospheric window", is during the night responsible for the radiative cooling phenomenon of infrared (IR) emitting dew condensers. Harvesting dew occurs because the radiation emitted by a dew plate condenser at ambient

temperature is not balanced by the atmospheric downward radiation. By exploiting this window (769-1250 cm⁻¹) one can cool a dew condenser on the Earth's surface by radiating its heat (radiative mechanism) away into cold outer space. Therefore, we remark that the lawsonite as dew condenser presented seven absorption bands in the 769-1250 cm⁻¹ region due to vibrational behavior of Si₂O₇ structural group. The higher emissivity of lawsonite as dew condenser in the atmospheric window involves its higher rate of cooling by radiation [15]. In Table 1 are report summary Raman and IR vibration modes of natural lawsonite in the atmospheric window 769-1250 cm⁻¹.

Table 1: Vibrational IR and Raman frequencies of natural lawsonite, symmetry types and possible assignments in the 769-1250 cm⁻¹[15]

Frequency IR (cm ⁻¹)	Frequency Raman (cm ⁻¹)	Symmetry type	Assignments
622	694	A _g	ν_s (Si - O - Si)
1030	1047	B _{2g}	ν_{as} (Si - O - Si)
888	916	A _g	ν_s (SiO ₃)
---	912	B _{2g}	ν_s, ν_{as} (SiO ₃)
950	963	A _g	ν_{as} (SiO ₃)
---	959	B _{1g}	ν_{as} (SiO ₃)
923	936	B _{3g}	ν_{as} (SiO ₃)

b) Dew model description

The dew plate condenser in our model is an inclined collector sheet of natural lawsonite mineral

(Fig.2). The parameter values used in our dew formation model are tabulated in table 2.

Table 2: Some parameters used in dew model[15]

Parameter	Value
Sheet specific heat capacity Cc871J kg ⁻¹ K ⁻¹	
Sheet density ρ_c 3100 Kg m ⁻³	
Sheet IR emissivity	0.83

It was difficult to grind lawsonite because of its hardness (Tab.2); for that reason, flat lawsonite pieces were chosen in the dew harvesting model.

Table 3: General mineral information

Specimen	Chemical formula	Hardness
	$\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2 \bullet \text{H}_2\text{O}$	8

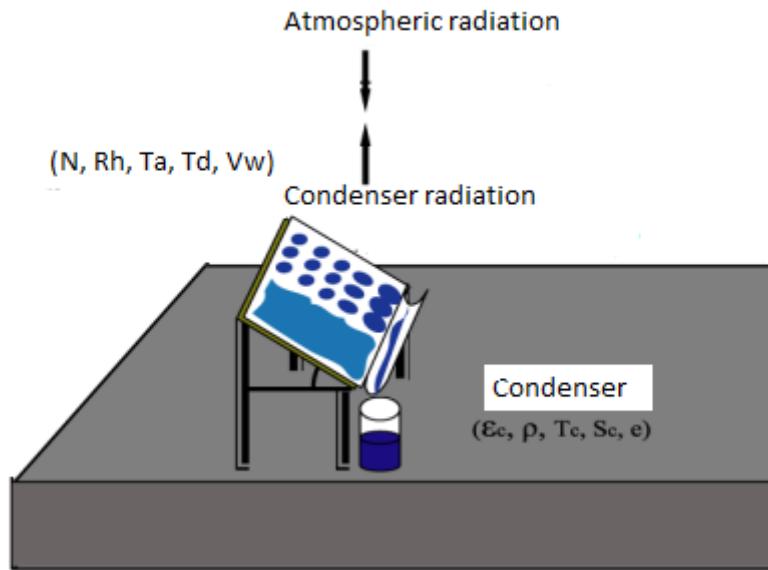


Fig. 2: Harvesting dew model

In implementing the model that describes the harvesting dew, we followed the approach presented by Nikolayev et al., Wahlren, 2001, Jacobs et al. and O. Clus[16-20]. The heat energy balance as given by the following equation:

