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Asynchronous Electric Drive

Discernment About Dark Matter

Highlights

General Theory of Black Holes

New Quantum Model of Mass Evolution

Discovering Thoughts, Inventing Future

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Monologue of Discernment about Dark Matter

By Francesco Pia

Abstract- The aim of this work on DM is to confine it whether it belongs to the dark periodic table or is part of a single very small dark element as mentioned in *[10]* making it possible to improve the works presented by the undersigned in the bibliography for example teleportation *[7]* could be improved with elements inserted in a certain way from the dark periodic table: in the *W* spiral of the classical periodic table, or in the antigravity '*Poynting vector*' in *fig. 3 [5]*.

Keywords: *artificial intelligence vs multiple sclerosis.*

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Monologue of Discernment about Dark Matter

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Keywords: artificial intelligence vs multiple sclerosis.

I. Introduction

In this work we propose to use artificial intelligence and the seed of discernment [12] to evaluate whether the dimension we found in the previous work [10] by varying its dimensions in the "bucolic" equation and how the size of the dark matter particle varies accordingly; but, if this dimension wanted to vary more or less gradually as the atomic numbers of the periodic table can be gradual, therefore relating to the hypothetical periodic table of dark matter; or, if we discover that by varying even the size of the drop, in this case, the other dimension varies so little that it could be said that dark matter is made up of a single element.

II. Methods and Tools

This is, let's say, the main objective: is dark matter made up of several elements or a single element? One of the key steps to resolve this dilemma is to confine the dark matter: what if it appears intangible?

Confinement could then be achieved if we could construct objects made of dark matter from the dark periodic table; or, for example, by taking the hypothetical iron elements, which would presumably confine the dark oxygen elements.

Well, this is, let's say, what we would like to address; otherwise, we would confine the aggregate dark matter. The problem is: how can we aggregate the DM? Since no container exists, since we cannot create the first one; what would we use, in ancient times, to collect some water from the stream? By joining hands! This seems like a fascinating problem for us, because a virtual container that would confine the DM could be part of a "single element" or a dark table or a virtual container; a container that creates movement and confines the DM in a restricted environment, so for example, a solenoid that would act on iron: how can I block the dark iron? Drip it, grill it, making it a little more tangible, less obscure? Or with a thermal chamber or ice, which would likely carry elements of dark iron.

Using the double NN with the seed of discernment to discern whether the DM is a single element or belongs to different elements, thus constituting the hypothetical so-called 'Dark Periodic Table' determinable thanks to the variation in the diameter of the bucolic inputs 'drops' and the cosmological outputs, and therefore verifying the functioning of the neural network and what it would tell us: we would have certain elements available to us and we would teach the NN that certain atoms belonging to the classical periodic table such as air, water, etc., etc., and with the elements of the dark periodic table. This is a very important leap, because it would mean that we could insert a dimensional factor into the DM to be able to observe if what we are saying has a certain validity, otherwise it would be like saying: there is a certain distance between the elements of the same "dark" periodic table, however, we are not sure, if instead we assign a dimensional factor to the DM as input to the NN then yes, we could use it as a seed of discernment to observe if the AI answers us affirmatively: the DM is most likely made up of different elements, or no: the DM is made up of a single element.

This, just said, appears to be the main objective, other objectives will not be considered.. One could create a table with different "drops" of water and observe whether the dimensions of the DM vary greatly and whether this variation can be interpreted with the scale factor, from classic training elements of the classical periodic table; there shouldn't be many problems with generating the database, because it is the concept, the idea seems viable. We don't want to use a NN in reality, it would be absurd and unsustainable for the modest computer apparatus we have at our disposal, but it could be done: using a NN to try to understand if a dark periodic table exists or not, we discern this characteristic of the DM; like, by training a NN with a scale factor when we treat the DM (to be optimized, for example 10^18) take "for granted" that the most probable drop *[10]* that, not accelerating while falling from the sky, has a diameter of 3 mm, and the galaxy particle has an average size as in *[10]*, the NN does not have to do a 'terrible' job on this difference between the input of the classical periodic table and the input of the dark periodic table; the scale factor should be in favor of the one observable in the classical sense, better a scale factor that greatly enlarges the elements of the DM. As depicted in the next figure *fig. [1]*.

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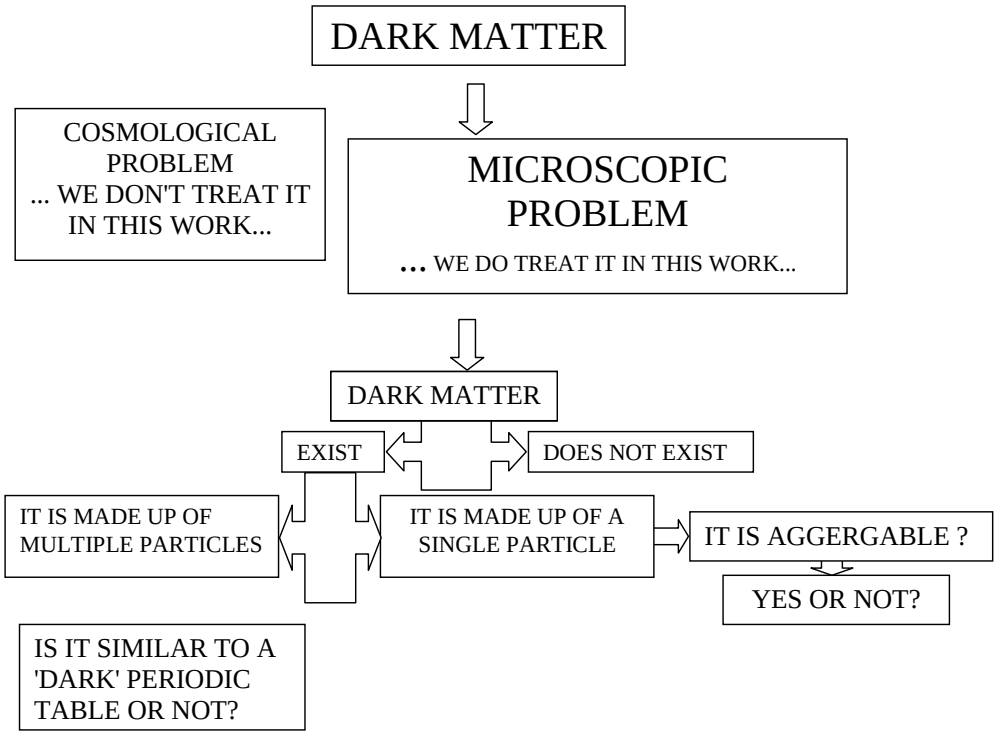


Fig. [1]: Representation of the different possibilities regarding the DM

Talking about dark matter is very fascinating because if one tries to study it from videos, on social media, one realizes that almost everyone feels its presence but no one can observe it: why? It does not interact with light, with other matter, it does not interact with anything. We have published an article *[10]*, the problem that we want to address now is (the confinement of dark matter) because the dimensions have been calculated; therefore, now remains, as they say, giving variations in size to the observed objects in a "bucolic" way to calculate the approximate size of the dark object which fortunately is larger than the Planck constant and is smaller than the smallest "observable" element: it is in the middle.

By varying, the *bucolic*, observation of the object that allowed us to formulate a proportion, looking at the Milky Way, let's say, because in every galaxy the presence of this dark matter is felt. Therefore, by varying the size of the drop falling through the atmosphere, everything changes, and thus a new periodic table can be constructed. Let's say, how can we confine it? It passes through traditional matter, doesn't interact with light, and no one "sees" it.

So, the ideal scenario would be, if we could confine it... to group it; like, for example, two drops of lead (*Pb* with atomic number Z=82) that, when heated until they melt, and brought together, merge into a single, more observable "drop." These considerations must be made, basing everything on classical physics techniques for the movement of matter, with the hope that we are discussing a hypothetical periodic table of dark matter: a set of elements that "correspond" phenomenologically, etc., to lead, iron, carbon..... The problem is how to confine them, how can we unite two dark matter elements of the same "type" or group them together if they are identical in constitution if this hypothetical dark periodic table does not exist. The fundamental problem that follows is to maintain a line of investigation in which we can assume the existence of a dark matter periodic table and its non-existence; that is, dark matter elements that do not have periodic characteristics.

An important aspect of dark matter is that one could calculate, in principle, the mass: by averaging the elements of the periodic table, the average density, the average radius, and then in addition to the weight also whether or not it belongs to a periodic table since only gravity exists which is inherited from a cosmological concept and, let's say, it is also valid for the microscopic aspect treated in this work.

The only solution for the confinement of DM is a DM container, so its aggregation for now remains the only way to contain it, therefore CHANDRA 2.0 or WEBB 2.0 telescopes; we need their layouts or to redesign them and put them into orbit with the necessary appropriate modifications: to be able to affirm its existence, whether there is a periodic table of DM or it is a single element.

Since the graviton doesn't help, let's say made up of lattices of atoms, it could, in the case where the DM passed through the orbitals, that would be a problem that could only be discovered by an extra-

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atmospheric examination, because since there is less mass, if there is DM it passes through the objects and therefore classical methods can be used, such as condensation, slowing down, aggregation, classic methods from the 1800s or thereabouts.

Some works published by the undersigned would be more feasible thanks to the possibility of manipulating the DM, such as antigravity *[5]* or teleportation *[7]*.

III. Conclusion

An important aspect of MD is that one could calculate, in principle, also the mass, by averaging the classical periodic table and the various densities and comparing it with the average radius; and then, in addition to the average weight, also the belonging or not to a periodic table; considering that the only thing common to the two matters is the gravity inherited from a cosmological vision and therefore also valid for a microscopic vision...

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General Theory of Black Holes (Preliminary Draft)

By Stuart Edward Boehmer

Abstract- We discuss corrections to the mainstream theory of black holes and stars.

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General Theory of Black Holes (Preliminary Draft)

Stuart Edward Boehmer

Abstract- We discuss corrections to the mainstream theory of black holes and stars.

I. Introduction: Two-Dimensional Riemann Geometry

a) Euclidean Space

The distance between two points separated in the Cartesian coordinates, (X,Y), by (dX,dY) is,

$$\delta s^2 = dX^2 + dY^2.$$

Transforming to curvilinear coordinates, (u,v), we have,

$$\delta s^2 = \left[\left(\frac{\partial X}{\partial u}\right)^2 + \left(\frac{\partial Y}{\partial u}\right)^2\right] du^2 + 2\left[\frac{\partial X}{\partial u}\frac{\partial X}{\partial v} + \frac{\partial Y}{\partial u}\frac{\partial Y}{\partial v}\right] dudv + \left[\left(\frac{\partial X}{\partial v}\right)^2 + \left(\frac{\partial Y}{\partial v}\right)^2\right] dv^2$$

$$\coloneqq g_{mn} du^m du^n.$$

b) Non-Euclidean Space

Generally speaking, where we call the X_m^r the tetrads, defining the directions δX^r, where now the δX^r are differential forms and not, as in the Euclidean case, exact differentials of quantities, X^r, where,

$$\delta s^2 = \delta X^2 + \delta Y^2 = \delta_{rs} X_m^r X_n^s du^m du^n \coloneqq g_{mn} du^m du^n.$$

The boundary conditions on a real two-dimensional Riemannian space is that the coordinates, (u,v) and the tetrads be real and nonsingular functions, and that g_{mn} be of full rank (rank two).

Moreover, the conditions on the space being extended into a certain region is that the gmn have signature (+1,+1), that is, they are given by the expression implied by the above relation.

Therefore, if we solve the eigenvalue problem, $g_{mn} U^n = \begin{bmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{bmatrix} \boldsymbol{U}$, and either of the eigenvalues, λn, equals zero, and g_{mn} is of rank one. The corresponding point is a pole of the coordinate system.

For example, in polar coordinates in Euclidean space, $\delta s^2 = dr^2 + r^2 d\theta^2$, and the eigenvalues of gmn are 1 and r^2. When $r^2 = 0$ (or $r = 0$), that is the origin of coordinates is a pole of the coordinate system. No one has ever suggested that the space could be extended into regions below $r = 0$ where r was imaginary and the signature of gmn was (+1,-1) and θ was in some sense time-like. No one has ever even suggested that regions where r was real and < 0 exist (even though the signature of g_{mn} would remain (+1,+1)). *Any* pole of the coordinate system—defined by one of the eigenvalues being zero—is similar to this elementary pole: it represents a terminus of the coordinate system. (By the way, of course we are *not* using the word "pole" in the sense of the theory of functions of a complex variable, that is, as an infinity of a function asymptotically equal to some negative integral power of z, but in the sense of "the North Pole.") Some coordinate systems (exempli gratia, Cartesian coordinates in a Euclidean space) do not have any poles, while others (polar coordinate system on a Euclidean plane or the axis of spherical polar coordinates in Euclidean space or the latitude-longitude coordinate system on a spherical surface) do. Everyone understands this in the context of ordinary geometry, but the mainstream scientific community seems to be confused about this in the context of general relativity and space-time geometry, as we will examine at greater length below.

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By the way: the resolution, $\delta s^2=\delta X^2+\delta Y^2$, for a general Riemannian space is correct, because Riemann assumed that at any point, g_{mn} could be locally transformed to the form δ_{mn} by a coordinate transformation.

Note: in this paper, our practice is to denote exact differentials by the symbol "d" and differential forms by the symbol "δ." Thus, an exact differential, df, can be integrated to give a well-defined function of the coordinates, f(u,v), which is not path-dependent, while integrating a differential form, δf, would generally yield a result dependent upon the path, C, between the endpoints $(u_0,v_0),(u_1,v_1)$. Thus, for example, we denote the spatial distance differential by δs rather than ds because the distance between two points was proven by Euclid to be path dependent: the distance between two vertices, A, B, of a triangle ABC is always shorter if we go directly along the line connecting A and B than if we take the route from A to B through C—something that Epicurus said Euclid hadn't needed to "prove" because this fact was known already to an ass. Place an ass at point A, some fodder at point B, and when the ass becomes hungry, he will not proceed along the route through C!

c) Relativistic Space-Time

Here, we must have the space-time metric, $G_{\mu\nu}$, resolvable into the form $\eta_{\rho\sigma}X^{\rho}_{\mu}X^{\sigma}_{\nu}$, where the tetrads, X^{ρ}_{μ}, and the coordinates, w^{μ}, are real and non-singular, and,

$$\eta_{\rho\sigma} \coloneqq \begin{bmatrix} -\delta_{mn} & 0 \\ 0 & c^2 \end{bmatrix},$$

that is, $G_{\mu\nu}$ must possess signature (-1,-1,-1,+1), and points where its signature degenerates into, for example, (-1,-1,-1,0) (where one of the eigenvalues of $G_{\mu\nu}$ becomes zero) are poles of the coordinate system, not regions of transition to realms in which $G_{\mu\nu}$ has the signature, for example, (-1,-1,-1,-1) and the time variable becomes somehow spacelike, or signature (-1-1,+1,-1), where the rôles of space and time are mysteriously reversed and exotic physical effects occur.

II. Schwarzschild Point Mass Solution [Schwarzschild, *Sitzungsberichte*, 1916, p. 313]

The space-time line element is given as,

$$\delta\sigma^2 = c^2(1-2GM/c^2\hat{r})(du^0)^2 - \frac{d\hat{r}^2}{1-2GM/c^2\hat{r}} - \hat{r}^2d\theta^2 - \hat{r}^2sin^2\theta d\varphi^2,$$

where we have denoted by the symbol $\hat{r}$ what Schwarzschild denoted by r, reserving the symbol r for the radial distance from the point mass singularity at the origin,

$$r = \int \frac{d\hat{r}}{\sqrt{1-2GM/c^2\hat{r}}} = \int \frac{\sqrt{\hat{r}}d\hat{r}}{\sqrt{\hat{r}-2GM/c^2}},$$

which is an elementary quadrature that can be looked up in standard tables.

One eigenvalue of $G_{\mu\nu}$ is G_{00}, which equals zero when $r*=2GMc^2$. This is therefore a pole of the coordinate system, the origin of coordinates, and not a surface at some remove from the physical mass-point singularity at the origin, but coincident with it. There is no space-time in the region $\hat{r}<2GMc^2$ - no baby universes, time warps, multiverse or any other such stupidities. The point $\hat{r}=2GMc^2$ is a pole of the coordinate system coincident with and identical with the point $r=0$. The relationship between $\hat{r}$ and r is that of a coordinate transformation. There is no region in real space-time corresponding to $0\leq\hat{r}\leq2GMc^2$, nothing lying below the point $\hat{r}=2GMc^2$ any more than there is a region $r<0$ below the pole of the polar coordinates of the ordinary two-dimensional Euclidean plane. I appear to be the first person with a clear understanding of this trivial fact, amazingly enough, after 109 years of research by supposedly brilliant minds.

There are other poles at $\hat{r}^2=0$ and $\hat{r}^2sin^2\theta=0$; that is, $\hat{r}=0$ and $\theta=0,\pi$. The one at $\hat{r}=0$ is superceded by the one at $\hat{r}=2GMc^2$; that is, it is never realized because there is no space below the pole at $\hat{r}=2GMc^2$.

Writing,

$$r = \int_{2GM/c^2}^{\hat{r}} \frac{\sqrt{r'}dr'}{\sqrt{r'-2GM/c^2}},$$

we see that the point $\hat{r}=2GMc^2$ is coincident with the origin, r = 0—just another coordinate representation of the origin.

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The function r(r̂), or its inverse r̂(r), defined by the relation (1) is just a coordinate transformation between r and r̂ and the point a the origin can be equivalently represented by the equation r = 0 or r̂ = $2GMc^2$—it is the same point, just by two different names.

Moreover, interpreting the equation of motion of a particle subject only to gravity,

$$\ddot{u}^{\mu} + \Gamma^{\mu}_{\rho\sigma}\dot{u}^{\rho}\dot{u}^{\sigma} = 0,$$

we see that it is appropriate to define the gravitational field strength as $g^m = -\Gamma^m_{00}$, which in this case leads to $g^1 = -\frac{c^2\partial G_{00}/\partial r}{2G_{00}}$. This can be seen to lead to the correct Newtonian Limit ($c\to\infty$). Then at the point where G_{00}=0 we see that the gravitational field strength becomes infinite—another impossibility.

Moreover, there is the following curious effect of the singularities at the origin, r = 0, r̂ = 2GM/c^2:-

The radius of the point is zero, but the equatorial circumference, $\int_0^{2\pi}\hat{r}d\varphi = 4GM/c^2$, is finite. Not only is there a singularity in the gravitational field strength here, but—more relevantly, there is a singularity in the spatial Ricci curvature, a singularity in the structure of space itself (this is due to the fact that the density is a Dirac delta function, infinite at the origin and zero everywhere else; calculations of my own indicate that the spatial Ricci curvature of a static, rotationally symmetric solution of the Einstein Field Equations is $16\pi G\rho/c^2$. This calculation is confirmed by Schwarzschild's result that the spatial radius of curvature of the distributed mass solution [dicussed in section III, below. It corresponds to the section of a hypersphere.] is $R=\sqrt{3c^2/8\pi G\rho}$, while the Ricci curvature [the contraction of the spatial Ricci tensor, that is the Ricci tensor calculated with the spatial metric rather than the space-time metric] is $6/R^2$).

Point particles simply cannot occur in Nature—not only do they introduce infinities in the gravitational and electromagnetic field strengths, but, as we see here, they also introduce singularities into the very structure of space. And, any particle has a gravitational field, described by general relativity, even if it may be of small enough magnitude that it may be ignored in practical calculations.

It is well known, for example, that if we attribute a finite, non-zero radius to the electron, the renormalization infinities appearing in quantum electrodynamics disappear because it introduces an upper energy cutoff (caused by the uncertainty principle: a small, nonzero, Δr leads to a large Δp_r in the momentum, and therefore a related one in the energy) in the relevant energy integrals.

Point particles do not occur in Nature, categorically. End of story. They exist only as mathematical abstractions, and even that leads to difficulties, as we see here. Let us therefore banish the use of them from fundamental theories! This means that even elementary quantum mechanics needs to be repurposed (the particles are point particles; it is only their probability distribution, $|\psi(\boldsymbol{x},t)|^2$, that has a finite Δx).

Therefore, the mainstream picture of what a point-mass black hole is has been completely transformed with a few strokes of the pen, and much of what has been written on this subject has been shown to be rubbish. There are no event horizons, baby universes, time warps or multiverse. The eminent scientists who promulgated this sort of garbage (and we know who their names are!), really should have exhibited a little more common sense. I always have—I have been posting articles online for years stating my suspicions that there are no true black holes in Nature. It is only now that I can defend my opinions against those with the most esteemed of credentials with rigorous theoretical arguments.

III. Schwarzschild Distributed Mass Black Hole or Star [Schwarzschild, *Sitzungsberichte*, 1916, p. 424].

Introduction:

Of course, there are no point masses or singularities in Nature, so rather than the theory of § II, we must use for a more realistic model of a star a distributed mass of finite density and size that contains no singularities.