$$\left(\frac{dT_c}{dt}\right)(MC_c + m_w C_w) = q_{IR} + q_{cd} + q_{conv} + q_{cond} \quad (1)$$

where T_c , M and C_c are the dew condenser's temperature, mass and specific heat capacity, respectively. The dew condenser's mass is given by $M = \rho_c S_c \tau_c$, where ρ_c , S_c and τ_c are its density, surface area (square meter) and thickness (see Table 1). C_w and m_w are the specific heat capacity and mass of water, representing the cumulative mass of dew water that has condensed onto the collector sheet (Fig. 2).

q_{IR} , q_{cond} , q_{cv} and q_{cd} describe the powers involved in the heat exchange processes. The radiation term, q_{IR} is given by

$$q_{IR} = R_l - R_c = S_c \varepsilon_c \varepsilon_s \sigma (T_c + 273)^4 - S_c \varepsilon_c \sigma (T_c + 273)^4 \quad (2)$$

where R_l and R_c are the incoming thermal infrared radiation flux from the atmosphere and the outgoing radiative power from the dew condenser, respectively. ε_c and ε_s are the condenser and the sky emissivity.

Returning to Eq. (1), the term q_{cd} describes the conductive heat exchange between the dew condenser surface and the ground (blackbody). We assume perfect insulation; the conductive heat exchange is negligible.

The convective heat-exchange term q_{conv} , is given by:

$$q_{conv} = S_c h_c (T_a - T_c) \quad (3)$$

$$h_c = Kf \left(\frac{V}{D}\right)^{1/2}$$

where T_a is the ambient air temperature and h_c is the heat transfer coefficient [21].

The final term in Eq. (1), q_{cond} , represents the latent heat released by the condensation of water:

$$q_{cond} = \lambda_c \left(\frac{dm_w}{dt} \right) \quad (4)$$

λ_c is the specific latent heat of condensation for water

For the rate of condensation, we can write a mass balance equation by the following relationship:

$$\frac{dm_w}{dt} = S_c \alpha_m [P_{sat}(T_d) - P_c(T_c)] \quad (5)$$

$$P_{sat}(T_d) > P_c(T_c); \text{ If not } \frac{dm_w}{dt} = 0$$

α_m is the mass transfer coefficient.

$P_{sat}(T_d)$ is the saturation pressure at the dew point temperature.

$P_c(T_c)$ is the vapor pressure over the condenser sheet. The dew point temperature T_d is defined by [22]:

$$T_d = T_a - (14.55 + 0.14T_a)(1 - 0.01RH) \quad (6)$$

where RH is the relative humidity.

II. RESULTS AND DISCUSSION

The average of relative humidity (R_H) in the Mirleft region is about 80.6% for dry season but reaches 5% for the wet season. In table, 4 we present the key statistics of the daily average of the day and night average, maxima and minima[22].

Table 4: The relative humidity (R_H) data during the dry and wet seasons[23].

R_H (%)	Daily	Daily maximum	Daily minimum	Diurnal	Nocturne
Dry season					
average	80.6	88.7	69.6	77.9	83.6
Wet season					
average	75.8	86	63.7	75.7	76.7

The daily wind speed recorded at the Mirleft station does not exceed 2.4 m s^{-1} . Low speed wind was found at the night during the study period with

an average of 2.2 m s^{-1} . In wet season, wind speed (ms^{-1}) is generally less than that of the dry season (ms^{-1}).

Table 5: The wind speed data during the dry and wet seasons [23].