In 1916, Schwarzschild found such a solution of the Einstein Field Equations corresponding to the section of a hypersphere of radius of curvature $R=\sqrt{3c^2/8\pi G\rho}$ (where ρ is the density of a star, taken to be, for the purposes of modeling, which is at least qualitatively valid, an incompressible perfect fluid) of radius r_a.

The space-time line element for this solution is,

$$\delta\sigma^2 = c^2\left(\frac{3cos\chi_a - cos\chi}{2}\right)^2 - R^2d\chi^2 - R^2sin^2\chi d\theta^2 - R^2sin^2\chi sin^2\theta d\varphi^2,$$

where χ_a is a parameter defining the surface of the star.

The poles of the hypersphere are defined by $sin^2\chi$=0 and $sin^2\theta$=0, or χ=0,π; θ=0,π.

In this case, from $dr=Rd\chi$, we have, $r=R\chi$ and $r_a=R\chi_a$.

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Therefore, in this case, we have the following picture: the star is represented by density ρ on the "polecap" of the hypersphere of radius R (actually, πR; that is, more precisely, because $r=R\chi$ and χ extends from 0 to π, r extends from 0 to πR) from $\chi=0$ to $\chi=\chi_a:=r_a/R$, while the outer vacuum solution is found by fitting this solution to the appropriate Schwarzschild vacuum solution (point mass solution outside the ball $r\geq r_a$, with M appropriately chosen to satisfy the boundary conditions [in general, *not* the mass of the star]).

If $\chi a=cos^{-1}(1/3)$ then $G_{00}=0$ at $\chi=0$, which is the pole of the coordinate system. It is also a point where the gravitational field strength $\left(-\frac{c^2\partial G_{00}/\partial r}{2G_{00}}\right)$ becomes infinite. This can never occur; therefore, we have the restriction $cos\chi_a>1/3$, or $\chi_a<cos^{1}(1/3)\sim1.23$, which is a *strict* inequality.

This much was completely understood by Schwarzschild in 1916. His only error was his interpretation of the point mass solution, which I have corrected above.

The mystique vis-á-vis "black holes" remains—to this day—centered on Schwarzschild's incorrect interpretation of the point mass solution. I repeat: there are no event horizons or black holes in the original sense of the term (as something possessing an event horizon). What was imaged in 2019 would, more properly, be called a supermassive dead star.

IV. The Kerr Problem: Rotating Stars. [Reference: Mike Guidry, "Modern General Relativity," Cambridge University Press (2019)]

Many authors (including Guidry) make the erroneous assumption that $g_{mn}=-G_{mn}$, but according to a formula of Tolman ["Relativity, Thermodynamics and Cosmology," Clarendon Press, 1934],

$$g_{mn}=-G_{mn}+\frac{G_{0m}G_{0n}}{G_{00}}.$$

If, based upon this formula applied to the Kerr space-time metric, we calculate the eigenvalues of $G_{\mu\nu}$, we find that they are $(-g_{mn}, G_{00})$.

The pole that we are principally interested in is represented by $G_{00}=0$, the ergosphere. Nothing lies below this point (it is a point, not a surface, just as is the case for the point $r*=2GM/c^2$ in the Schwarzschild point mass solution—and it is unattainable, the gravitational field strength being infinite there by very reason of $G_{00}=0$).

Calculating g_{33} on the ergosphere, we find that it is infinite: the radius of this point is zero, but its equatorial circumference is infinite, while its polar circumference is finite and non-zero! Certainly, a curious mix!

Of course, this represents an unphysical singularity in the structure of space, indicating once again that point particles do not occur in Nature, nor even in an acceptable fundamental theory.

What we need is, of course, a distributed mass, rotating star solution. This remains unavailable to this day.

I think that it is a fair bet that if an analytic solution to this problem existed, it would have already been found—it's been about 62 years since Kerr found his solution.

Therefore, numerical methods/machine computation is probably a necessary approach for this problem, and with that, a solution would be trivial and should be forthcoming shortly (if anyone cares to follow my advice).

Because all supermassive dead stars observed to date have been rotating, this calculation would give refined values of the estimates of their masses.

V. Conclusion

I have been studying black hole theory for many years, finding irregularities now and then, here and there along the way. This month what happened was that I began to understand what I had been doing in bits and pieces, but now I understood it all comprehensively—and a new gestalt formed in my mind. That is what has been accomplished in this paper: the description of a new gestalt, replacing the one that Schwarzschild (erroneously) formed in 1916.

I now understand consciously what I had been saying all along: that there are no event horizons or black holes (in the sense of an object possessing an event horizon), just supermassive dead black stars. No baby universes, time warps, multiverse—in short, no psychotic fantasies.

It took many years to form this gestalt, but when it came together at last, it formed suddenly—like a bolt from the blue. But this was a process having roots going back some thirty years (that is when I first began to seriously investigate the nature of *time* in relativity. My explicit study of black hole theory, motivated by this investigation, began many years later.)

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The most difficult object of the subconscious to disinter is an assumption that we do not even realize we are making—a subliminal assumption, as it were—particularly when its truth is being asserted by all the leading authorities. Who was an ordinary mortal such as myself to go against all *that*?

Psychological experiments have shown that, when presented with two straight lines of obviously unequal length, an individual, who has heard everyone else in the room assert that they are of equal length, will very likely affirm that, yes, they are of equal length, and not merely affirm it, but in fact *perceive* it.

It took me thirty years to come to my senses, and today I shout the obvious: "The Emperor has no clothes!"

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Vysikaylo's Laser for de Broglie Waves of Electrons to Protect the Earth from Asteroids. Interdisciplinary Research of Incongruent Electric Field Shock Waves

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Abstract- We have proposed a mechanism that explains all phenomena observed in nature during lightning propagation and all phenomena during the fall of the Chelyabinsk meteorite in the Russian Federation. These positively charged cumulative-dissipative plasma systems (+CDS), as we have established, are surrounded by incongruent shock waves of the Vysikaylo electric field (VSW). We demonstrate that de Broglie waves of free electrons arising in the plasma tail behind the meteoroid behave similarly to electromagnetic waves in a laser. There, a cumulative jet of high-energy electrons (CJ) is formed, which breaks into the meteoroid, causing it to collapse according to the Coulomb mechanism. The formation of VSW in the atmosphere is due to the peculiarities of the chemical kinetics of negative ions at the boundary of the plasma tail. *The time of Vysikaylo-Poisson's structural turbulence, providing the formation of CJ in the plasma tail, was ≈ 1.5 s.*

Keywords: *cumulative-dissipative systems, entering and runaway electrons, coulomb explosion, asteroid fragmentation according to vysikaylo.*

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VYSIKAYLOS LASER FOR DE BROGLIE WAVES OF ELECTRONS TO PROTECT THE EARTH FROM ASTEROIDS INTERDISCIPLINARY RESEARCH OF INCONGRUENT ELECTRIC FIELD SHOCK WAVES

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Keywords: cumulative-dissipative systems, entering and runaway electrons, coulomb explosion, asteroid fragmentation according to vysikaylo.

I. Introduction

Louis de Broglie suggested: "Particles can behave like waves". The author claims that the movement of free electrons in the plasma trail of the asteroid is similar to the movement of electromagnetic waves in a laser. As a result, a CJ occurs, which catches up with and explodes the asteroid. *The time of Vysikaylo-Poisson's turbulent relaxation, which ensures the formation of CJ in the plasma tail behind the Chelyabinsk asteroid, was≈ 1.5 s.* These phenomena occur when the energetic threshold is reached. In the case of the Chelyabinsk asteroid, its energy was sufficient to form CJ that fragmented the asteroid when it hit from behind using a Coulomb explosion. We have calculated the velocities of meteoroids and asteroids necessary to generate such processes. We have proved that the virial theorem is performed in this process: half of the asteroid's total kinetic energy (converted into capacitor energy) is spent on creating a CJ catching up with the asteroid, and the other half is spent on ejecting positive ions along the plasma tail behind the meteoroid, in the direction opposite to its movement. The process of transforming the kinetic energy of the meteoroid into the energy of a radial capacitor and, during its breakdown, into the electric energy of a polarized electric cord - an analogue of linear lightning - is considered. Electrons escaping from the trail create a positive Coulomb barrier similar to that which occurs in ordinary lightning [1]. This barrier leads to radial self-focusing (cumulation) of the trail.

Based on this, a *new 4D cumulative-dissipative inertial-polarization-wave mechanism for fragmentation of asteroid, meteoroid and comets was proposed and investigated*. This mechanism is based on a similar behavior of electrons in pulsed lightning from negatively charged clouds [1-3]. The formation of a CJ in front of a pulsed lightning was studied in the experiments of Shenland [4]. A explanation for such behavior of lightning was first given in [1]. Based on the model [1] and the results of observations of the Chelyabinsk meteoroid, I developed a theoretical concept that explains all the accompanying processes.

a) Date and methods observations of events near chelyabinsk

On 15 February 2013, NASA scientists reported that an explosion near Chelyabinsk. As is known [5], sensors installed on geostationary satellites operating in

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the interests of the US Department of Defense and Department of Energy can track both airborne nuclear explosions and measure the luminosity curves of fireballs burning up in the atmosphere. On 1 March 2013, NASA became aware of updated data on the total luminosity of the super-bolide, which amounted to E_0 = 3.75 10^{14} J or 90 kt, from which, according to the empirical formula for the total energy of the explosion, follows $E = 8.2508\ E_0^{0.885}$, which is 440 kt. The speed of the fireball according to the same data at the moment of maximum brightness was 18.3 km/s, and the event occurred at an altitude of 23.3 km. The estimated mass and size of the meteoroid at a density of 3.6 t/m^3 were 11,000 tons and a diameter of about 18 meters. NASA estimates that it is the largest known celestial body to hit Earth since the Tunguska meteorite fell in 1908. Where the bulk and energy of the meteoroid went is still a mystery to mechanical astrophysicists.

Only Marat Akhmetvaleev, a nature lover of his region, and another photographer unknown to me managed to photograph and present to the public the unique details of this event (Fig. 1). Based on his photographs and our knowledge of the physics of the Vysikaylo's cumulative dissipative plasma systems (CDS), we will explain where the main part of the meteoroid went and how kinetic energy was dissipated in the atmosphere and ionosphere of the Earth. We detail the pulse-periodic mode of execution of the virial theorem.



Fig. 1: Photographic evidence of plasma cumulation in a meteoroid's wake. This is a photograph (Marat Akhmetvaleev, 2013) of the Coulomb explosion (see [3] for more details)

In photo 1 we see that the length of the plasma tail (L) significantly, by 1.5 times, exceeds the explosion height of 23 km, i.e. the length $L \approx$ 30 km. This indicates the existence of plasma for ~1.5 seconds after the passage of the meteoroid. The plasma does not dissipate as a neutral medium, but is focused by the forces of cylindrical cumulation, as in the case of linear cylindrical lightning. Of particular interest is the behavior of the meteoroid fragments (photo 1). They fly apart not only in different directions from the meteoroid, but also forward, accelerated by some force acting behind the meteoroid. This clearly indicates a new mechanism of meteoroid fragmentation. The speed of the meteoroid at the moment of its destruction is 18.3 km/s. This significantly exceeds the speed of any detonation waves of any explosives known to mankind. Therefore, such speeds can only occur in electron beams accelerating in an electric field following a meteoroid! These phenomena and interactions occur at the speed of light or close to this speed with an increase in the characteristic dimensions of positively charged Vysikaylo's cumulative-dissipative systems (+CDS) [1-3].

Several dozen witnesses reported that during the passage of the meteoroid, several minutes before the arrival of the shock wave, they heard a hissing sound similar to the sound of burning sparklers. This means that we are talking about the phenomenon of "electrophone ball lightning". This phenomenon can only be explained by the electromagnetic interaction of polarized charged system or the runaway electrons from +CDS such as lightning [1,3] (Fig. 1). These phenomena and interactions occur at the speed of light or close to it as the characteristic dimensions of these system increase.

A few days after the fall of the Chelyabinsk meteorite, there were reports of observations of anomalous noctilucent clouds at altitudes of 75-80 km. A similar phenomenon was observed in 1908 after the fall of the Tunguska meteorite. This time, ground observations of noctilucent clouds were confirmed by satellite data. Mechanical models cannot explain the release of water vapor from the meteoroid to such an altitude. As a result of the search for the remains of the meteorite, a mass was discovered that did not exceed 1 ton (~0.01% of the total mass of the meteoroid).

According to RIA News 03/21/2013, the Chelyabinsk fireball caused magnetic storms in the Earth's ionosphere, similar to storms that occur when solar wind penetrates into the Earth's ionosphere. According to IZMIRAN RF, the disturbances affected almost the entire ionosphere. Thus, fluctuations in the concentration of electrons in the F2 ionospheric layer (about 250 kilometers high) were recorded 5.5 h after the explosion at the ionospheric station in Yekaterinburg (V_a = 10 m/s), 6 h later in Rostov-on-Don (V_a = 79 m/s) and 7 h later in Moscow (V_a = 60 m/s). The speed of longitudinal propagation of plasma disturbance along the trajectory of the meteoroid in the direction of Moscow (it was flying from Omsk) after its destruction is equal to 1,500 km/7 hours = 214 km/hour = 60 m/s. This speed is more than 4 times less than the speed of sound at altitudes from 20 to 500 km. This velocity corresponds well to the possible *velocity of ambipolar drift* in gas-plasma in breakdown fields [1].

The disturbance zone was local—it was a long "tongue" moving westward, the width of which in the Yekaterinburg region was about 100 km, and on the Moscow-Rostov meridian was about 500-600

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kilometers. Without considering the violation of electrical neutrality and the formation of cumulative oppositely directed jets of electrons and positive ions, none of the astrophysicists for 12 years could explain all these phenomena. *I prove that flows of charged particles in the atmosphere and ionosphere are created by electric fields. The influence of magnetic fields is small compared to electric fields* (*by the parameter v*/c).

II. Mechanical Models and their Problems in Explaining the Phenomena of Meteoroid Destruction

The problem of the asteroid-comet threat has received considerable attention (in words). Scientific conferences are held, hundreds of articles and a number of books have been published see [6-13].

The state of the question of mechanical destruction of cosmic bodies upon entering the atmosphere in the times before the Chelyabinsk meteoroid was presented by the mechanic S.S. Grigoryan (Institute of Mechanics, Lomonosov Moscow State University, Moscow) in [10-12]. He made quantitative estimates of all the effects accompanying the motion of bodies in the atmosphere at cosmic speeds.

According to Bronshten [13]: "we still have a poor understanding of how the fragmentation process itself occurs. To clarify this issue, special experiments are needed...." And so we are presented with experiments of nature in the form of the Chelyabinsk meteoroid (Fig. 1).

Mechanics still do not have clear explanations for all the phenomena that were observed when the Chelyabinsk asteroid entered the Earth's atmosphere. My research is based on electrical phenomena.

Comparison of Grigoryan's model (Fig. 2) with the photograph in Fig. 1 shows that:

1) When a meteoroid disintegrates, its parts gain additional acceleration not only in the direction perpendicular to its velocity vector, but also in the direction of its motion. The meteoroid's velocity is 18.3 km/s. The propagation speed of detonation waves in explosives is significantly lower (less than 10 km/s). Within the framework of the mechanical model (Fig. 2), such behavior of the meteoroid explosion (Fig. 1) is inexplicable! To explain such behavior of the meteoroid's parts, something must be moving behind the meteoroid at speeds significantly exceeding the meteoroid's velocity (18.3 km/s). Only electrons can be such particles due to their low mass;
2) The plasma tail (train) of the meteoroid in Fig. 1 clearly does not correspond to Grigoryan's mechanical model with an expanding tail (Fig. 2). All mechanical models fail to explain the clearly observed phenomenon of plasma cumulation in the meteoroid tail over 1.5 s (Fig. 1). According to the mechanical model, the characteristic size of the meteoroid tail should increase with the speed of the Mach shock wave (Fig. 2).
3) Grigoryan's model does not take into account or discuss the virial theorem. According to this theorem, half of the meteoroid's potential energy should return to the region of its arrival. We describe this process in detail in the section "Introduction of asteroids and meteoroid bodies into the planet's atmosphere".

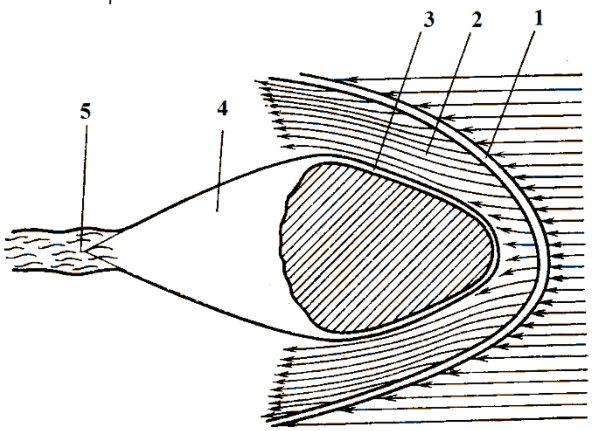


Fig. 2: General 3D diagram of shock wave elements: 1 – shock wave front, 2 – shock (compressed) layer, 3 – boundary layer, 4 – stagnant zone, 5 – trail

Comparison of photograph 1 with Fig. 2 shows the inadequacy of the Grigoryan's mechanical model to explain the photograph. Other modifications of his theory, including those made by Chernogor for other meteoroids [14,15], do not deserve close attention. His research led to the conclusion: "The role of the dust component of the plasma was insignificant" [15]. In his works, only Mach shock waves are considered. Mach shock waves compress bodies penetrating the Earth's atmosphere (Fig. 2), and thus destroy this body, acting on it from the front.

The author draws attention to the formation of Vysikaylo'sshock waves of the electric field, leading to the action of CJ on such bodies from behind!

III. Vysikaylo's Classification of Shock Waves

In the modern world, there are three types of shock waves:

1. Mach'sshock waves, also known as parameter jumps, in the field of gas dynamics. Their study began with his work of in 1881.
2. Magnetic field shock waves were described by R.Z. Sagdeev;
3. Shock waves of the electric field, described theoretically and experimentally in detail in (https://ieeexplore.ieee.org/document/10875031).

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Based on theoretical and experimental works on the study of Vysikaylo's shock waves of the electric field in gases, in this work we will formulate a model of Vysikaylo's incongruent shock waves in electronegative gases (air). These waves surrounded the plasma tail behind the Chelyabinsk asteroid and limited the radial expansion of the plasma and thus lead to the formation of a CJ, spraying the asteroid with a Coulomb explosion. This is how the virial theorem in the Earth's atmosphere is solved according to the Vysikaylo's model.

IV. General Analysis of the Chelyabinsk's 2013 Meteoroid Phenomenon

According to NASA calculations, the Chelyabinsk meteoroid, about 18 meters in diameter and weighing 11,000 tons, entered the Earth's atmosphere at a speed of about 18.3 km/s and almost completely disappeared in the Earth's electronegative (air) atmosphere. The kinetic energy of the meteoroid is $W_M \approx 2 \cdot 10^{15}$ J. How was all this energy and mass of the meteoroid focused and where did they go? The destruction was a series of phenomena accompanied by the spread of shock waves and crackling sounds, creating the impression that someone was shooting at the meteoroid. This is also indicated by the features of the dispersion of the meteoroid parts in Fig. 1. The entire "West" does not have effective anti-missile defense against Russian supersonic missiles, the speed of which is only 2.7 km/s. And here the speed is 7 times higher (18.3 km/s). This is fast hypersonic (12.3 ÷ 30.7 km/s). Neither Russia nor Iran have achieved such speeds yet. This paper proposes a new mechanism for such missiles with 50% efficiency, but the author hopes that it will not be implemented for special purposes for another 20-30 years. During this time, the elites in the United States will realize Hegel's law of the unity and struggle of opposites (and their mutual development, not destruction).

According to NASA estimates, 20% of the total energy of the meteoroid goes to radiation - 90 kt. This means that the energy of the meteoroid is used to destroy itself. The plasma tail not only wags the meteoroid (the dog), but also participates in its destruction. The mechanical model, in principle, cannot explain this phenomenon. The total energy received by air molecules due to collisions with a meteoroid during the entire flight of the meteoroid (before its destruction) does not exceed $8 \cdot 10^6$ J. Moreover, the energy received by one air molecule during a collision with a meteoroid is about 50 eV. This energy is sufficient for complete ionization and dissociation of all air molecules in the meteoroid's wake. In this case, the temperature of the electrons in the plasma tail of the meteoroid will be about 50-25 = 25 eV or 250÷300 thousand degrees. At this temperature, electrons leave the area of collision of air molecules with a meteoroid in a microsecond. Wake polarization occurs, in which a significant portion of the plasma energy in the wake of the meteoroid is retained in the form of potential Coulomb energy. Due to the polarization of the plasma in the meteoroid's wake, dynamic Coulomb surface tension is generated. This tension localizes energy in the plasma tail. This creates a cylindrically symmetrical tube of fully ionized plasma behind the meteoroid. The potential energy of a meteoroid at a small angle of entry into the Earth's gravitational field is no more than 10^{10} J. All these energies are significantly less than the kinetic energy of the meteoroid $2 \cdot 10^{15}$ J and the radiation energy recorded by NASA - $4 \cdot 10^{14}$ J. This means that the energy external to the meteoroid is not enough for such a glow, observed at the moment of its spraying. Thus, we, on the basis of the photograph in Fig. 1, have proven that, according to the law of conservation of energy and the directions of explosion fragments in Fig. 1, the mechanical model (Fig. 2) in principle cannot explain such a spray of a meteoroid in all directions (at a speed greater than the speed of the meteoroid) (Fig. 1).