Wind speed (m s^{-1})	Daily	Daily maximum	Daily Minimum	Diurnal	Nocturne
Dry season					
Average	2.47	4.98	0.46	2.65	2.25
Wet season					
Average	2.08	4.49	0.16	2.19	1.93

Dew water is influenced by ambient temperature T_a , dew temperature T_d , dew condenser temperature T_c and other metrological factors. Cumulative dew was calculated hourly for 12 h period (per night) as a function of temperature dew condenser is shown in Fig. 3. It shows that the effect of dew plate condenser temperature (T_c) on dew formation (m_c) per night is linear for all parameters combination employed. Fig.3 illustrates also that dew formation declines linearly with dew condenser temperature. The amount of condensed water obtained varied from 0.56 to 1.67 L/m^2 per night as a function of dew condenser temperature T_c . For the given dew condenser, creating an imbalance between the incoming thermal radiation from the sun and the outgoing thermal radiation from the surface dew condenser through the transparency window ($8-13\mu\text{m}$), is key to achieving dew condensation. The algorithm imposes an approximate relation condition, with T_a and T_d , provides a reasonable estimation of dew occurrence [24-25]:

$$T_a - T_d < T_c < T_d \quad (7)$$

This condition cannot be used to estimate the cumulative dew; however; it can give a good estimation of its occurrence. Condition (7) can be expressed as a condition on relative humidity ($T_a - T_d$ corresponds to relative humidity [25]) and condensation occurrence when the temperature of the dew condenser (T_c) is below the dew point temperature (T_d).

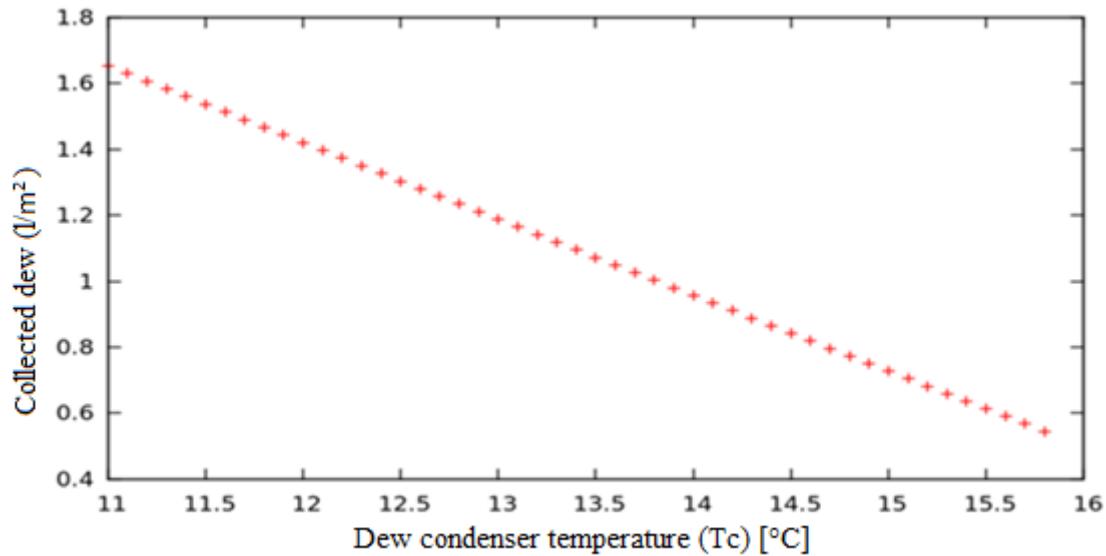


Fig. 3: Collected dew in relation to dew condenser temperature

Figure 4 illustrates the sensitivity of the modelled dew formation to changes in the dew condenser thickness at different values of dew condenser temperature. The effect of dew condenser temperature is more complex: increasing the dew condenser temperature reduces the collected dew,

whereas decreasing the dew condenser temperature increases convective heating. Collected dew declines linearly with dew condenser thickness. It has a big influence on collected dew for both cases: T_c decreases or increases.