V. General Analysis of Phenomena and Criticism of the Mechanical Model

We will consider in detail the problems of electrical phenomena indicated in [8]. In [8], many errors were made in the explanation, which we will dwell on in detail:

1. The appearance of noctilucent clouds at a height of 75 - 80 km after the destruction of the meteoroid was ignored in [8]. This was due to the lack of a decent model in mechanics for the cumulative transfer of positively charged ions to the upper layers of the atmosphere through a cylindrical plasma channel (Fig. 1). According to my model, they are dropped through a huge pipe that radially focuses the flows of positive ions to an altitude of 75-80 km;
2. The mechanism of obtaining an additional "mysterious" impulse by a number of meteoroid fragments in [8] is not explained. The additional "mysterious" impulse does not lead to the deceleration of all possible fragments in accordance with the action of the shock wave according to (Fig. 2), but to their powerful acceleration (see Fig. 1). The detonation velocity of octogen alone is 9.1 km/s, but this velocity is many times less than the meteoroid velocity. In plasma, only electrons have a velocity of more than 18 km/s. The author proves that it is the accelerating (runaway) electrons, which are formed into cumulative jets, overtaking the meteoroid by inertia, that cause all the recorded "mysterious" phenomena (Fig. 1);

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3. In [8] it is not explained (ignored) the nature of the explosion that scattered parts of the meteoroid in different directions with enormous speeds, clearly exceeding the initial speed of the meteoroid as a whole (Fig. 1). Within the framework of the classical mechanical model, the meteoroid is compressed by the main shock wave from the front and sides (Fig. 2), and is not accelerated by it from behind! Such scattering of meteoroid fragments, as observed in Fig. 1, in principle cannot occur only due to compression of the meteoroid by the shock wave. To explain such an explosion (see Fig. 1), we formulated a new model of Coulomb initiation of fragmentation of the rear part of the meteoroid;
4. In [8] the characteristic time intervals are given: formation of turbulence (10^{-2} - 10^{-1} s), attachment of electrons to oxygen molecules and recombination with meteoric ions (10^{-2} - 10^{-1} s). The frequency of electron attachment to oxygen molecules is dissociative and is 4 orders of magnitude greater than that indicated in [8] and about 10^{-6} s. The lifetime of plasma in the meteoroid tail is 1.5 s. This clearly indicates the presence of not only dissipative (scattering) processes from the plasma tail, but also cumulative flows into the plasma tail, which cumulate energy, mass, momentum and angular momentum. The solution to this paradox is given in the section "Vysikaylo's incongruent shock wave of the electric field in the Earth's atmosphere and Vysikaylo-Poisson's turbulence".
5. In [8] the discussion of sudden, sometimes pulsating, local increase in the brightness of the bolide is ignored. I will quote the text from [16] in full: "At present, there is no gas-dynamic model of a bolide flare... Perhaps one of the causes of flares is fragmentation... The question of the nature of the flare can be resolved only by the joint efforts of observers and specialists in mathematical modeling."

The answers to these questions are based on the cumulation (self-focusing) of plasma flows and the formation of CJ [1-3]). Here, a new cumulative-dissipative plasma-beam mechanism of Coulomb initiation and maintenance of cascade fragmentation of large meteoroids is proposed. The feedback mechanism is based on the phenomenon of coherence of de Broglie waves of electrons and ions in positively charged plasmoids in the electronegative atmosphere of the Earth. As a result of these phenomena, a beam of high-energy "runaway" electrons is formed, penetrating the meteoroid from behind. This leads to a Coulomb explosion of a part of the meteoroid. At the first moment when electrons in CJ hit the meteoroid, it is weakly fragmented, since the energy concentrated in the air is insufficient. When the mechanism of acceleration of small parts of the meteoroid by CJ is turned on, they can move faster than the main meteoroid (Fig. 1). The cumulation of all the kinetic energy of powerful explosions of small meteoroid particles and its transformation into the energy of electrons falling into the meteoroid closes the feedback loop in the process of Coulomb fragmentation. This energy already corresponds to the density of the meteoroid and is ~ 200 eV per meteoroid atom. This leads to a catastrophic fragmentation of the meteoroid. Its parts explode and are completely ionized. By the virial theorem, ½ of the potential and internal energy of the plasma trail returns to the meteoroid, and the other half is ejected into the upper layers of the atmosphere through a channel with plasma self-focusing.

The presence of explosions of small fragments behind the meteoroid and the transformation of their energy into the energy of CJ electrons contributes to the further destruction of the meteoroid, changes in its trajectory and even the acceleration of its fall. According to this scheme, a self-organizing pulsed plasma jet engine with an efficiency of 50%, sparkling with radiation (Fig. 1), is formed behind the fast-moving object, dropping mass due to the fragmentation of the back side of the meteoroid;

6. In [8] the mechanisms that ensure the fulfillment of the virial theorem or Newton's third law in a continuous medium (air) when a meteoroid penetrates at a speed of about 10 km/s - 70 km/s into the Earth's atmosphere and "mysteriously" disappears before reaching the surface of the Earth have not been studied;
7. In explaining the electrophonic effect in [8], Gauss's theorem in 3D space is ignored.

I am detailing point 7). The electrophonic effect is understood as the audibility of crackling sounds by a person at large distances from the meteoroid and long before the acoustic disturbance created by the body's movement reaches the observer. It is believed that the theory of this three-dimensional phenomenon, occurring at a speed close to the speed of light, has not been developed in detail [8]. The basics of this theory are presented in the work [3], based on coherent phenomena in the case of a violation of electrical neutrality in the meteoroid's trail. According to the erroneous ideas in [8] (based mainly on the mechanical model), there are two (I and II) probable mechanisms that can qualitatively explain the electrophonic effect that was observed by several eyewitnesses of the phenomenon in Chelyabinsk in 2013.

1) According to [8], when a cosmic body falls in the atmosphere, it becomes electrified. This causes a charge of the opposite sign to flow down from the Earth's surface. The process is accompanied by an acoustic effect. According to estimates in [8], the charge leakage begins at a field strength of about several kV/m, and in the case of the Chelyabinsk meteorite, the intensity reached 0.5–5 MV/m.

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In this mechanism, the author [8] does not take into account that fields with an intensity of 0.5–5 MV/m are formed quasi-stationary only in the meteoroid area. I note that these fields at an altitude of 20 km are 50 times higher than the breakdown fields. Even with nanosecond discharges, the breakdown values of the *E/N* parameter can only be increased by 2 times to 150 Td. At distances *L* of about 20 km or more from the meteoroid, the electric fields from the meteoroid become negligibly small due to the geometric reduction coefficient following from the Gauss theorem, $\xi = (R/L)^2 \approx 10^{-6}$.There will be no "chirping" from these fields at distances $L \sim 23$ km (or more). In Moscow, there is the Lenin Institute of Higher Power Engineering, which has a setup that imitates lightning. There the electric field strength is of the same order (~3 MV/m), and its dimensions are about 10 m, but Moscow residents, even on the next street, do not experience any "chirping" in their ears.

2) According to [8]: "Electromagnetic waves of the sound range are transformed into sound due to the piezoelectric effect in objects surrounding the observer or in the person himself. At a frequency of f ~ 1 kHz, the electric field strength should be no less than hundreds of V/m. Such fields arise on the surface of the earth with a current strength in the trace of $I = 5*10^4$ A." Here in [8] there is a trace along which "mysterious" currents flow, which in principle cannot be in its initially neutral mechanistic model without consider the electrical imbalance in the trace. Such a sharp transition from a mechanical model to a cylindrical and electrodynamic model with currents looks somewhat strange when explaining the electrophonic effect. In mechanism II, author [8] relies on Tesla's frequency discharge and again sets the necessary condition for "chirping" - more than 100 V/m, which, in principle, is not realized according to the mechanical model at distances more than 23 km from the meteoroid due to the same geometric reduction coefficient $\xi \approx 10^{-6}$. And in this case, author [8] does not take into account the size of the plasma *positively charged tail* of about 30 km, observed in Fig. 1.

During the Chelyabinsk meteorite, the electrophonic effect was observed at a distance of more than 23 kilometers. Two mechanisms proposed in [8] based on the neutral mechanical model do not explain the observed phenomenon due to the small spatial coefficient $\xi \approx 10^{-6}$.

All two mechanisms of the electrophonic effect proposed by the author in [8] do not stand up to criticism. This always happens when the researcher does not understand the essence of the main phenomenon. Therefore, all the phenomena in 8 are not collected into a single picture. The author of [8] is forced to throw out some of the phenomena. He does not discuss and does not understand the phenomenon of periodic powerful fragmentation of the meteoroid, which is accompanied by explosions (as if someone is shooting at the meteoroid with a machine gun) and a simultaneous pulsed increase in the brightness of the glow of the fireball. In the work [8], the author does not mention this main problem of all mechanical models. They cannot explain the main pulse phenomena caused by detonation (shock) waves of electron gas in plasma in a positively charged trace of the meteoroid at 30 km. The speed of detonation waves of electron gas is several times greater than the speed of the meteoroid.

With the "arrival" of such amateurs of their region as Marat Akhmetvaleev (https://uraloved.ru/foto-marata-ahmetvaleeva?ysclid=lpig4qi5dl786130180) and others in the research field, the current state of the problem of the destruction of large cosmic bodies upon entering the Earth's atmosphere has shone with renewed vigor (Fig. 1). This completely new phenomenon falls outside the framework of the mechanical model. To describe the photographically recorded phenomena, we need to use synergetics (coherent processes) in plasma dynamics in the tail of meteoroids, see [3].

VI. Coulomb Self-Focusing of A Plasma Trail

If the speed of the asteroid reaches 20 km/s, then the energy that the air molecules receive is approximately 50 eV.An energy of 50 eV per molecule is sufficient for complete dissociation and ionization of molecules and atoms. About 20 eV remain for each electron. The air (in the form of a plume) becomes an electropositive gas in which electrons are not attached to atoms. Electrons, as a more mobile gas, leave the plasma plume faster than positive ions. This is how the plasma is polarized behind the meteoroid and a potential Coulomb radial barrier for electrons is formed (Fig. 3). The radial potential blocking the movement of electrons in the radial direction increases logarithmically depending on the effective length of the cylindrical positively charged plasmoid. Outside the plasma trail, the electrons lose energy and stick to oxygen molecules. In this case, a layer of negative ions is formed, which move into the positively charged plasma trail at a significantly lower speed. Negative ions cumulate enteringinto the plasma trail with excited plasma are destroyed and electrons are released. This leads to the cumulation of the plasma tail. These electrons are affected by the 3D electric field of a positively charged cylindrical column. The radial component cumulates the electrons to the center of cumulation, and the longitudinal field behind the meteoroid accelerates them to catch up with the meteoroid. This further cumulates plasma in the tail behind the meteoroid. In the area limited by the positively charged cylindrical radial barrier with the

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Coulomb potential, not only all the kinetic energy received by the air molecules is concentrated, but also the kinetic energy of the meteoroid's parts during its gradual and then catastrophic destruction. The self-focusing plasma column with high conductivity participates in the 4D scattering of all the kinetic energy of the meteoroid. (The return of negative ions to the plasma tail of the meteoroid is carried out at the speed of the negative ions). Self-focusing of highly conductive plasma structures allows to extend relaxation processes hundreds of times (up to 1.5 seconds) and return half of the kinetic energy of the entire meteorite through a cylindrical plasma channel to the upper layers of the atmosphere and ionosphere. This explains the influence of the meteoroid tail on the parameters of the ionosphere and demonstrates a three-dimensional structural implementation of the virial theorem in a pulse-periodic process.

Coulomb self-focusing is observed in various plasma formations, from atoms and molecules to electric arcs, lightning, meteor trails and intergalactic lightning. In cylindrical systems, transverse electric fields effectively cumulate electrons toward the center. Longitudinal electric fields, although weaker but longer, form and accelerate cumulative flows in the plasma trail along the trajectory of the meteoroid. In a gas discharge or linear lightning, electrons move toward the anode by a similar principle. In a plasmoid limited by the Coulomb potential, electrons collide during complete ionization of atoms, transferring energy to the tail of the velocity distribution. The high energy of electrons leaving the plasmoid causes electrophonic effects when meteoroids enter the Earth's atmosphere.

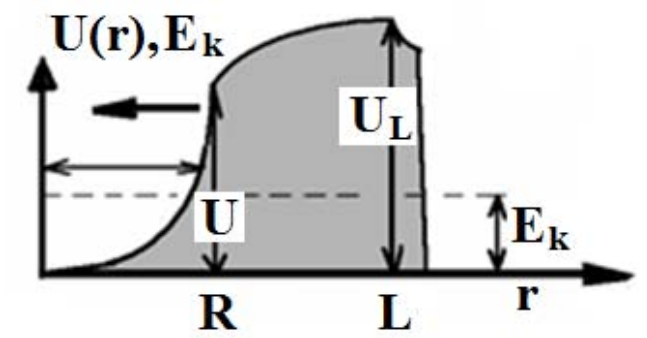


Fig. 3: This is a potential barrier $U(r)$ for electrons in a cylindrical plasmoid with a positive charge. The characteristic transverse size of the potential well in this case is greater than the radius of the system and is determined by its length ($\approx L$), and not by the radius (R)

VII. Coulomb Mechanism of Meteoroid (Asteroid) Fragmentation

The plasma tail behind the meteoroid transmutes the kinetic energy of the asteroid into the electric energy of the cylindrical capacitor. The positively charged cylindrical polarized tail grows linearly with the velocity of the asteroid. The radial capacitor is therefore broken through by a CJ. CJ behaves coherently, like laser radiation. Electrons catching up with the meteoroid periodically explode it and accelerate parts, including the asteroid itself. We estimated the parameters of the electron beam for lightning (~5 MeV) and the plasma tail of the Chelyabinsk asteroid (~100 GeV).

1/2 of the kinetic energy of the asteroid is spent on acceleration and destruction of fragments by the CJ, the other ½ is spent on the emission of positive ions into the upper layers of the atmosphere (up to 70-80 km) along the cylindrical trail. Our research explains all the phenomena observed during the destruction of the Chelyabinsk asteroid at an altitude of 23 km.

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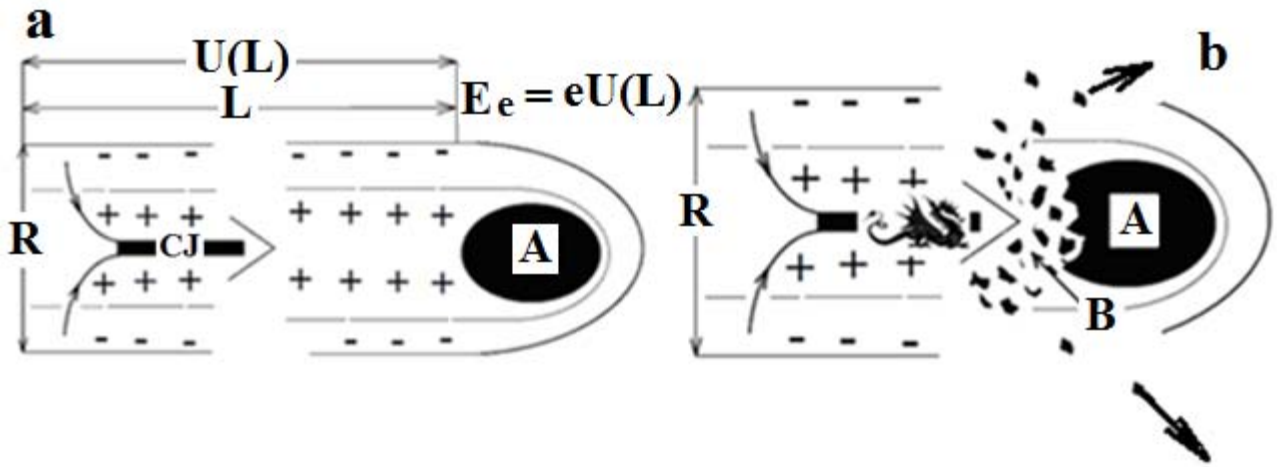


Fig. 4: 2D diagram

a) In Vysikaylo's gun, the spatial charge (polarization) of the plasma behind a fast-moving object – A in the medium is divided. This division is indicated by the signs "+" and "-". A positively charged plasma column forms a CJ, transforming the energy of polarization (the energy of the asteroid) into the energy of the CJ;

b) A new method of destruction of meteoric bodies based on the cumulative plasma mechanism of fractal fragmentation. This mechanism is triggered by Coulomb explosions. B - these are fragments that explode and create a jet thrust behind object A, simultaneously destroying it from behind.

VIII. Cumulative-Dissipative Systems

In nature, convective cumulation (focusing) processes were discovered long ago. Gravitational cumulation processes were studied by Newton, Kepler, Euler (1767), Lagrange (1772), Besant (1858), Rayleigh (1917), Guderli (1942, compression shock wave), Zababakhin (1965) and others. We are most interested in the studies of unlimited cumulation processes in the works of E I Zababakhin [18]. In the conclusion of this book, the authors (V A Simonenko) say that "despite the instability of cumulation in continuous media, it remains a very useful idealization that allows one to find exact solutions and indicates how to approach it in practice, without relying, however, on self-focusing" [17,18]. And now, more than 36 years have passed, and we are successfully solving the problems of self-focusing (cumulation) of electrons de Broglie waves in quantum resonators in the most "subtle experiments", both at the level of nanometer sizes, and also in the mesoworld of huge plasma trails behind meteorites penetrating the Earth's atmosphere. Atomism and the associated size limit indicated in the works of Zababakhin are already coming to the forefront and have even been overcome in nuclear physics (https://ojs.acad-pub.com/index.php/N-C/article/view/1297). But the definition given by Ya.B. Zeldovich to the concept of cumulation for continuous media remains a very useful and fairly general definition of this phenomenon, observed from the fem to world of atomic nuclei to the world of stars and galaxies. "Cumulation, that is, the concentration of force, energy or other physical quantity in a small volume, is the most important phenomenon of nature," asserted Ya. B. Zeldovich in his preface to the book "Phenomena of Unlimited Cumulation" [17]. The definition of cumulation given by Ya. B. Zeldovich is the most successful, clear and at the same time quite complete definition of the phenomenon of self-focusing in natural, physical, social, political, economic and other phenomena and the Vysikaylo'sCDSformed by them, which differ significantly from the dissipative structures of Prigogine-Turing-Kolmogorov-Fisher [3].

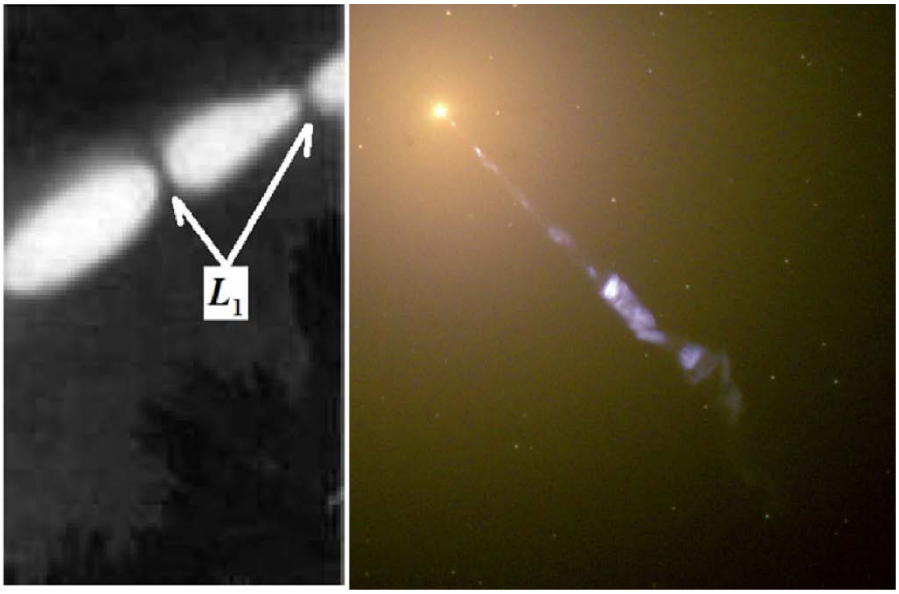
E.I. Zababakhin was the closest to the discovery of cumulative-dissipative systems (CDS), which differ significantly from Prigogine's dissipative structures (PDS). PDS are formed by diffusion and birth processes. CDS are formed by convective and diffusion processes of self-focusing of energy, mass and momentum flows. During cumulation, new degrees of freedom are excited: 1) rotation, 2) violation of electroneutrality and 3) generation of electromagnetic fields. CDS exist as a result of structural dissipation of a certain energy source and therefore belong to a new class of dissipative systems discovered by Vysikaylo [1-3].