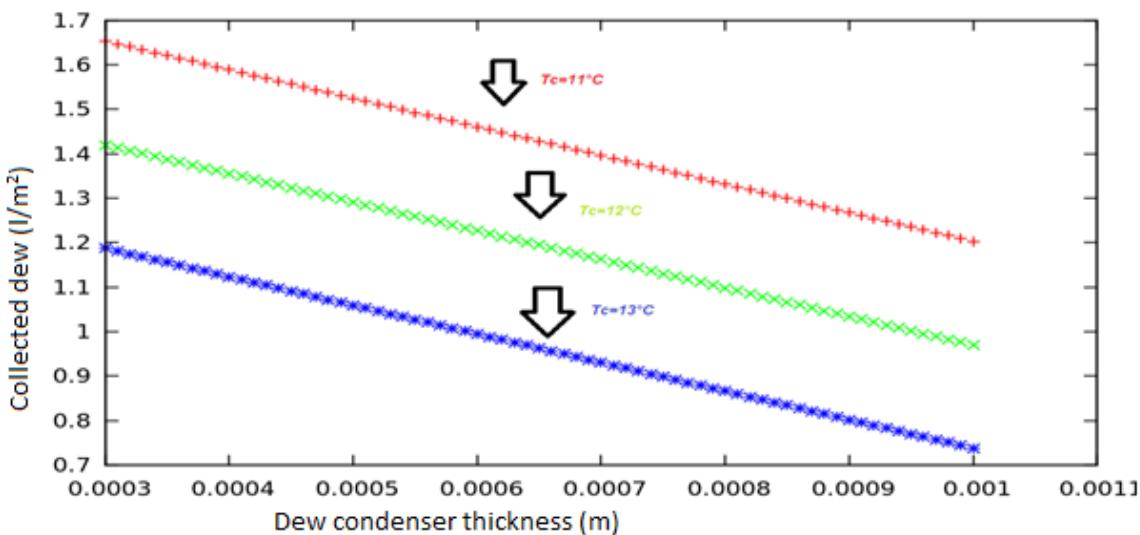


Fig. 4: Effect of dew condenser thickness on collected dew at different values of condenser temperature