IX. Architecture and Super-Properties of the Vysikaylo's Cumulative-Dissipative Systems

CDS have long been observed in nature (Fig. 5). However, these phenomena were considered paradoxical, since they had no explanation. The basic provisions of the theory of gravitational structures were presented in the works of Euler, Lagrange, Roche (Fig. 6). The Kepler problem has long been solved in the general case for the Coulomb and gravitational

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potentials. However, the discovery of cumulation and libration points in plasma between positively charged systems (Fig. 5) was discovered by me in 2009. Here we will analyze the architecture of the cumulation and dissipation processes in Vysikaylo's CDS based on Fig. 6. To do this, we will mentally fill the Roche lobe of the Sun and Jupiter (Fig. 6) with ordinary dust and hit the dust (in the Roche lobe) to the left of the Sun with a large palm. The dust will move in the direction of the Roche lobe of Jupiter. After passing the dust particles through the region of the Sun, the equipotential will focus at the cumulation point L_1. This means that the points discovered by Euler (1767) are not libration (Lagrange) points, but are in fact Euler's cumulation points [2]. After passing the cumulation point L_1, dust flows from the solar Roche lobe penetrate into the Roche region of Jupiter and expand there.



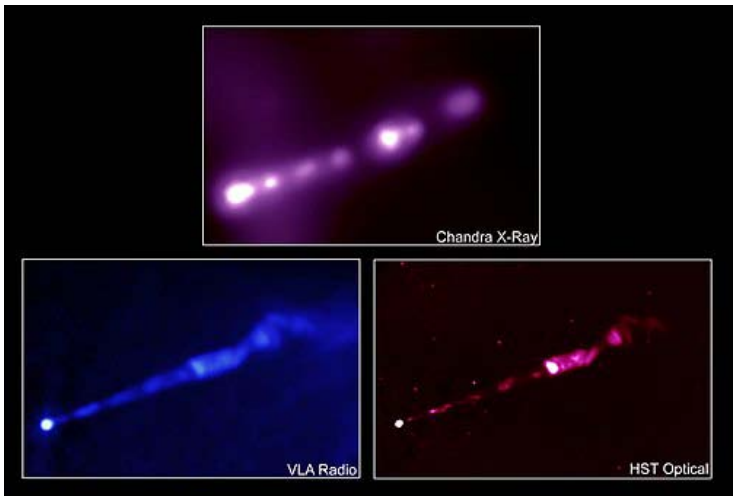


Fig. 5: Photo of energy cumulation due to dynamic surface tension in plasmoids:

a) Dotted lightning in the electronegative Earth's atmosphere. L_1– cumulation points [2,3].

b) The central region of the M 87 galaxy with an active nucleus. Jet size ~ 1.5 kpc. Hubble Telescope (NASA). We observe jet stratification and formation of cumulation regions

The formation of Vysikaylo's bicyclones, discovered in [1-3], can also be explained based on the Euler-Vysikaylo's model (Fig. 6). To do this, it is necessary to simultaneously hit the dust with large "palms" from opposite sides on the Roche lobes. In this case, dust from the Roche lobe of the Sun will penetrate into the Roche lobe of Jupiter, and dust from the Roche lobe of Jupiter will tend to get into the Roche lobe of the Sun. This problem of the frontal collision of dust flows from the Roche lobe of the Sun and Jupiter at the cumulation point L_1 is solved in 4D space-time by generating rotation of these flows in opposite directions. Such bicyclones with constrictions in L_1 are complete analogues of Cooper pairs discovered in the nanoworld, so the author called such bicyclones quasi-Cooper bicyclones. The idea of the joint organization of Cooper

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pairs led to the discovery of quasi-Cooper cyclones or Vysikaylo's bicyclones in the micro-, meso- and macroworlds. On this basis, the joint co-organization of cyclonic and anticyclonic flows into a single system, a bicyclone, was discovered. Double currents enhance each other's rotation and transform any kinetic and potential energy into rotation, distributing these energies equally between cyclonic and anticyclonic movements. The idea of such a joint organization of double convective (not diffusion) flows made it possible to discover Vysikaylo's structural turbulence and to explain and describe analytically all the phenomena observed during the formation of tropical cyclones [1-3] (these phenomena observed in nature are collected in the works of Erokhin and Artekha).

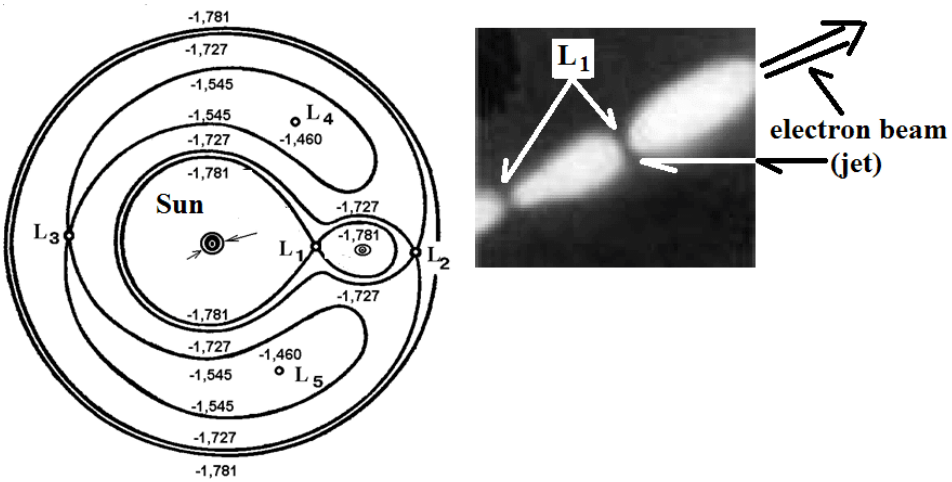


Fig. 6: This is a 2D cross-sectional diagram of equipotential surface profiles (3D Roche' cavities) surrounding:

a) The gravitating system of two attractors (Sun and Jupiter), taking into account the centrifugal potential in the Euler problem of linear cumulation points $L_{1\text{-}3}$ and triangular Lagrange libration points $L_{4,5.}$,

b) This is the formation of Vysikaylo's cumulation points in a beaded lightning between the luminous positively charged cumulative-dissipative Vysikaylo's systems.

Similar phenomena of structural cumulation are observed at the libration point L_1 when ordinary stars are consumed by quantum stars in stellar pairs [2] (the phenomena and paradoxes that arise are described in [19,20]. They still don't understand Vysikaylo's structural turbulence). The main achievement within the framework of the Vysikaylo's structural turbulence model was the description of the eye (eye) of a tropical cyclone, which is not described in the Rossby's models and other, as AAVlasov said, inferior models. The second discovered property of structural turbulence or bicyclones is an increase in the cumulation of such a structure with an increase in rotation and an increase in rotation during cumulation [1-3].

X. Cumulation and Libration Points for Electrons between Positively Charged Systems

Euler was the first to think about the interaction of gravitational and centrifugal potentials when he analyzed the two-dimensional motions of a small third body in the plane of rotation of two massive objects. His idea of cumulation points L_1, which was already known to Newton, and the discovery of three linear cumulation points $L_{1\text{-}3}$, arising from the influence of the centrifugal potential, were the result of the analysis on the line connecting the two massive bodies. Lagrange, developing this idea, derived the results of the analysis in the plane of rotation of Jupiter around the Sun, which led to the discovery of two triangular points L_4 and L_5. These classical discoveries allowed me to discover the libration and cumulation points of electrons around positively charged Coulomb centers.

The study of flows in 4D space-time revealed to me that the gradients of potentials: 1) gravitational, 2) Coulomb and 3) pressure form flows of energy, mass and momentum in a similar way. This allowed me to classify the points discovered by Euler in 1767 as cumulation points, and the points discovered by Lagrange in 1772 as libration points [2].Generalization of the works of Euler, Lagrange, Roche and other researchers of the system of gravitational attractors allowed me to explain a number of "puzzling" experiments, for example, the pulsed propagation of lightning in the experiments of Schonland (1937) (jets are formed in the same way, Figs. 3-6) and other paradoxes in gas-discharge plasma in laboratories, the ionosphere, the heliosphere and galaxies.

Research [1-3] led me to the creation of the generalized mathematical transposition method

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(GMTM). This method allows the transfer of mathematical models from well-studied areas of science to less explored areas. With the help of GMTM, knowledge of gravitational systems can be used to describe electrodynamic processes with violation of electrical neutrality, and vice versa. This opened up new possibilities for testing general theories in the natural sciences and making discoveries. The method is also applicable to hydrodynamic and quantum-mechanical phenomena. Thus, within the framework of synergetics, the science of the interaction of many elements, a new section devoted to CDS appeared [1-3].

XI. Vysikaylo's Perturbation Theory for Describing Phenomena in Plasma with Current

We have already explained all the phenomena that occurred when the Chelyabinsk meteoroid entered the Earth's atmosphere, based on experiments with lightning and plasma systems. When air molecules collide with a meteoroid, plasma is formed - a gas consisting of positive ions and electrons. We have developed a mathematical model to describe the transition layers in a non-uniform plasma with current. However, numerical modeling of such plasma causes difficulties due to the lack of experimental data on the rate of processes of plasma particle generation and transfer from the parameter E/N. According to Vysikaylo's perturbation theory, in the system of Poisson equations for the electric field and the transfer of ions and electrons, one can obtain one four-dimensional equation for the transfer of plasma parameters. This equation takes into account the smallness of the current of positive ions compared to the current of electrons:

$$\partial n_e/\partial t - \partial[(l_{E0}/\mu_e)\nabla](\mu_e n_e)/\partial t + (j/e)\nabla(\mu_{+0}/\mu_{e0}) - \nabla\{(\mu_{+0}E_0/\mu_{e0})(l_{E0}\cdot\nabla)(\mu_{e0}n_e)\} = I_{+0} - R_{+0}, \quad (1)$$

Herein the zeroth approximation of our perturbation theory, the drift velocity of electrons and ions is described by the relations: $V_{e0} = \mu_{e0}E_0$, $V_{+0} = \mu_{+0}E_0$, here are the mobility of electrons – μ_{e0} and ions – μ_{+0}, respectively, $l_{E0} = E_0/(4\pi e n_e)$ *vectorized characteristic size of electric field strength change*. Since the plasma in the trail is completely ionized, the length of the violation of electrical neutrality is small and a sharp jump is formed along the entire boundary of the luminous plasma trail (Vysikaylo's shock wave of the electric field) [1-3]. The four-dimensional Vysikaylo's equation is derived from the ion concentration equation $\partial n_+/\partial t + \mathrm{div}(n_+ V_i) = I_+ - R_+$, where the n_+ is replaced by $n_e - (l_{E0}\nabla)(n_e \mu_{e0})/\mu_{e0}$. This change takes into account the violation of electroneutrality described by the Poisson equation for the electric field. The second term in the equation, containing mixed derivatives with respect to time and space, has no analogues in hydrodynamics. The fourth term is similar to the diffusion one. In hydrodynamics, a similar transition from convective to diffusion transport is observed during the formation of shock waves discovered by Mach. The term due to the violation of electrical neutrality suggests the presence of shock waves of the electric field in the plasma. These waves form the dynamic surface tension of plasmoids ranging in size from 10 cm to 1.5 kpc (Fig.5). Shock waves of the electric field in a gas discharge were discovered and visualized by Vysikaylo and his colleagues in 1985-1987. The second and fourth terms of the equation with mixed derivatives allow us to describe stationary and traveling shock waves of the electric field - strata (parameter E/N) both in a conventional gas discharge plasma and in the ionosphere and heliosphere, where global currents flow.

During discharge in pure nitrogen, the ambipolar drift in the positive plasma column reaches 70 m/s. It moves from areas with low values of the E/N parameter to high ones. This drift promotes plasma cumulation in the centers or lines [1-3]. In air, the ambipolar drift can exceed 100 m/s. As a result, the plasma self-focuses behind the meteoroid, causing disturbances to spread in the ionosphere at a speed of V_a(according to RIA News 03/21/2013).

When a meteoroid moves through the atmosphere, it leaves behind a plasma trail. Highly energetic electrons leaving this trail create a positively charged column with electric forces acting on the positive ions moving away from the meteoroid and on the electrons moving toward the meteoroid. The radial Coulomb barrier (Fig. 3 and 4) prevents the flow of electrons from the plasma cylinder and thus focuses it radially. This plasma system, 30 to 80 kilometers in size, sprays the meteoroid substance, including water vapor, into the upper layers of the atmosphere in the form of positive ions. One of the indications of cylindrical plasma cumulation in the trail is the registration of noctilucent clouds at altitudes of up to 75 kilometers.

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XII. Discussion of Results

In this section we argue that the cylindrically symmetric plasma system (hose behind the meteoroid (Fig. 1)) is formed by the processes of ambipolar drift (the third term in (1)). According to our theoretical and experimental studies, this type of ambipolar drift (caused by different dependences of the electron and positive ion mobilities) is directed from small values of the parameter E/N to the region of large values of this parameter. In the case of a limited (droplet model) plasma positively charged system, the ambipolar drift is directed toward the self-forming boundary of the plasmoid (Fig. 7). Thus, plasma disturbances are directed toward the boundaries of the plasmoid and such solutions are stitched together by the formation of Vysikaylo's shock wave of the electric field with a characteristic size l_E [3].

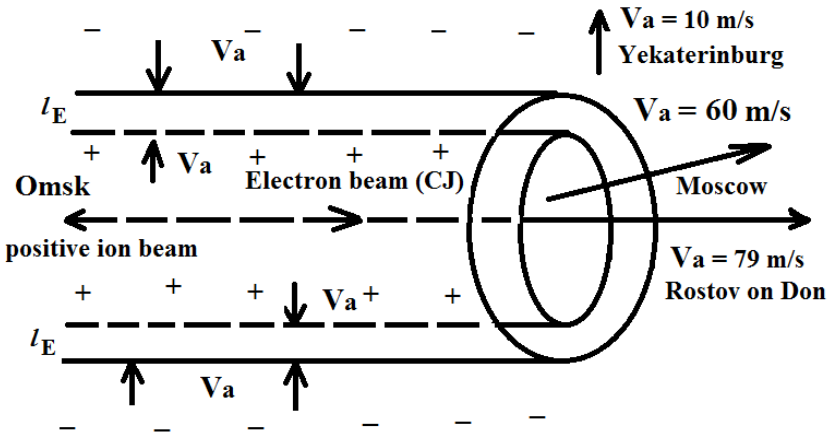


Fig. 7: 3D schemes: formation of the Vysikaylo's laser-gun by ambipolar drifts directed towards the boundaries of the plasma system and the propagation of plasma disturbances in the ionosphere at the speed of ambipolar drift V_a(these are analogs of Mach's shock waves) of plasma disturbances after the destruction of the meteoroid according to the Vysikaylo's fragmentation scheme

Fig. 7 shows the formation scheme of a partially open in the direction of the asteroid motion (closed from the sides) cumulative-dissipative polarized Vysikaylo's systems. All the kinetic energy of the meteoroid and ionized air molecules is converted into the energy of a cylindrical electric capacitor, limited by a Coulomb cylindrical barrier (Fig. 7). When the capacitor energy reaches a critical value, it is broken down by CJ. The introduction of CJ into the meteoroid leads to a Coulomb explosion and fragmentation of the meteoroid from behind according to the Vysikaylo model (Fig. 4*b*). Limitation of the radial propagation of the plasma disturbance occurs due to converging waves of ambipolar drift (the third term in (1)), directed to the boundaries of the self-forming cylindrically symmetric plasmoid. This occurs in complete analogy with the formation scheme of ordinary linear lightning and other Vysikaylo's positively charged cumulative-dissipative systems(+CDS) [1-3]. At the boundary of the plasmoid, a Vysikaylo's shock wave of the electric field is formed, compressing +CDS.

After the final Coulomb fragmentation of the meteoroid (to ions and electrons) according to the Vysikaylo's scheme (Fig. 4*b*), as shown by the experimental data presented to RIA News 03/21/2013, the electron beam pulse continues its movement in the form of plasma ambipolar waves with different velocities V_a, depending on their direction of movement. Such a dependence of the propagation speed of disturbances clearly indicates the ambipolar nature of the momentum transfer in the direction of the meteoroid movement. This once again proves the electrical nature of the effect of +CDS (Fig. 4,7) on the entire ionosphere and atmosphere of the Earth. According to the diagram (Fig. 4*b*, 7), the virial theorem may be fulfilled earlier than the meteoroid collides with the Earth's surface. This occurs when the Vysikaylo's +CDS is broken through by a cumulative electron jet in a pulse-periodic mode, which corresponds to the meteoroid being periodically shot (destruction) by its tail.

XIII. Vysikaylo's Incongruent Shock Wave of the Electric field and Vysikaylo-Poisson's Turbulence

Air (the Earth's atmosphere) is an electronegative gas. In electronegative gases, along with ionization processes (the creation of free electrons and positive ions), there is an intensive creation of negatively charged ions. Negative ions in the air are formed as a result of two processes: 1) dissociative attachment of a free electron to an oxygen molecule. Here, the O^- ion is formed. The O^- ion can be modified into the O_3^- ion; 2) three-body attachment of a free

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electron to an electronegative oxygen molecule. Here, the O_2^- ion is formed. The O_2^- ion can be modified into the O_4^- ion.At an altitude of 23 km, the number density of molecules is 24 times lower than at sea level. This means that the frequency of three-body electron attachment is less by more than 500 times. Therefore, the main negative ion outside the plasma tail behind the asteroid can be considered the O^- ion. The speed of the O^- ion return to the positively charged cylinder - the plasma tail behind the asteroid is about 10^5 cm/s. This corresponds to characteristic times of $9[m]/10^{-3}[m/s] \approx 10^{-2}$ s.The negative ion returning to the plasma tail is destroyed in collisions with any excited particle and turns into a free electron, which gains energy in electron-electron collisions in the plasma tail and again escapes from the plasma tail of the asteroid. And again, with dissociative attachment to an oxygen molecule, it turns into a negative ion. Thus, one electron can form a negative ion up to 10^2 times. This is how *Vysikaylo-Poisson's turbulence* is formed at the boundary of the plasma tail behind the Chelyabinsk asteroid.Not only ionized air particles but also asteroid particles transformed into nanodust by a beam of highly excited electrons via a Coulomb explosion take part in the formation of this *structural turbulence* (Fig.7).

The electrons and negative ions returning to the center (of the positively charged tail) hold the positively charged ions in a cylindrical plasmoid behind the asteroid with their pressure. Their pressure leads to the preservation of the characteristic radial size of the plasma tail behind the Chelyabinsk asteroid at 30 km (Fig. 1).

All kinetic energy received by air molecules (during the collision with the Chelyabinsk asteroid) is spent on their destruction into ions, and then its remains at the level of 25 eV (in the electric field of positive ions) flow into the energy of electrons. Electrons have a small mass compared to ions and therefore leave the plasma tail of the meteoroid faster. This is how a dynamic capacitor is formed behind the meteoroid. All the energy remaining after the destruction of molecules flows into this dynamic cylindrical capacitor.

The frequency of dissociative attachment of electrons to an oxygen molecule ν_a for electrons with an energy of 25 eV is of the order of $(10^{-11}x10^{17})$ [32] 10^6 s^{-1}. The speed of electrons (V_e) with an energy of ≈ 25 eV in air is of the order of $3{\cdot}10^7$ cm/s. Where does the characteristic radial size of the plasma tail increment in the mode of destruction of air molecules only come from: $L \sim V_e/\nu_a \approx 0.3$ m.

This means that the radius of the plasma systems where the plasma with the particle energy of 25 eV is concentrated is about the radius of the Chelyabinsk meteoroid ~ 9+0.3≈ 9 m.

At the boundary of this capacitor, free electrons leave the plasma tail behind the Chelyabinsk asteroid, as a result of dissociative adhesion to oxygen molecules they turn into O^-. The O^- ion returns back to the positively charged tail at a speed hundreds of times less than the speed of electrons.

Fig. 7 shows a diagram of the implementation of a cylindrically symmetric electric field shock wave surrounding the plasma in the tail of a meteoroid (asteroid). According to the diagram, the shock wave separates the plasma with negative ions and the plasma where these ions are destroyed in collisions with excited particles and thus turned into atoms, positive ions and free electrons, capable of being accelerated by the electric field in +CDS (in a positively charged electric cord) more quickly than negative ions.

The presence of plasmas with different contents of negative ions at the boundary of the shock wave allows us to classify such shock waves as incongruent jumps of plasma parameters.

In Fig. 7, we detailed how the Le Chatelier – Brown's principle is implemented in such jumps: the medium is polarized, forms a capacitor, which, when destroyed, fragments the disturber of the equilibrium of the medium and throws off its remains in the form of positive ions in the direction opposite to the direction of its movement (Fig. 7).

The movement of positive ions in their own electric field (Fig. 7) (in the opposite direction to the movement of the Chelyabinsk asteroid) solves in a pulse-periodic mode (periodic breakdown of a cylindrical capacitor by CJ the problem of fulfilling the virial theorem during the complete destruction of the asteroid in the upper layers of the atmosphere.

XIV. Conclusion

The Chelyabinsk meteoroid of 2013 showed the fragility of our civilization, which is not yet able to understand, comprehend and apply in practice all the phenomena recorded on video cameras by amateurs in their region. "Classical" science was unable to explain all the observed effects. The press suggested that we are being protected by some higher intelligence that is shooting at the Chelyabinsk meteoroid.

Having analyzed these visualized phenomena, I come to the understanding that these: photographs (Fig. 1); data presented by NASA on all the parameters of the explosion (in particular, the transition of a significant part of all the kinetic energy of the asteroid into electromagnetic radiation); data on the spread of plasma disturbances at the speed of ambipolar drift, presented by RIA News 03/21/2013 and all the videos and eyewitness accounts of the event collected on the Internet, are undoubtedly worthy of the highest awards and praise, since they completely overturn the "classical" mechanical ideas about many natural phenomena (Fig. 1,5). These data allow me to claim that I have created for the first time a model of meteoroid and asteroid fragmentation that takes into account their

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destruction into dust down to electrons and positive ions. This model explains how a flow of energy in the form of CJ can carry out this fragmentation and direct half of the kinetic energy of a celestial body after it for its further destruction.

We were the first to propose a model of the Coulomb explosion of a meteoroid based on the model of ordinary linear lightning. We were the first to propose a model of the Coulomb explosion of asteroid, meteoroid - its fragmentation and described in detail how such fundamental principles as the Le Chatelier-Brown principle and the virial theorem, formulated in 1870 by Clausius for gravitating systems, Fock for quantum physics, are fulfilled in this process.

Our pulse-periodic mechanism that destroys meteoroids solves the problem of fulfilling the virial theorem for any meteoroid speeds - from 10 km/s to 70 km/s and more - even before their collision with the Earth's surface.

In the case of a positively charged plasmoid (see Fig. 1), the analogue of a fully reflecting mirror is the end of its tail, which is located at a distance of approximately 30 kilometers from the meteoroid.

The analogue of a transparent mirror is the area near the asteroid, the movement and destruction of which generates a new element of the positively charged plasmoid (Fig. 4b). All the kinetic energy of the asteroid initially passes into the electrical energy of the radial capacitor (Fig. 7), and when it is broken down by CJ, into the electrical energy of a highly conductive line polarized in the longitudinal motion of the meteoroid (Fig. 7). All this is accompanied by bright explosions and radiation.

Within the framework of mechanical models alone [6-16, 21-33] or the charging of the meteoroid alone [34,35], it is impossible to explain the entire spectrum of amazing phenomena that occurred during the penetration of the Chelyabinsk meteoroid in 2013 into the electronegative atmosphere of the Earth (Fig. 1). As for the libration (cumulation) points L_1 between binary stars, in modern works the structural Vysikaylo-Poisson'sturbulence is taken into account at all [3].The results [1-3] are useful for making discoveries that were previously not possible, resolving controversies, and creating innovative technologies such as the use of a plasma tail or an external combustion engine.

Our research proves the validity of the further development of Louis de Broglie's hypothesis: "particles behave like waves" and can form their flows similarly to electromagnetic waves in a conventional laser (in the plasma tail of an asteroid or meteoroid). In this case, the role of Vysikaylo's incongruent shock waves of the electric field restraining the radial expansion of the plasma tail behind the asteroid is significant.

The mechanism we proposed [1-3] explains all the observed phenomena during the propagation of electric arcs, lightning, and the 2013 Chelyabinsk meteorite entering the Earth's atmosphere, and proves that de Broglie electron-wave lasers with a resonator length of 10 cm to 30 km and a diameter of about 18 m are realized in nature and can be described theoretically. This gives us grounds to use this mechanism to explain the joint organization of opposite proton jets from black holes [3] and electrons into black holes. These laser-like jets have already been observed in Hubble-type telescopes and have a length of up to 1.5 kpc (Fig. 5). Thus, our cumulative-reactive mechanism is capable of explaining the increased velocities of active neutron stars. We have described in detail for the first time the chemical kinetics of nanoparticles in incongruent Vysikaylo's shock waves of electric field for protecting the Earth from asteroids and explained in detail the pure transmutation of the kinetic energy of the asteroid into opposite jets of charged particles by analogy with ordinary lightning.

In this paper, we present a new interdisciplinary approach that combines plasma physics, quantum theory, and atmospheric observations. Our model, based on cumulative-dissipative systems and the application of Vysikaylo's mechanisms for co-organization of cumulation and dissipation processes of energy-mass-momentum flows (EMMF), offers an innovative view of meteoroid fragmentation and observed phenomena associated with the Chelyabinsk event.

To prove the correctness of our approach, we provide the necessary detailed theoretical explanations and references to historical and recent observational data. Analogies drawn between lightning discharge mechanisms, astrophysical jets, and plasma behavior in laboratory conditions help us convincingly unite various physical phenomena and thus prove that the world from femto-structures to the world of galaxies is governed by fairly general laws of cumulation and dissipation of EMMF [36].

Despite the richness and technical component of the article, the presentation retains the clarity of the main scientific arguments.

Readers with experience in plasma dynamics and field theory will likely find our ideas interesting and thought-provoking.

The author believes that this paper will make a significant contribution to the ongoing debate about natural high-energy atmospheric events and the mechanisms that protect planet Earth.

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Asynchronous Electric Drive with Reactive Power Control

By R. A. Chepkunov

Abstract- A method of controlling an asynchronous electric drive based on measuring and regulating the reactive power of an induction motor is proposed. The independence of the rotor flux and the electro mechanical moment from the change in the parameters of the induction motor is ensured, a continuous range of speed regulation, including zero, and fast-acting regulation is ensured.

Keywords: *asynchronous electric drive, rotorflux, changing the parameters of an induction motor.*

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Asynchronous Electric Drive with Reactive Power Control

R. A. Chepkunov

Abstract- **A method of controlling an asynchronous electric drive based on measuring and regulating the reactive power of an induction motor is proposed. The independence of the rotor flux and the electro mechanical moment from the change in the parameters of the induction motor is ensured, a continuous range of speed regulation, including zero, and fast-acting regulation is ensured.**

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I. Main Text

Introduction

The peculiarity of the control of an asynchronous electric drive (ED) is the need to ensure the rotor flux coupling of an induction motor (IM) to ensure the necessary electromechanical torque of the motor. With the correct solution of this problem, an asynchronous ED in terms of its dynamic properties approaches a direct current ED with independent excitation.

During scalar control of an asynchronous ED, the rotor flux is formed due to the functional dependence of the IM voltage on the frequency with possible consideration of the current. With vector control - due to the direct and inverse transformation of the coordinate system of the current and voltage vectors of the frequency converter (FC) with the selection of active and reactive components of the current relative to the FC voltage and relative to the EMF of the rotor and the regulation of signals proportional to the ED speed and rotor flux coupling [1-3].

The error in determining the rotorflux coupling depends on the error entered for the calculations of the internal inductances and resistances of the IM, especially on the resistances of the stator and rotor, which are subject to temperature changes. This error can significantly worsen the ED characteristics, in particular, limit the speed control range from below due to the impossibility of creating the necessary electromagnetic moment at low IM rotation frequencies.

To improve the characteristics of the ED, an observer is used, which automatically monitors the change in IM parameters, which depend on the accuracy of determining the components of the current relative to the EMF and the signals that determine the IF voltage and the speed of the ED. The existence of many types of observers [2] speaks of the problem of taking into account changes in IM parameters. High-quality monitoring requires high computing capabilities of microprocessor control systems of FC for ED.

To track the time constant of the rotor, which can change during the operation of the ED due to the temperature change of the active resistance of the rotor, or the change in the inductance of the rotor, the reactive power of IM that is consumed is determined in work [3]. The current value of the rotor time constant determined in this way is subsequently used in the above forward and reverse coordinate transformation to control the stator current, rotor flux coupling and ED as a whole.

Considering that the reactive power is uniquely related to the rotorflux coupling and in the steady state does not depend on the resistances of the stator and rotor, it is possible to simplify the task of controlling the ED by determining the rotorflux coupling and the speed of the ED through the reactive power [4].

The purpose of the work is to consider the features of the practical use of the method of controlling an asynchronous ED, which is based on the measurement of the reactive power consumed by the IM.

Presentation of the main material. Based on the expressions given in [3], the relationship between the rotor flux coupling and the instantaneous reactive power of IM can be written in the form:

$$\bar{U}_S \, x \, \bar{I}_S = I_S{}^2 \omega \sigma L_S + \frac{\omega_\Psi \Psi_r{}^2}{L_r} + \frac{\omega_r}{R_r} \frac{d\Psi_r}{dt} \Psi_r , \qquad (1)$$

where each term without taking into account the proportionality factor means the following:

$\bar{U}_S \, x \, \bar{I}_S$ - the vectors product of the stator voltage $\bar{U}_S$ and current $\bar{I}_S$, which determines the instantaneous reactive power (the full instantaneous reactive power of IM is 3/2 times more); $I_S{}^2 \omega \sigma L_S$- reactive power on the dissipation inductance σL_S of the stator phase, I_S – modulus of vector $\bar{I}_S$; $\frac{\omega_\Psi \Psi_r{}^2}{L_r}$ – reactive power on the inductance of the rotor; Ψ_r -moduleof the vector of the rotor flux;

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$\frac{\omega_r}{R_r}\frac{d\Psi_r}{dt}\Psi_r -$ is the dynamic component of reactive power.

Relating to the stator the resistance and inductance of the entire circuit between the FC and IM, the product of the stator voltage and current vectors can be given as the product of the FC voltage and current vectors $\bar{U}\bar{I}$. By plotting the FC voltage and current vectors in the rotating orthogonal coordinate system oriented by voltage, the product of the voltage and current vectors can be defined as the product of the FC voltage U and the reactive component of the FC current I_{XU} relative to this voltage: $\bar{U}\bar{I} = UI_{XU}$, where $I_{XU} = I\sin\varphi$, φ is the angle between voltage and current vectors. The value of the current I_{XU} at the angle θ_U, which is counted from the moment of the phase A transition of the FC voltage from minus to plus (also the angle of rotation of the rotating coordinate system), can be found using the coordinate transformation formula

$$I_{XU} = -i_a \sin\theta_U - \frac{1}{\sqrt{3}}(i_a + 2i_c)\cos\theta_U, \qquad (2)$$

where ia, ic are the instantaneous value of the currents of phases A and C at the moment of current measurement at the angle θ_U.

Finding the active component of the current relative to the voltage $I_{RU} = I\cos\varphi$ according to the formula

$$I_{RU} = i_a \cos\theta_U - \frac{1}{\sqrt{3}}(i_a + 2i_c)\sin\theta_U, \qquad (3)$$

the square of the full current can be determined:

$$I^2 = I_{RU}{}^2 + I_{XU}{}^2.$$

In the steady state, the dynamic component of the reactive power is zero, and the rotor flux coupling frequency ω_ψ is equal to the output frequency of the FC voltage ω. In this mode, expression (1) taking into account the above-mentioned re-designations takes the form:

$$UI_{XU} = I^2\omega L_C + \frac{\omega\Psi_r{}^2}{L_r}. \qquad (4)$$

Here, L_C is the inductance of the stator circuit, including the dissipation inductance of the stator phase σL_S. Violation of this condition causes a transient process. If at the same time the FC voltage is influenced by changing the reactive power UI_{XU}, it is possible to reach a steady state again, in which the rotor flux coupling will correspond to the reference rotor flux Ψ_{r*}.

This influence can be carried out with the help of the FC voltage regulator. With an integral regulator according to the formula:

$$U = k_{int.U}\int\left(I^2\omega L_C + \frac{\omega\psi_r^*}{L_r} - UI_{XU}\right)dt, \qquad (5)$$

where $k_{int.U}$ is the integral coefficient of the voltage regulator.

The specified value of the flux coupling of the rotor Ψ_r^* is determined by the dependence $U(f)$ of the voltage on the FC frequency $f=\omega/2\pi$. For low-frequency regulation requirements, the characteristic [5] can be used:

$$U(f) = I_{\mu*}\sqrt{R_C{}^2 + [2\pi f(L_C + L_0)]^2},$$

where R_C is the resistance of the stator circuit, L_0 is the mutual inductance of the stator and rotor; I_μ^* is the set value of the magnetization current, which can be determined through the nominal values of frequency f_{nom} and voltage U_{nom} according to the formula $I_{\mu.}^* \approx U_{nom}/2\pi f_{nom}(L_S + L_0)$. (Here voltage and current are given in actual values).

The voltage value U is determined by the microprocessor control system as a function of all variables at a given discreteness interval, and its value at the previous discreteness interval is taken as the value of U in the right part of the formula. The discreteness of calculations is determined by the modulation frequency, which in modern FCs is measured in kilohertz. As a result of the transformation of the coordinate system into a rotating system with constant variables in expression (5), the voltage U is constant at all periods of discreteness.

The FC voltage calculated in this way does not depend on the IM resistances, which are subject to temperature changes, and ensures that the rotor flux coupling corresponds to the set value.

At frequencies close to zero, you can use the value of the reactive power for some frequency close to zero, at which the calculated error does not exceed the permissible, for example, 1% of the nominal. In this way, it is possible to ensure the nominal IM torque over the entire range of speed changes, including zero.

In the ED without a speed sensor, to ensure the compliance of the speed with the set value, it is necessary to take into account the IM slip, the frequency of which f_S is proportional to the rotor current I_r. If the rotating orthogonal coordinate system is oriented not by the FC voltage, but by the flux-coupling EMF of the rotor, then the active component of the current relative to the EMF I_{RE} will mean the rotor current I_r: $I_{RE} = I_r$. Then the sliding frequency can be found as:

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$$f_s = \frac{1}{2\pi\Psi_r} R_r I_{RE} \quad (6)$$

and ED speed regulation should be carried out according to the formula:

$$f = f^* + f_s,$$

where f is the frequency of the output voltage of the inverter ($f=2\pi\omega$), $f^*$is the reference frequency.

The constancy of the rotor flux Ψ_r provided by the voltage regulator, allows you to use this formula in the entire regulation range.

The active component of the current relative to the EMF I_{RE} can be determined from the expression for coordinate transformation, in which, unlike expression (3), instead of the angle θ_U, which is independent of IM parameters, the angle θ_E is used, which is calculated from the transition of the EMF of phase A through zero. At the same time, the angle θ_E, which is due to the IM parameters, depends on their change.

The I_{RE} current will not depend on changes in IM parameters, if it is found based on the reactive power, taking into account formula (4):

$$I_{RE} = \sqrt{I^2 - \frac{UI_{XU} - I^2\omega L_C}{\omega L_r}}, \quad (7)$$

where the expression under the root is the difference of the squares of the full current and the reactive component of the current I_{XE} relative to the EMF. As can be seen, there are no temperature-dependent active resistances in this expression.

Thanks to the rotor flux coupling regulator, Ψr does not depend on changes in IM parameters. However according to (6), the slip frequency f_S, and therefore the IM speed $v = f - f_S$, at a constant current I_{RE} and a certain moment depend on the temperature change of the rotor resistance. Therefore, with high requirements for speed regulation accuracy, adaptation of the regulation system to changes in rotor resistance should be used or a speed regulator should be used.

If full slip compensation, when $f = f^* + f_s$, is provided at some average rotor temperature, there will be overcompensation at a low temperature, and under compensation at a high temperature. When overcompensating for slippage, the possible instability of the control system should be taken into account. Thus, when overcompensating with a coefficient for an integral frequency regulator, the stability condition has the form [6]:

$$k < \frac{T_{\text{int}}}{T_M(1 + T_C / T_{\text{int}})}, \quad (8)$$

where T_M is the electromechanical time constant of ED; T_C is the time constant of the stator circuit; T_{int} is the integration time constant of the frequency control circuit.

The structural diagram of the ED with reactive power control [7] is presented in Fig. 1, where CC is a coordinate converter; SS and SR - speed sensor and speed regulator; n, n^* – speed and reference speed; Ud is the input voltage of the inverter (the circuit that provides the motor voltage U regardless of the change in Ud is part of the inverter); i_a, i_c – currents of phases A and C of the frequency converter (FC); k_f,T_{int} – coefficient and the time constant of the frequency regulator.

Functional blocks perform operations:

F1 - determines the reference of the reactive power

$$Q^* = I^2\omega L_c + \frac{\omega \Psi_r^{*2}}{L_r},$$

where L_c,L_r are the stator and rotor inductances, $\Psi_r^*$is the reference rotorflux, $\omega = 2\pi f$.

F2 - determines the active component of the rotor current, according to (7). The I_{RE} value is calculated without taking into account the sign.

The sign of the I_{RE} current depends on the specified direction of rotation of the IM and on the mode in which it operates, engine or generator. To determine the sign, you can use the expression for active power P_R:

$$P_R = UI_{RU} - I^2 R_C,$$

where R_C is the resistance of the stator circuit, including the resistance of the connecting wires between the inverter and the motor.

If the active power is positive, then the I_{RE} is marked with a "+", if it is negative - the sign is "-". Since the active power depends on R_C, which is prone to temperature changes, it is advisable to periodically specify its value, this is possible with the output frequency of the inverter close to 0 Hz (in the frequency range of ±0.1 Hz) in a stable mode of operation: $R_C \approx U/I$. Taking into account theit can beimplemented programmatically.technological due to the features of the electric drive,

The direction of slip compensation depends on the sign of I_{RE}: with the "+" sign, the slip compensation increases the frequency, with the "-" sign it decreases the frequency, possibly to zero and reverse.

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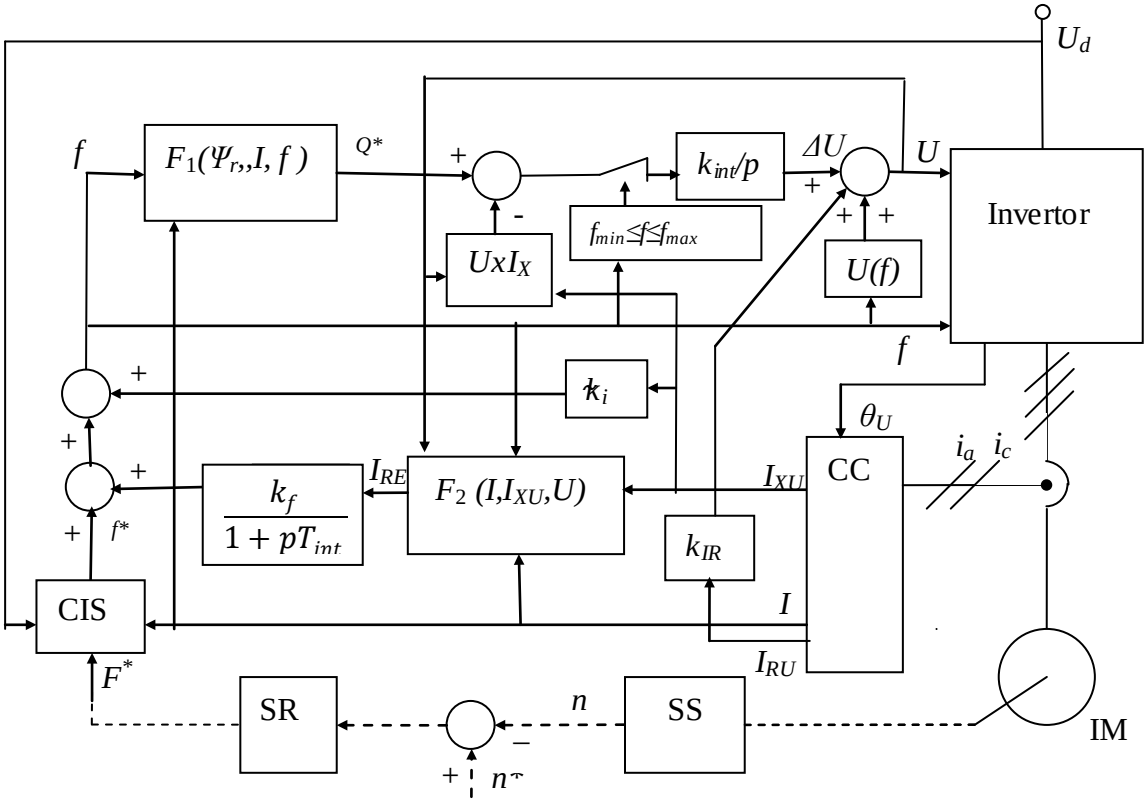


Fig. 1

The figure also shows:

CIS is a controlled intensity setter that controls the set frequency f^*, limits the rate of change of f^* at a high rate of change of the frequency F^*at the input of the set intensity setter; prohibits increasing the frequency when the current I exceeds the permissible value or reduces it when it is greatly exceeded; prohibits frequency reduction when the input voltage of the inverter U_d exceeds the permissible value;

k_{IR} – the IR-compensation coefficient, which increases the voltage of the converter by the value of the voltage drop on the internal resistors of the AM at current I;

k_i is the feedback coefficient of the reactive component of the current to ensure the stability of the automatic control system at low FC frequencies. In the given scheme, before multiplying by k_i, the variable component of the signal I_{XU} is allocated.