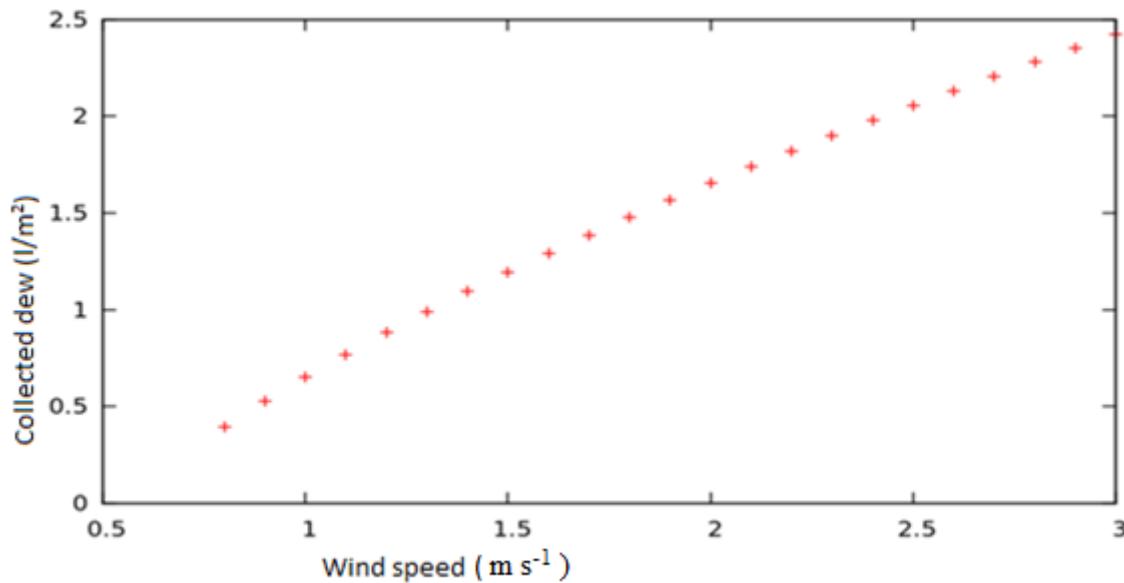


Fig. 5: Collected dew as a function of wind speed

Figure 5 shows that the effect of wind speed on dew formation is non-linear. The effect of wind speed on dew formation (Fig. 5) is more complicated than that of the dew condenser thickness and dew condenser temperature parameters just discussed above. Beysens et al found that the wind speed of 0 m s^{-1} is the threshold for dew occurrence [25]. However, Monteith found that the dew formation is negligible when the wind speed drops below 0.5 m s^{-1} , and that the dew formation increases when wind speed is $2-3 \text{ m s}^{-1}$ [26]. We observe that collected dew increases with wind speed up to a certain value of $V=3 \text{ m s}^{-1}$ and then decreases again. Similarly, the wind speed of 0.5 m s^{-1} is the threshold for dew occurrence.

III. CONCLUSION

The numerical simulations for dew formation on lawsonite collector sheet were investigated by implementing a dew collection model based on solving the energy balance equations. We show that dew collection yield depends on several meteorological factors such as relative humidity, cloud cover and wind speed. On the other hand, we observe that dew collection yield depends also on the dew condenser thickness and dew condenser temperature. The result obtained is that the lawsonite sheet condenser collected between 0.5 and $0.165 \text{ L/m}^2/\text{night}$ of water. The lawsonite thin film has high emissivity across $8-13 \mu\text{m}$; which indicates that it can be used as good radiative cooling and dew water condenser mineral. Further experiments and numerical simulations are required for new minerals that can increase dew collection yields.

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Frictional Heat Generation and Geothermal

By Li Xuefeng

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GJSFR-A Classification: DDC Code: 813.54 LCC Code: PS3552.R718



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I. THE ESSENCE OF FRICTIONAL HEAT GENERATION

When we were young, we often played the game of smashing sparks at night, that is, smashing the small stone in our hand on the big stone, you will find that if there is sliding, the spark will be very small, and the spark will be when it touches will be great. This is in great contradiction with the theory of frictional heat generation that we have learned. Is there any other explanation? The current popular explanation, the energy transformation of objects. If we must understand in this way, we will further consider how these energies are converted from kinetic energy to heat energy of molecular motion.

To talk about the essence of frictional heat generation, we must first talk about the essence of friction. The relative motion of two objects forms friction. From a macro perspective, the relative motion of two objects is the relative displacement of the two contact surfaces. From the perspective of microscopic particles, it is the relative displacement of the two particle clusters. The contact surface of the two particle clusters has obvious unevenness, and friction is the mutual collision of the convex parts of the contact surface. And the essence of the collision, we can infer that it is the pressure generated by the particles in the contact part. It can be considered that the essence of friction is: the pressure generated by the collision between the particles of the convex parts of the two relative motion contact surfaces. From the point of view of weak gas pressure, the molecular kinetic energy is increased, the molecular oscillation is intensified, and the radiation energy is increased. From the perspective of high-intensity pressure, just like the principle of proton collider, proton collision produces the same effect of splitting, resulting in great atomic splitting and releasing a lot of energy. Therefore, the heat generated by friction is generated by the strong pressure between the contact parts. When the pressure is strong, the particle structure

can be broken and changed, resulting in breaking excitation, thereby releasing a large amount of energy.

From the calculation point of view, the frictional heat generation Q , is proportional to the contact surface pressure, P and speed V . It can be seen from this that pressure plays a decisive role in frictional heat generation. The pressure formula for the collision of moving objects, $p=mv/st$. m is the mass, V is the decrement in velocity, s is the contact area, and t is the action time.

Substituting the data in can calculate the pressure at the touch. This formula extends to collisions between small particles and can be transformed into $p=mv^2/r^2$. V is the velocity and r is the particle radius.