As can be seen from the structural diagram, all the signals on the adders are marked "plus", except for the signal of the measured reactive power UxI_{XU} for the reactive power regulator and the signal of the speed sensor in the presence of a speed regulator. Such a scheme provides optimal microprocessor control of the electric drive with the permitted rate of change of the speed of the electric motor. The reactive power regulator with the output signal ΔU regardless of the temperature change of the electric motor parameters provides the necessary flux coupling of the rotor to create the necessary mechanical torque of the motor over the entire speed control range, including zero speed.

The structural diagram shows a comparison of the set and actual values of the reactive power and presents a variant of the regulator, when the output signal does not change in the specified frequency interval near the zero value, therefore the regulator is taken as integral, *kint* is the coefficient of the regulator.

The speed of the ED is demonstrated on the oscillogram of the reverse current at a frequency of 30 Hz in the alternating current ED EKT4R-250-380-50 with electricity recovery into the power supply network of the Zaporizhzhya Electrical Apparatus Plant, given in [7], (Fig. 2). When the frequency f is reduced, there is a limitation of the speed of the frequency change according to the voltage U_d, and when the frequency is increased, there is a limitation according to the current I. Taking into account the limitations of the voltage and current, the reversal time is minimal. The reverse can be judged by the change in the phase alternation of the currents i_a, i_c.

With voltage or current restrictions, the reactive power regulator does not work. But when the ED works without limiting the signals, it increases the quality of the ED due to pre-voltage regulation by the ΔU signal.

A feature of a high-quality ED is the ability to work with multidirectional disturbances aimed at braking or acceleration of the engine. This is important for the

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electric vehicle drive, crane electric drive, metallurgical, for example, divert ingroller conveyors with a combination of acceleration and braking and other electric drives.

Different polarity disturbances when working with a 30 kW engine are shown in fig. 3. At the same time, the speed is reduced to one pair of IM poles, therefore the signals of the speed n, the set value of the speed n^*, the frequency f, the set value of the frequency f^* , F^* have the same scale. In the absence of a speed regulator and one pair of poles $n^* = F^*$. Values along the ordinate axes are in hertz and amperes. Voltage U is reduced to frequency by multiplying by the ratio of nominal values f_{nom}/U_{nom}. All signals were calculated for each discreteness interval. In this case, the discreteness of the calculations is 0.5 ms, which corresponds to the microprocessor modulation frequency of 2 kHz. In practice, there may be a higher modulation frequency. This makes it possible to approximate the sinusoidal voltages of the inverter with great accuracy and to form almost inertialess regulation processes in the ED. In case of braking disturbances, in which the speed decreases, the control system increases the FC frequency, and in acceleration disturbances, in which the speed increases, it reduces the IF frequency, while ensuring the necessary IM sliding.

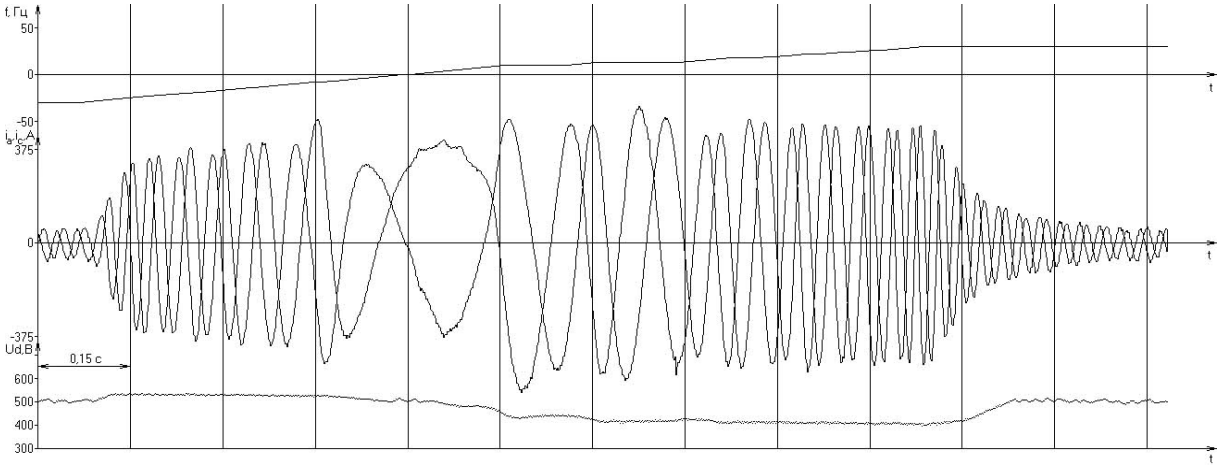


Fig. 2

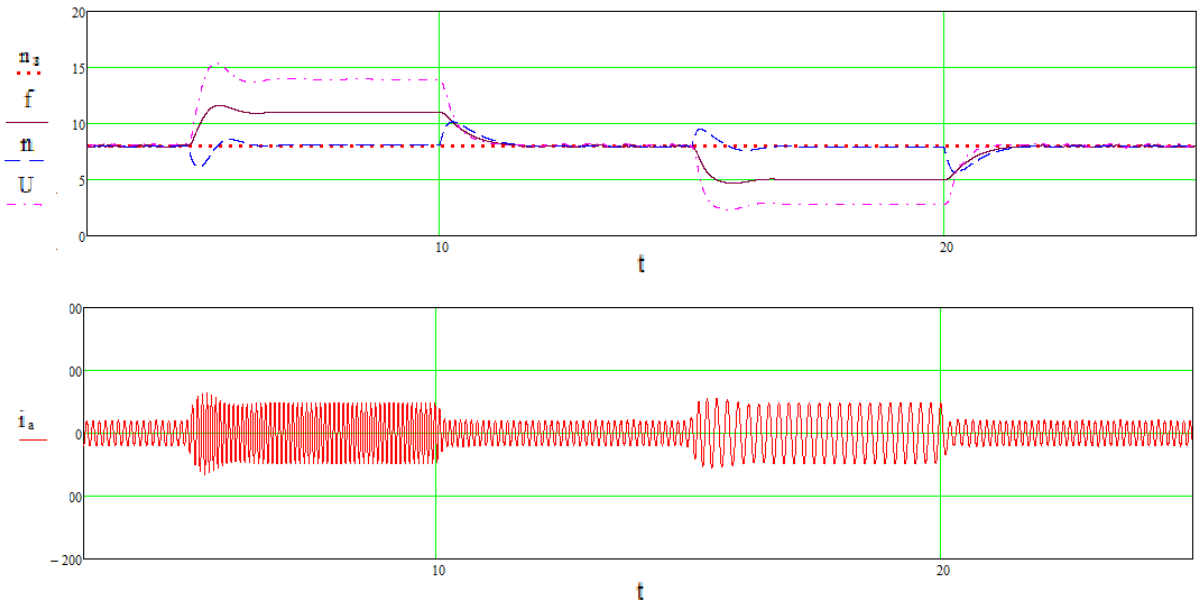


Fig. 3

The decrease and increase of sliding in the figure corresponds to the application of the nominal load moment to the electric motor in one direction or another.

If there quired frequency reduction is greater than the set value of the speed, then the inverter must reverse, and the established value of the frequency after the reversal f_R must complement the set value nback to

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the value of the sliding frequency f_S required for the compensation of the slip f_S:

$$f_R = f_S - n^*.$$

This was confirmed during testing of the electric drive and can be seen from the oscillogram obtained during mathematical modeling in fig. 4, where the set value n^* gradually changes from +1 Hz to –1 Hz when the direction of periodic disturbances is alternately changed. Also, as in fig. 2, in fig. 4 shows two currents i_a, i_c, by alternating which it is possible to judge the direct or reverse mode of operation of the electric drive.

With the second and last disturbance in fig. 4, the frequency increases as with the first disturbance in fig. 3. And with the first, third and fourth disturbances, the frequency decreases to zero and after the reversal increases to f_R.

The details of the process can be seen in the figure with an enlarged time scale during the first disturbance. In the first section, the frequency decreases to zero, then reverses (on the diagram at the moment of 5,52 s), which can be seen from the change in the phase alternation of the currents ia, ic. Then the frequency increases to the value f_R and the speed n approaches the set value nback. After the end of the disturbance, the frequency of the currents decreases to zero, a reversal occurs (on the diagram at the moment 17,5 s), and the frequency increases to correspond to the set speed value. At the same time, the reverse process is continuous and inertialess, unlike similar processes in a direct current drive with separate control of bridges with three-position or scanning logic [8].

It should be borne in mind that at a frequency close to zero, the reactive component of the current decreasesfor the calculation of the reactive power required for controlling the ED, and the error in its determination also increases. One of the ways to determine the reactive power at a frequency close to zero is to use the value of the reactive power at the border of the interval, where the error is still satisfactory. The existing error does not mean a reduction in the speed control range, since the speed differs from the frequency due to slippage, and the speed measurement error is smaller, the greater the engine load. When the frequency is close to zero, the speed depends on the load moment of the electric motor.

Thus, within the frequency interval $f_{min} < f < f_{max}$ (see fig. 1), where the reactive power measurement error is large, the output signal of the reactive power regulator ΔU takes the value $\Delta U(f_{min})$ or $\Delta U(f_{max})$, depending on whether the frequency increased in the region of negative frequencies, reaching fmin , or decreased in the region of positive frequencies, reaching fmax.

The change in the load moment in the middle of the specified frequency interval can be taken into account by the corresponding change in the current

$$I = \sqrt{\frac{4}{3}(i_a^{\,2} + i_a i_c + i_c^{\,2})}, \qquad (9)$$

and not its active component, which is acceptable, since at low frequency the difference between them is small. (According to formulas (2, 3, 9) the amplitude values of the current and its active and reactive components are calculated).

To reduce the error of determining the active and reactive current components at low frequency, and the corresponding reduction of the limited frequency interval around the zero value, their instantaneous values can be calculated not only relative to the transition time of the voltage curve of phase A of the FCfrom the region of negative values to the region of positive values, but also relative to time of the next transition through zero of any of the phases both from the region of negative values to the region of positive values according to expressions (2, 3), (11), (13), and from the region of positive values to the region of negative values according to expressions (10), (12), (14) with the current values of the angles θ_a, θ_b , θ_c and θ_{-c} , , θ_{-a} ,, θ_{-b} , respectively. The "minus" sign in the index means that the angle is calculated from the transition of the voltage curve from a positive to a negative value.

$$i_R = -i_c \cos\theta_{-c} - \frac{1}{\sqrt{3}}(i_a - i_b)\sin\theta_{-c}$$

$$i_X = -i_c \sin\theta_{-c} - \frac{1}{\sqrt{3}}(i_a - i_b)\cos\theta_{-c} \qquad (10)$$

$$i_R = i_b \cos\theta_b + \frac{1}{\sqrt{3}}(i_c - i_a)\sin\theta_b$$

$$i_X = i_b \sin\theta_b + \frac{1}{\sqrt{3}}(i_c - i_a)\cos\theta_b \qquad (11)$$

$$i_R = -i_a \cos\theta_{-a} - \frac{1}{\sqrt{3}}(i_b - i_c)\sin\theta_{-a}$$

$$i_X = -i_a \sin\theta_{-a} - \frac{1}{\sqrt{3}}(i_b - i_c)\cos\theta_{-a} \qquad (12)$$

$$i_R = i_c \cos\theta_c + \frac{1}{\sqrt{3}}(i_a - i_b)\sin\theta_c$$

$$i_X = i_c \sin\theta_c + \frac{1}{\sqrt{3}}(i_a - i_b)\cos\theta_c \qquad (13)$$

$$i_R = -i_b \cos\theta_{-b} - \frac{1}{\sqrt{3}}(i_c - i_a)\sin\theta_{-b}$$

$$i_X = -i_b \sin\theta_{-b} - \frac{1}{\sqrt{3}}(i_c - i_a)\cos\theta_{-b} \qquad (14)$$

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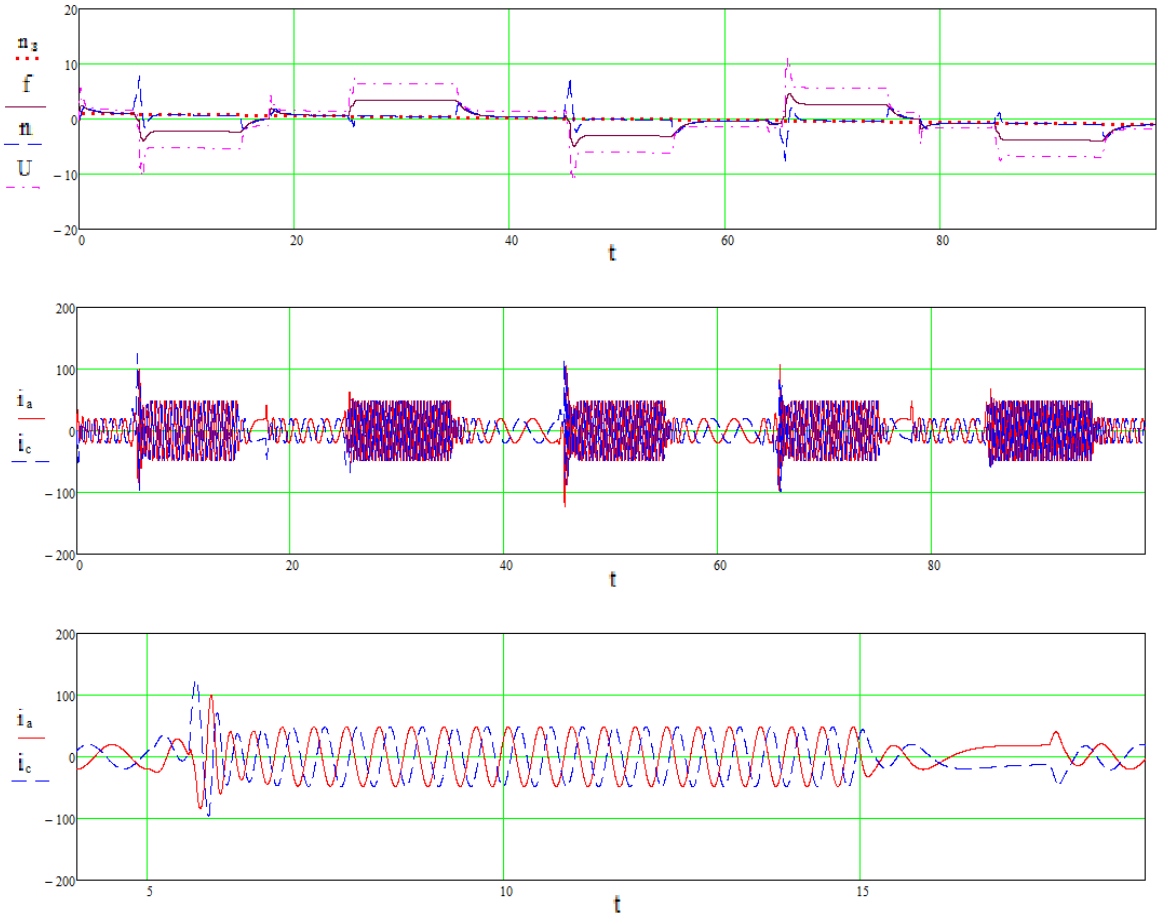


Fig. 4

The modes of operation of the electric drive described here were carefully studied at the Zaporizhzhya Electric Apparatus Plant, including on a crane electric drive with a 20 kW induction motor with an EKT4D-100 frequency converter at different speeds of moving loads up and down, especially at speeds close to zero, and were confirmed by mathematical modeling.

II. Conclusions

The independence of the electromagnetic torque of the motor from the change of internal resistances allows the asynchronous electric drive with reactive power control to have practically inertialess regulation and inertialess reverse, which is determined by pulse-width modulation of the FC voltage. Such regulation can occur both with large changes in control signals and when the electric drive is operating at a frequency close to zero, including when applying a braking mechanical torque that reduces the frequency to ensure the necessary rotor slippage. To increase the accuracy of the adjustment, the time count when determining the reactive power at low frequencies can be made from the last transition through the zero of the FC output voltage. In the interval of positive and negative frequencies close to zero, in which the error of determining the reactive power is significant, the reactive power is equated to its last value at one or another boundary of the interval. Such properties make it possible to supply an asynchronous electric drive with reactive power control instead of more expensive and less reliable direct current electric drives.

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Towards a New Quantum Model of Mass Evolution through Symmetry Breaking

By Nishant Sahdev & Chinmoy Bhattacharya

Abstract- The phenomenon of symmetry breaking has remained a significant and widely discussed topic in physics over the past few decades. It has been postulated that the mass of the universe evolved from the spontaneous breaking of symmetry in the atoms or molecules of baryonic matter. However, no concrete theory or model currently exists in the literature that can explain the mechanism of symmetry breaking in a tripartite manner—that is in regard to physics, mathematics, and topology—despite substantial research efforts.

A major problem in physics arises from the inconsistency that, while the volume or size of atoms and molecules is approximated as three-dimensional spheres, the dimension of mass remains non-deterministic.

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Towards a New Quantum Model of Mass Evolution through Symmetry Breaking

Nishant Sahdev [α] & Chinmoy Bhattacharya [σ]

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A major problem in physics arises from the inconsistency that, while the volume or size of atoms and molecules is approximated as three-dimensional spheres, the dimension of mass remains non-deterministic.

In this research article, a topological quantum model—logically grounded in the philosophies of both mathematics and physics—is presented to reveal the mechanism of the "evolution of mass from spherically symmetrical atoms and molecules." The dimensional form of mass, in relation to the fundamental dimension of length (L) in physics, is evaluated here. Furthermore, the classical principle of conservation of momentum is reinterpreted in terms of mass and volume, and a mathematical relationship between these two variables is established through the universal parameter π.

It has been firmly established in this article that while a quantum of volume exists in the direct three-dimensional "time-space" of the universe, a quantum of mass exists in the inverse three-dimensional space. Masses belong exclusively to this "reciprocal space," and mass and volume share a multiplicative inverse relationship. In general relativity (GTR) the mass has been defined as the 'warp' of the 'time-space' of the universe. The 'time-space' in GTR has been claimed to be a 4D one and is hyperbolic in their topology. A hyperbolic space has a negative curvature and does fall in the category of reciprocal space only. GTR of Einstein gave major emphasis on mathematics and most of the concepts were a sort of floating concept in physics. As well GTR had failed to reveal how a 'reciprocal space' is being evolved topologically from 'direct space' of the universe. The current model as being offered in this article fills the said gap in GTR and rightly evaluated the hyperbolic geometry of mass.

This new model has got a resemblance with Anti – De Sitter space too which is maximally symmetric Lorentzian manifold with constant negative curvature. This is very much significant in theoretical physics and general theory of relativity.

The conventional principle of equipartition of energy in physics deals only with the degrees of freedom of atoms and molecules, allotting (kT/2) energy for each degree of freedom, where k is the Boltzmann constant and T is the temperature in Kelvin. However, this formulation is silent on how volume and mass are distributed or partitioned. In this article, it is shown that an equipartition exists between volume and mass as well.

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I. Introduction

In the periodic table of elements, as one moves down any group from top to bottom, both the volume (or size) of atoms and their mass numbers generally increase. This trend reflects the addition of electron shells and the corresponding increase in atomic mass. Table 1 presents the atomic radii, mass numbers, and densities of Group I elements. As seen in the table, a consistent trend emerges—both atomic size and mass increase down the group—with the only notable exception being potassium (K).

$$\text{Atomic radii} \propto \text{Mass number} \propto \text{density}$$

Table 1: Atomic radii, densities, and mass numbers of Group I elements in the periodic table. [1]

Element	Atomic Radii (pm)	Density (gm/cc)	Mass number (gm)
Lithium	152	0.53	6.94
Sodium	186	0.97	22.99
Potassium	220	0.86	39.09
Rebuidium	244	1.53	85.47
Cesium	262	1.9	132.905

Like the mass numbers (or mass m), the densities of elements also tend to increase with increasing atomic radii. A higher density implies that more mass (m) is being concentrated within a given volume (V). Thus, both density and mass can be seen as indicators of the 'attractive' forces operating among atoms and molecules in the universe. Based on the experimental data presented above, one can conclude that:

$$m \propto V$$

This implies that the absolute *dimension* of mass and the absolute *dimension* of volume must be inversely related; otherwise, the observed direct proportionality between mass and volume cannot be theoretically justified. If volume and mass were

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dimensionally the same—for instance, if both were represented by 2D circles—then the forces at the center of mass and the center of volume would have to act in the same direction, as illustrated in Figure 1a below:

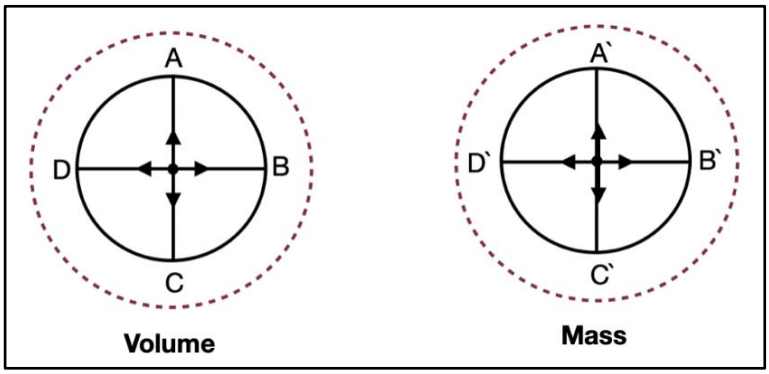


Figure 1a: Topological representation of volume and mass

Under such circumstances, the forces acting on both volume and mass would increase simultaneously as a function of atomic radii, eventually tending toward extremely large magnitudes. Since energy is defined as the product of force and distance, this would imply an infinite amount of energy—thereby violating the thermodynamic principle of conservation of both mass and energy. Such a condition is physically impermissible.

Conversely, if the topological geometries of volume and mass take on forms as illustrated in *Figure 1b* below, then the forces acting at the centers of mass and volume would act in opposite (inverse) directions. In such a configuration, the product of these forces would be constrained and could never approach infinity, preserving the physical and thermodynamic consistency of the system.

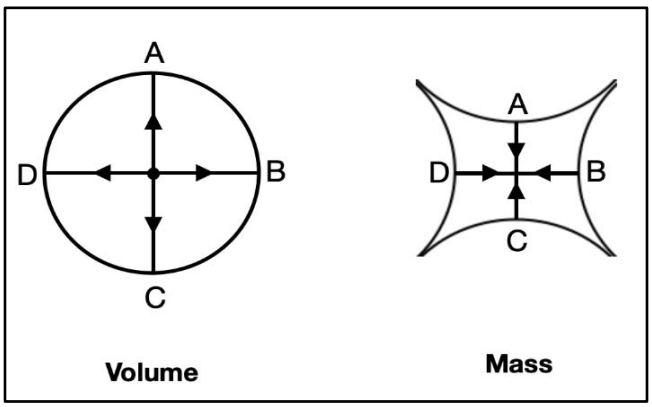


Figure 1b: Topological representation of the inverse dimensional relationship between mass and volume, illustrating the multidirectional character of volume versus the unidirectional character of mass

In *Figure 1b*, mass is represented by a 2D saddle-shaped geometry. Importantly, the hybrid or product of volume and mass can be expressed as:

$$(\text{Volume} \times \text{Mass}) \propto [S \times (1/Q)]$$

Here, *S* denotes the force acting through the center of volume, and *(1/Q)* represents the force acting on the center of mass, as illustrated in the figure. The detailed theoretical basis for this inverse relationship between volume and mass will be elaborated in the subsequent model. However, it is crucial to note that this inverse relation inherently prevents any violation of the principle of conservation of energy under all conditions. It will be shown that as the value of *Q* increases, *S* increases correspondingly, and vice versa, maintaining a balanced system.

In Anti De Sitter Space, the curvature of space like section is negative, corresponding to a hyperbolic geometry as is being shown in Figure 1b (i) below.

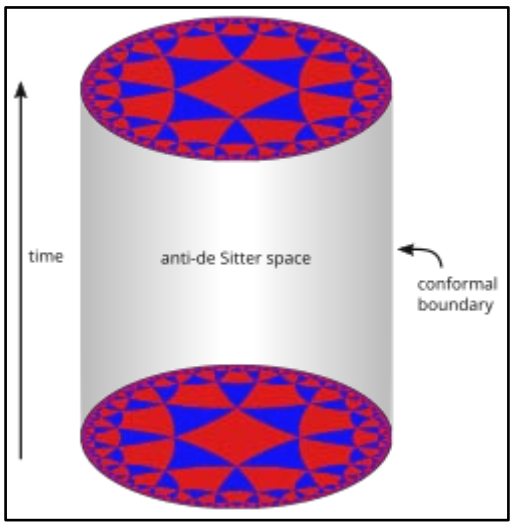


Figure 1b(i): Typical 3D presentation of a 3D Anti De Sitter hyperbolic 'time-space' of the universe

While Figure 1b(i) is the typical representation of a Anti De – Sitter space which had been derived mathematically , the Figure 1b of the new model offered in this article is a topologically derived very simple formalism of the 'mass-volume' relationship and the said 'mass-volume' are the building stone of the De Sitter and Anti De Sitter 'time-space' of the universe.

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II. Theoretical Quantum Model of the Symmetry Breaking Phenomenon

This section presents a theoretical model to topologically explain how attractive forces arise among molecules—regardless of whether the substance is in a gaseous, liquid, or solid state.

In physical chemistry and physics, atoms and molecules are generally considered spherical in shape. As molecular size increases, so does molecular mass. For instance, the average atomic radius of a hydrogen atom is approximately 37 picometers, whereas that of a cesium (Cs) atom is about 260 picometers. Correspondingly, cesium is roughly 133 times heavier than hydrogen (with atomic weights of 133.9 and 1, respectively). Thus, an increase in atomic or molecular weight is typically accompanied by an increase in atomic/molecular size.

As the size of atoms increases, more electronic orbitals are added, which in turn raises their total energy. Therefore, atomic size—or volume—can also be seen as an indirect representation of an atom's energy level.

To simplify the representation in this model, atoms and molecules are illustrated in *2D*. As shown in *Figure 1c* below, when four molecules become entangled, energy interactions occur among them. This interaction leads to the formation of an "inverse area"—an emergent attractive energy that is fundamentally topological or geometrical in origin.

In the configuration shown in Figure 1c, if a molecule attempts to move or collide with a boundary (such as a wall), the network of interlinked 2D circles exerts a pulling force that resists this motion. This demonstrates how topological entanglement generates a binding energy among molecules.

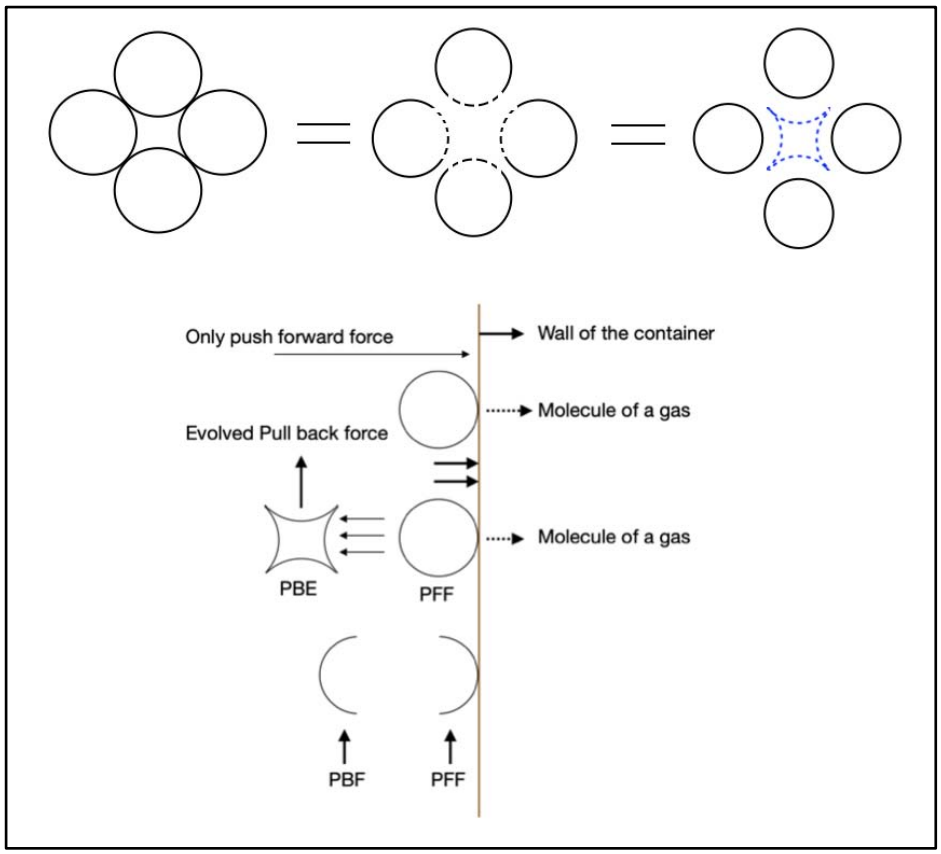


Figure 1c: Evolution of 2D saddle from 2D circle

The geometry that emerges from the interaction of entangled molecules is termed a *2D saddle*. While 2D circles represent random and isotropic configurations, 2D saddles are *attractive* in nature due to their *reversed curvature*. As illustrated in *Figure 2*, equal areas from each of the original circles (depicted as the shaded or lined portions) are removed, resulting in new, smaller circles. These new circles have reduced areas—diminished by a certain percentage of the originals—and their combined cut-out areas form the saddle-shaped geometry. This geometry, however, is *inverse* in nature compared to the original circles.

As previously discussed, the size of atoms is indicative of their energy levels. In the 2D representations used here, *areas* correspond to *volumes*, and thus *inverse areas* represent *inverse volumes*. Prior to the molecular entanglement shown in *Figure 5*, the geometry of the system was of a "push-forward" type. However, after the formation of the 2D saddle, a "pull-back" geometry emerges.

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In this model, it is shown that the product of the *push-forward area (PFA)* and the *inverse of the pull-back area (PBA)* remains constant. This relationship is expressed as:

$$K = [(\text{push forward area} \times \text{pull back area})] = \text{constant} \quad (1)$$

As demonstrated in *Figure 2*, PFA and PBA are *interconvertible*. This reinforces the principle that pull-back areas (PBA) evolve directly from push-forward areas (PFA), and conversely, PFA can evolve from PBA. These transformations highlight a dynamic equilibrium and topological symmetry in the geometry of mass–volume interaction.

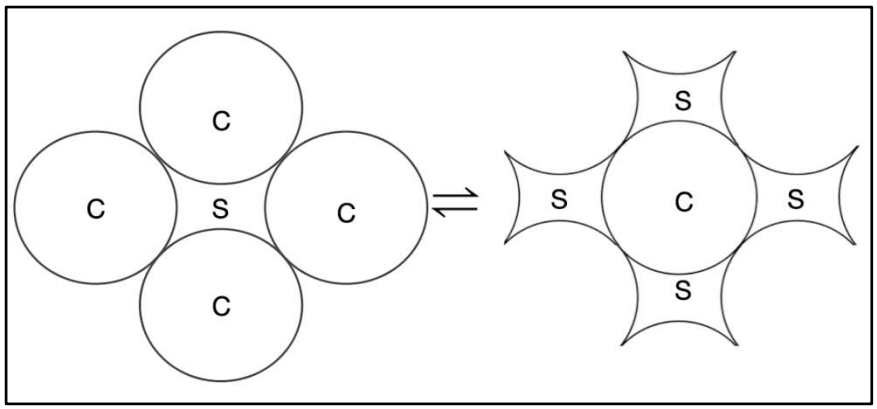


Figure 2: Interconvertibility of circle to saddle and vice versa

The *Push-Forward Area (PFA)* and the *Pull-Back Area (PBA)* are *complementary* to each other. As the PFA increases, the PBA also increases; however, their relationship is governed by a *mathematical multiplicative inverse*, as expressed in *Equation (1)*. This inverse proportionality ensures that their product remains constant.

Figure 3 illustrates how PFAs and PBAs vary in response to each other. As shown, an increase in one corresponds to an increase in the other, yet their behavior remains constrained by their inverse relationship—preserving geometric and energetic balance within the system.

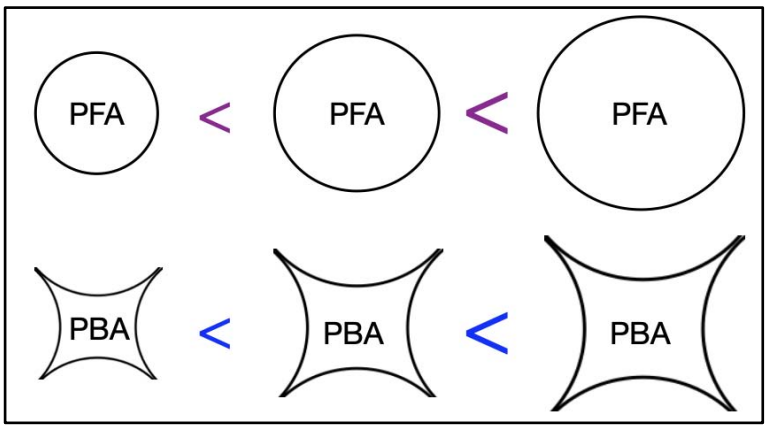


Figure 3: Topological representation of the growth dynamics of *direct space* (Push-Forward Area) and *reciprocal or inverse space* (Pull-Back Area)

As observed in *Figure 3*, an increase in the Push-Forward Area (PFA) is accompanied by an increase in the Pull-Back Area (PBA). However, since their dimensions are *inverse to each other*, the growth in the inverse area exerts a *dampening effect* on the overall pressure of the system. This phenomenon, and its implications, will now be discussed in detail.

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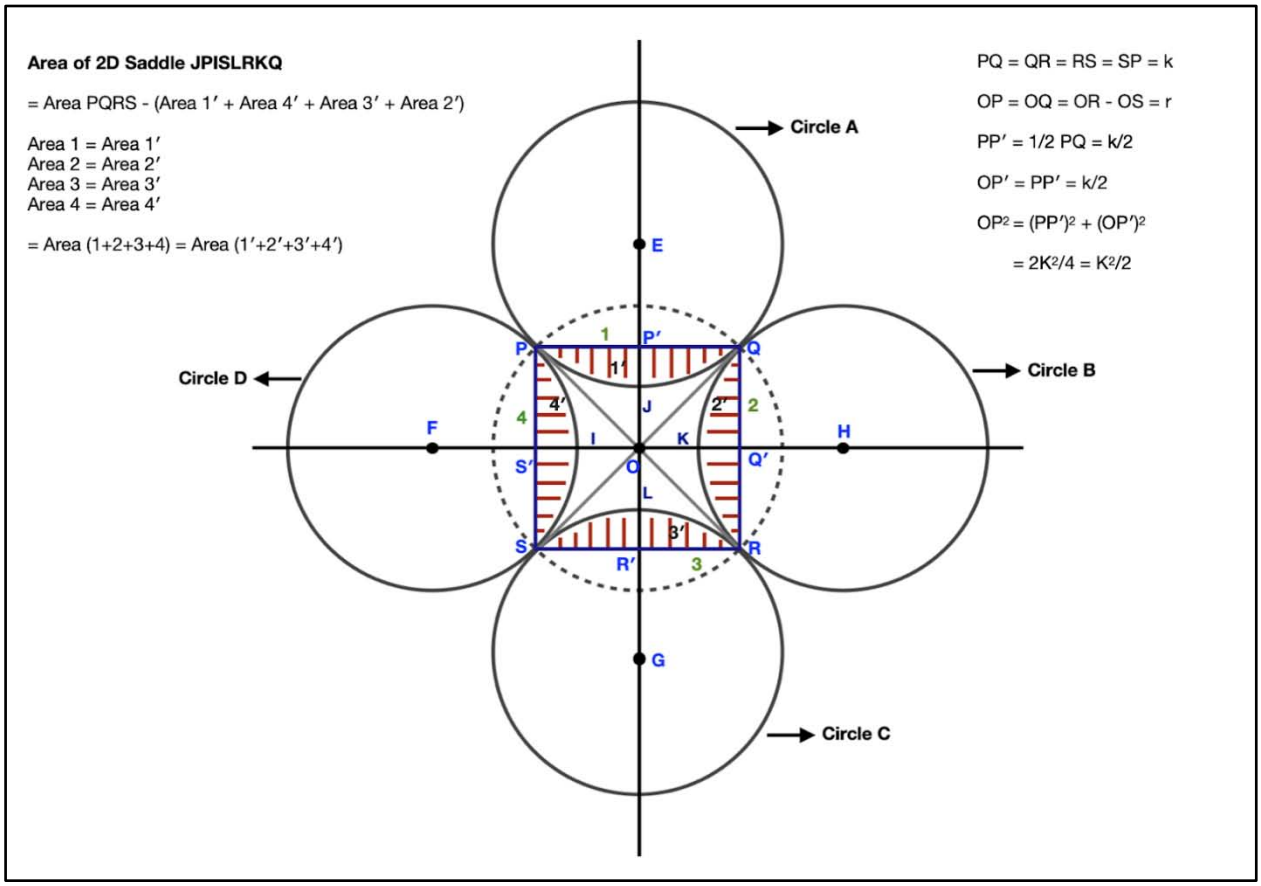


Figure 4: Topological representation of the entanglement between the *area quantum* and *inverse area quantum*, or equivalently, between the *volume quantum* and the *mass quantum*

As illustrated in *Figure 4*, four circles—labeled A, B, C, and D with centers at E, H, G, and F respectively—each having radius *r*, undergo a molecular entanglement. This interaction results in the formation of a *2D saddle*, denoted as *JPISLRQ*. An inner, imaginary circle *PQRS*, also with radius *r*, is shown for reference.

Each of the four outer circles has two symmetrical segments: the *upper segments* (areas 1, 2, 3, and 4) and the *lower segments* (areas 1′, 2′, 3′, and 4′), which are shaded or lined in the figure. Notably, *area 1 = area 1′, area 2 = area 2′*, and so on, indicating perfect symmetry.

From each of the four circles, identical lower segments (areas 1′ through 4′) are removed. These removed segments are then used to form *four new circles* of equal area. The *sum total of the removed areas*—that is, *area 1′ + area 2′ + area 3′ + area 4′*—is effectively *transferred* to the 2D saddle geometry.

However, as this area transitions into the *inverse space domain, a squeezing effect* occurs—reflecting a topological compression associated with the inverse curvature of the saddle. The mathematical formulation of this transformation is presented below.

$$\text{The area of the inner circle} = \pi r^2 \qquad (2)$$

If the length of each side of the square *PQRS* is taken to be *k*, then the lengths *PP* and *OP* (as indicated in *Figure 4*) are each equal to *k/2*. Therefore, we can deduce the following:

$$OP^2 = (PP)^2 + (OP)^2 = (k/2)^2 + (k/2)^2$$

$$\text{Or,} \quad r^2 = (k^2)/2$$

$$\text{Or,} \quad k = r\,2^{1/2} \qquad (3)$$

$$\text{Or,} \quad k^2 = \text{area of the Square} = (2r^2) \qquad (4)$$

Now the Area of the saddle is = [Area of the square PQRS – sum of the area of the four numbers of lined portion (1' + 2' + 3' + 4'), since sum of area (1 + 2 + 3 + 4) = sum of area (1' + 2' + 3' + 4') and since sum of area (1' + 2' + 3' + 4') = [area of the inner circle – area of the square PQRS].

$$= (\pi r^2 - 2r^2) \qquad (5)$$

So the Area of the 2D saddle = (area of square PQRS – sum of the area of the four numbers of lined portions) = $[2r^2 - (\pi r^2 - 2r^2)] = [r^2(4 - \pi)] = 0.86\,r^2$ (6)

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Now the total area of the non- lined portion = Area (1 +2 + 3 + 4) = (πr^2 - $2r^2$) and from each of the four numbers of outer circles ¼ th of the area of the total lined portion area is being cut out

The area of each of the new circle as being shown in Figure 1C = [(πr^2 - (πr^2 - $2r^2$)/4]

$$= r^2[(3\pi + 2)/4] \quad (7)$$

So the sum total area of all the 4 new circles formed = $r^2[(3\pi + 2)]$ (8)

Now, (sum total of 4 new circles / area of the formed 2D saddle JPISLRQ (= $0.86r^2$) = $r^2[(3\pi + 2)/(0.86\ r^2)]$ = $[(3\pi + 2)/(0.86)$ = constant (9)

Now the (area of each of each of the new circles formed) / (area of the 2D saddle formed) = $[r^2[(3\pi + 2)/4]/(0.86r^2)$ = $[(3\pi + 2)/(3.44)]$ = constant (10)

Another interesting correlation between the 'Sum total area of the 4 numbers of lined portion'(i.e the Total cut-out Area from the 4 numbers of outer circles in Figure 4) and the 'Inverse area of the saddle' is being constant always and they are being very close to be 'Multiplicative inverse' to each other. From equation (5) and equation (6), it can be written,

[('Sum total area of the 4 numbers of lined portion') x ('Area of the saddle in the inverse magnitude')] = (πr^2 - $2r^2$) x [$1/r^2$ (4- π)] = [(π -2)/(4 -π)] = constant = 1.34 (10a)

To become perfectly 'multiplicative inverse' the value of the constant in equation (10a) had to attain a value of unity or 1.