Why, when there is a lot of stress, energy is generated? This is the scope of solid-state physics research. Strictly speaking, I don't know. I only talk about my own feeling and understanding.

'We know that there are a large number of high-speed moving electrons around each atomic nucleus. Although two relatively stationary objects are stationary when viewed as a whole, they still have high-speed electrons at the level of the atoms in the contact surface and relative motion. As long as the pressure is large enough to make the two particles come into close contact with each other, breaking the respective laws of motion of electrons around their nuclei, the particle structure will change, resulting in mass-energy conversion to release energy. This is the essence of frictional heat generation.

We know that there is a large space around the nucleus, and there is a magnetic field generated by the movement of electrons. When the pressure on the material is greater than the binding energy, the normal feeling is that the object begins to change in shape or diffuse and slide around. But what happens if there is no room for activity? Let us boldly imagine that matter begins to compress space. At first, it compresses the circulation space of magnetic field lines around the nucleus. The magnetic cycle of a single atom cannot be completed, and the large cycle of the magnetic field of matter is forcibly completed, and the magnetic energy is collectively released to the outside, forming external magnetism. In the past, matter had no magnetism, because individual particles had their own magnetic cycles and exhibited random magnetism to the outside world, so there was no magnetism. Under the action of pressure, the magnetism is concentrated and released in a concentrated direction, so it appears magnetic to the outside. This is the principle of the formation of

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magnetism, and the magnetism of geomagnetism and stars is formed in this way. This is my reasoned understanding of the formation of the Earth's magnetic field, and I hope you can refer to it.

Under the pressure of the magnetic cycle, the pressure continues to increase, and the electron circulation around the nucleus is blocked. In order to achieve the cycle, the atom releases a part of the energy ions to keep itself intact. Due to the release of heat energy, the object begins to heat up, and as the pressure continues to increase, the material slowly liquefies, then vaporizes, and finally completes ionization. Continuing, the ions begin to decompose. First, the large ions are decomposed into small ions, and the small ions continue to decompose into a soup composed of protons, neutrons, and quarks. Finally, the quantization is completely decomposed, and the energy generation process of a star is completed. The reaction of protons in the ion soup of proton quarks is the pattern in the proton collider. The ions collide with each other and break apart, forming smaller ions.

Triboelectricity is a phenomenon we all know, and the phenomenon of stone tip sparks shows that there is an ultra-high temperature energy release process at the stone tip. The power of one person completes the spark of the stone tip, the power of the earth's plates, produces a volcanic eruption, and the power of the earth has geothermal heat. This is what I know about the source of the earth's heat.

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2. Three properties of matter.

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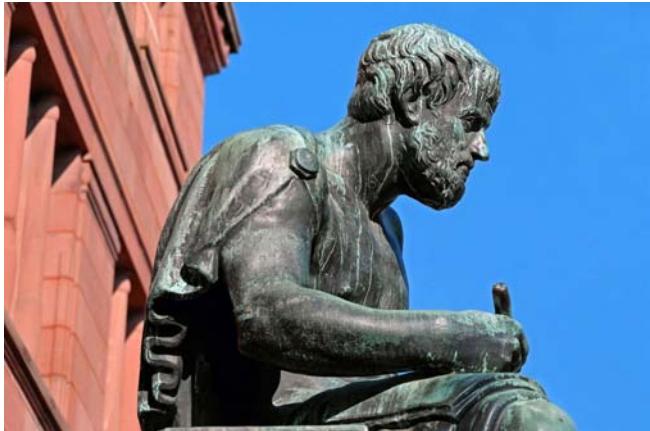
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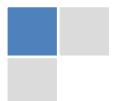
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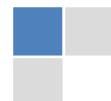
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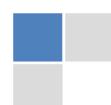
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1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

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3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference material and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

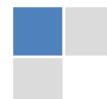
- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

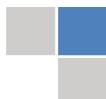
Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

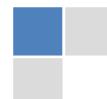
If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	C-D	E-F
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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