In this quantum model, the 'inverse areas/volumes' that are formed from the 'direct areas/volumes' upon symmetry breaking constitute the 'masses' of the universe. Hence, the physical significance of equation (10a) is that the amount or magnitude of volume (V) flowing into the 'reciprocal space'[2] from the 'direct space' attains a value about to be equal to the inverse or reciprocal of V, i.e., (1/V), and this appears in the form of the mass of the universe. Now the value of π had been considered as 3.145 to obtain the constant value 1.34 in equation (10a).

Equation (10a) can be expressed in the language of physics as,

(Decrease in the magnitude of area/volume) x (Increase in inverse area or mass in the mathematical inverse sense) = constant = 1.34 (10b)

In this model, the total area of four circles represents the 'push forward area (PFA)', and the inverse of the area of the 2D saddle represents the 'pull back energy (PBA)'. The hybrid, or the product of the PFA and PBA, remains constant.

[(Volume) x (1/(Area or Volume)] = Constant

Or (A quantum of volume) x (A quantum of mass) = constant and dimensionless (11)

This constancy of mass-volume indicates that substances in nature (solid, liquid, or gas), irrespective of the sizes of their molecules, adjust their total volumes and free volumes in such a manner that, at constant temperature (i.e., the average atmospheric temperature), the product of their 'volume' and 'mass' (as explained above) remains constant. It is to be noted that volume and mass both are being considered as 'quantum' unlike the continuous entities of classical physics As mentioned earlier, for the pullback areas or volumes to be generated or to grow, the availability of free volume is essential. Therefore, in equation (10a), the pullback area or volume would be directly proportional to the total available free volume (FV), and the push forward area or volume would be directly proportional to the total 'hard core volumes' (THCV) of the molecules. Thus, equation (12) can be rewritten as:

(THCV/ FV) = Constant and dimensionless (12)

[The free volume appears in the denominator in equation (18) since the pullback area or volume acts as the mathematical multiplicative inverse of the push forward area or volume.]

Another interesting feature is that the proportion of the area of each molecule (or each circle A, B, C, or D in Figure 4) that undergoes 'inversion' relative to the total area of each molecule always remains constant, irrespective of the radius of the molecules. The area of each molecule is πr^2, and the area of each molecule that undergoes inversion is (πr^2 – $2r^2$)/4 [equation (7)]. Hence, the ratio of the two is:

$[(\pi r^2 - 2r^2)/4]/\pi r^2$ = fraction of energy being inversed = constant (13)

The empirical data given in the following Table 2 shows that the ratio of equation (13) is independent of r (Radius of each molecule).

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Table 2: Data of 'fraction of energy to the total energy of the molecule' which does take place in the inversion process

Value of radius r of a molecule	Area of the circle (πr^2)	Area of a circle takes place in the inversion [($\pi r - 2r^2$)/4]	Ratio of [($\pi r^2 - 2r^2$)/4]/ (πr^2)
1	3.14	0.28	0.09
2	12.56	1.13	0.09
3	28.3	2.54	0.09
4	50.2	4.5	0.09

The physical significance of the constant relationship between the 'push forward area' and the 'pull back area', as shown in equations (9) and (10), is that nature exhibits a fixed or constant partitioning of areas or volumes between the push forward and pull back components of substances. When the PFA increases, the PBA also increases, or vice versa, but the ratio between the two remains constant.

Irrespective of the hard core volume (HCV) of each molecule, a fixed proportion of its area or volume is cut out and undergoes inversion. This 'area or volume of inversion' flows into the free volume (FV) of the substance, where it exerts a pullback force. If sufficient free volume is not available to hold this 'inversed energy', the inversion process itself does not occur. In such cases, due to the low FV, the ratio of HCV to FV increases, and the substance exhibits higher pressure. For example, in a gas cylinder, as more and more molecules are introduced, the free volume decreases, and the pressure rises.

This model is now extended to three dimensions. The circles are replaced by spheres, and the 2D saddles are replaced by 'inverse 3D saddles', as shown in Figure (4a) below. The 3D spheres represent 'quanta of volume', and the inverse 3D saddles represent 'quanta of mass'. The symmetry-breaking phenomenon [3] shown in Figure (4a), arising from the orientational interactions of four quanta of volume, leads to the generation of mass in the universe.

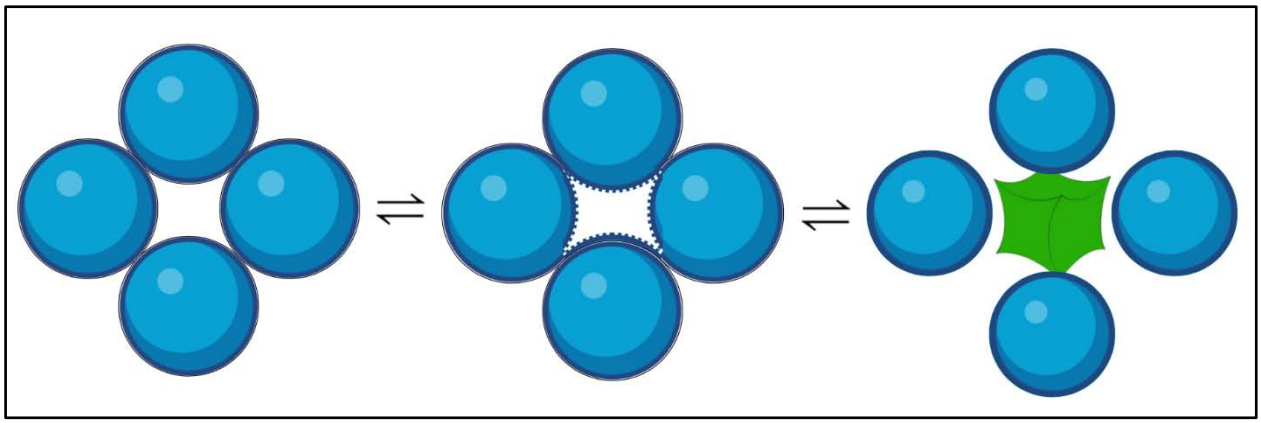


Figure 4a: Topological presentation of the entanglement of the four numbers of quantum of volume to form a quantum of mass of 3D inverse geometry

Figures 5 and 6 illustrate the mathematical relationships among the radius of the sphere, the radius of the saddle, and the depth of the saddle. [Note: The presentation has been made in 2D for simplification and ease of understanding.]

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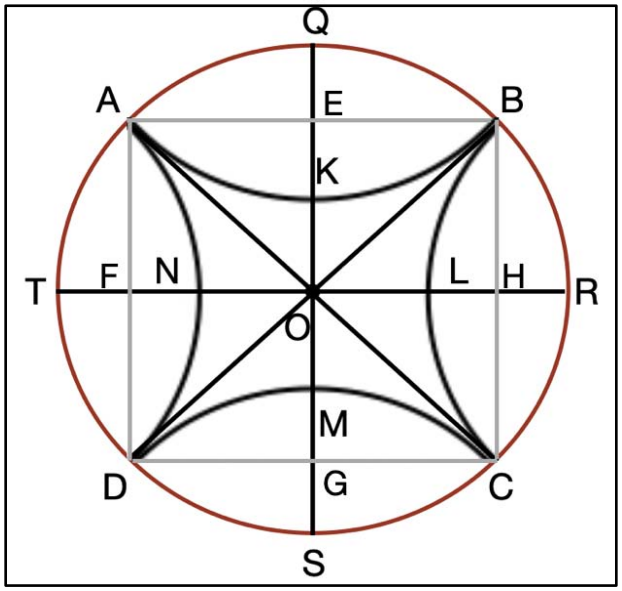


Figure 5: Geometry of the 2D saddle with its conjugate circle

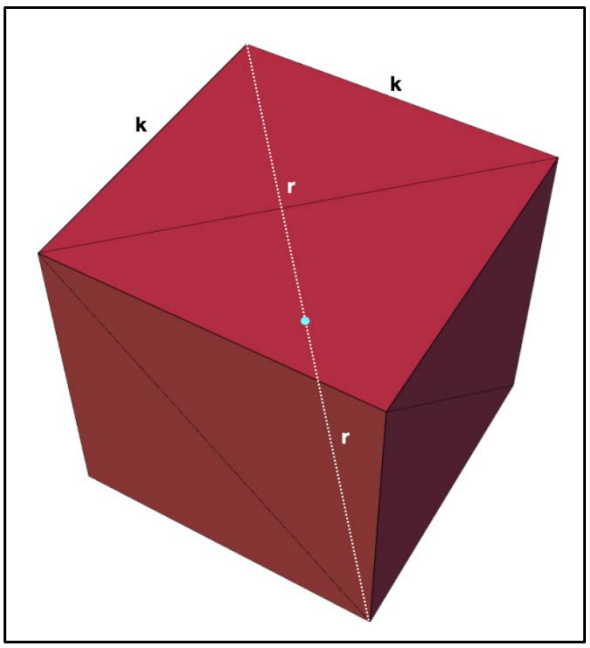


Figure 6: The inscribed cube of a sphere of radius r

From the above figure 5, it is to be noted that,

Radius of the sphere = radius of the saddle = r = OA = OB = OC =OD

Depth of the saddle = R = OK = OL = OM = ON

Now if the radius of the sphere be r and the length of the each side of the inscribed cube would be k as shown in Figure 6 above,

$$(\sqrt{3}k)^3 = (2r)^3 \quad (14)$$

Or, $$k^3 = (8r^3/3^{3/2}) \quad (15)$$

Or, $$k = (2r/3^{1/2}) = 1.15\ r \quad (16)$$

Now EQ = FT = GS = HR = small sagitta of the chord of length k = AB = AD= BC = CD = 1.15r

Now the geometric formula for the length small sagitta is, (If r be the radius and k be the length of the chord)

$$\text{Length of small sagitta} = [r- \sqrt{\{r^2 - (k/2)^2\}}] \quad (17)$$

Now for 3D sphere, k = 1.15r, so,

$$EQ = [r- (\sqrt{(r^2 - 0.33r^2)}] = [r- 0.82r] = 0.18r \quad (18)$$

From the Figure 5, it is to note that as per the geometrical figure, QE = KE = TF = NF = SG = MG = LH = LR = 0.18r and hence KQ = 2EQ = 0.36r

Now as per figure 9 above,

$$\text{Depth of saddle} = R = OK = (OQ - EQ) \quad (19)$$

$$\text{Now } KQ = 0.36r \text{ and } OQ = r \quad (20)$$

So the depth of the saddle = R = OK = (r - 0.36r) = 0.64r (21)

Now the volume of the 3D Saddle = [volume of the cube – volume of the lined portion] (of Figure 4] and the volume of the lined portion = volume of the non-lined portion.

The mathematical formula in 3D of the non-lined segmented cap in Figure 4 is,

$$\text{Volume of a segment cap of a sphere, } V_{cap} = 1/6[\pi h (3a^2 + h^2)] \quad (22)$$

[Where h is the height of the cap = EQ = 0.19r , a is the base radius of the cap = AE = (k/2) = 0.575r]

So the volume of the cap would be,

$$V_{cap} = 1/6 [\pi \times 0.19r \{3 (0.575r)^2 + (0.18r)^2]$$

$$\text{Or, } V_{cap} = 1/6 [0.59r^2 + 0.0361r^2] = 0.03\pi r^3 \quad (23)$$

So the volume of four numbers of non-lined cap segment = $0.12\pi r^3$

Volume of the cube = $(1.15r)^3$

So, the volume of the saddle = [volume of the cube – volume of the 4 numbers of cap]

$$= [r^3(1.15 - 0.12\pi)] \quad (24)$$

So the volume of each new sphere formed (in line with figure 1C)

= [Volume of the original sphere – volume of each of the 4 numbers of non-lined segmented cap]

$$= [4/3 (\pi r^3) - 0.03\pi r^3] = 1.30\pi r^3 \quad (25)$$

So the sum total volume of the four numbers of new sphere formed = $5.2\pi r^3$ (26)

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So, the ratio of, (sum total volumes of the four numbers of new sphere formed/ volume of the saddle)

$= [5.2\pi r^3] / [r^3 (1.15 - 0.12\pi)] = 5.2\pi/ (1.15 - 0.12\pi) =$ constant (27)

Ratio of the four numbers of the non-lined cap areas to the inverse volume of the saddle

$= (0.12\pi r^3/ [r^3 (1.15 - 0.12\pi)]$

$= [0.12\pi/(1.15- 0.12\pi)] =$ constant (28)

So the volume of the 3D saddle could be expressed in regard to the depth of the saddle as,

Volume of the saddle $= [r^3 (1.15 - 0.12\pi)]$ [equation 20],

Depth of saddle, $R = 0.64r$, $[r=(R/0.64)] = 1.56R$ (29)

So, volume of the 3D saddle $= [(1.56\ R)^3 (4.36 - 0.45\pi)]$ (30)

So from the above topological analysis, it turns out that while the radius of the sphere r increases the depth of the saddle does increase too monotonically as is being shown in Figure 9

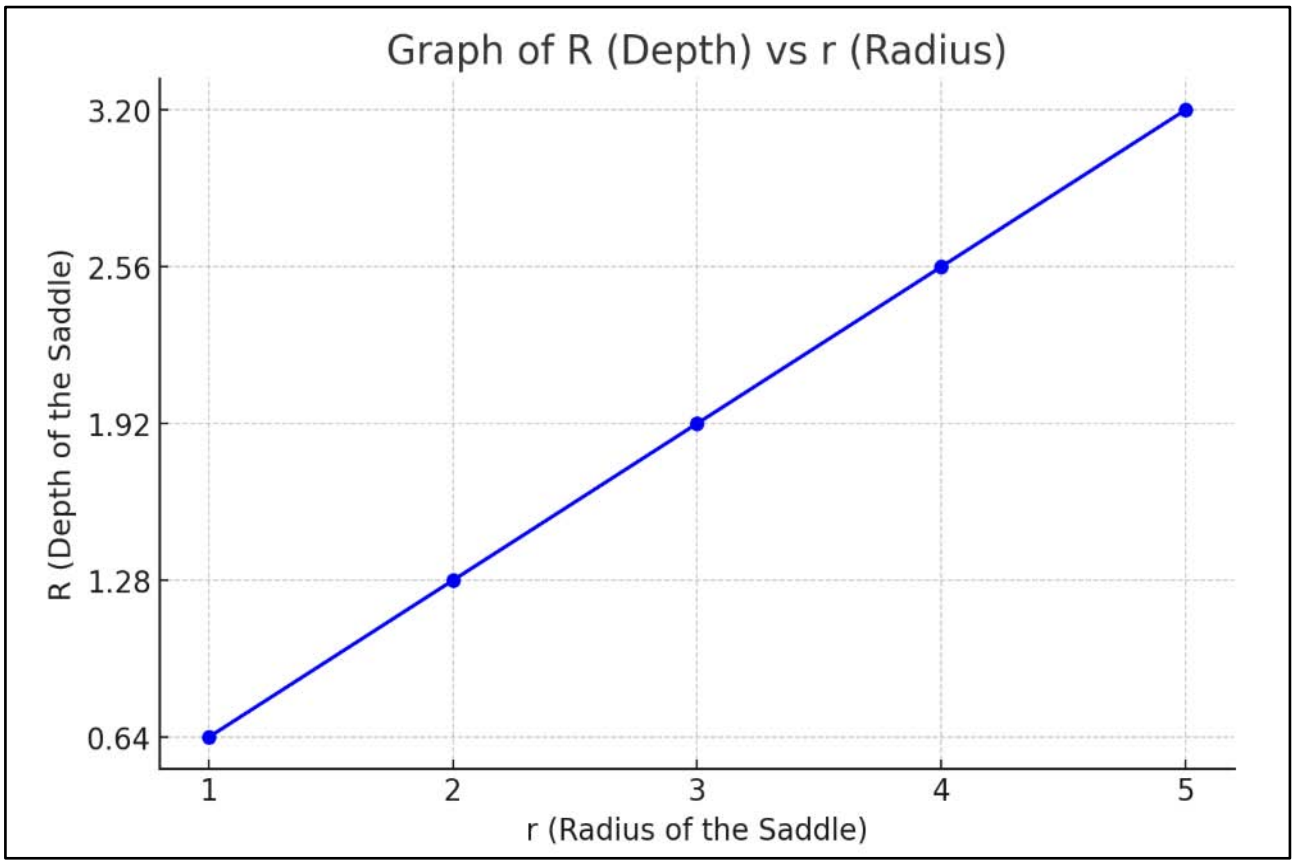


Figure 9: Graphical presentation of the variation of the depth of a 3D saddle (R) against its radius (r)

The index of volume is denoted by *r* (the radius of the sphere), and the index of mass is denoted by *R*. A higher value of *r* (indicating a larger volume) corresponds to a higher value of *R*, and thus, a greater mass.

The same results are obtained for both the 2D and 3D models in terms of the mathematical relationship between the ratio of the total area of the four newly formed circles to the inverse area of the 2D saddle, and the ratio of the total volume of the four newly formed spheres to the inverse volume of the 3D saddle. This ratio is constant and dimensionless.

Similarly, identical results are observed in both models for the relationship between the ratio of the area of a single newly formed circle to the inverse area of the 2D saddle, and the ratio of the volume of a single newly formed sphere to the inverse volume of the 3D saddle. This ratio too is constant and dimensionless.

This, in fact, represents the quantum-scale equipartitioning of volume and inverse volume in the universe. A molecule in its quantum form should be represented as shown in Figure 7 below.

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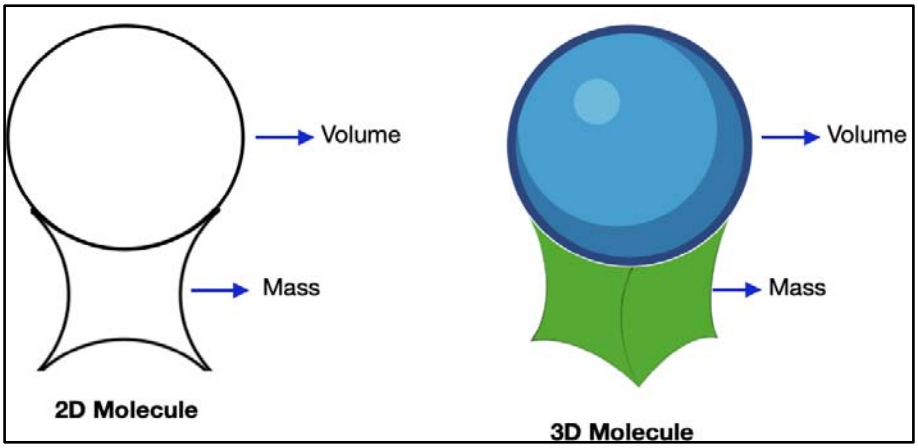


Figure 7: Topology of 'molecules' in a composite form of 'mass and volume' in 2D and 3D

The usual practice in science is to represent a molecule diagrammatically as a 2D circle or a 3D sphere. While a circle or sphere symbolizes the volume part (and, by extension, the energy) of a molecule, the 2D saddle or 3D saddle represents only the inverse volume or inverse energy component. Since 'masses' are formed through *symmetry breaking* [4,5,6,7], the 3D saddles—being the inverse of volume—represent the masses of the universe, as they are shown here to originate from the breaking of symmetries of the 3D spheres.

If a 'quantum of volume' is represented by V_r, as shown in Figure 5, and the volume of the resulting quantum of mass (as also shown in the same figure) is represented by m, then

$$mV = \text{Constant and dimensionless} \qquad (31)$$

Equation (23), however, represents the true *mass–volume conservation* of the universe, rather than the abstract *conservation of momentum* proposed by Newton, which is expressed as the product of mass and velocity. It is considered abstract because Newton did not reveal the topological nature of either 'mass' or 'time' while formulating the law of conservation of momentum. A molecule should be represented as a composite of both 'volume' and 'mass', as shown in Figure 7 above, rather than the conventional representation using only a circle or a sphere.

Figure 8 below should be referred to for understanding the mathematical relationship among the radius of the sphere, the radius of the saddle, and the depth of the saddle. [Note: The presentation has been made in 2D for simplification and ease of understanding.]

The index of volume is denoted by *r* (the radius of the sphere), and the index of mass is denoted by *R*. A higher value of *r* (i.e., a larger volume) corresponds to a higher value of *R*, and thus, a greater mass.

As one moves down any group in the periodic table, the average size—or volume—of the atoms increases, and so does their mass (or mass number). Therefore, the proposed model presented in this article is strongly supported by experimental data, which demonstrates a simultaneous increase in both volume and mass across the elements of the periodic table.

The concept of *singularity* [8] in Einstein's General Theory of Relativity (GTR) [9] aligns with the theoretical model of symmetry breaking proposed in this article. While Einstein suggested that there must exist a point of singularity in the space-time fabric of the universe—responsible for the existence of black holes—this research identifies the center point of the 2D and 3D saddles as corresponding to Einstein's singularity. Through these central points, all mass is directed or concentrated.

As mass increases, the size of the 3D saddles also increases, but the mass always flows toward the singularity. In contrast, as the size of quantum volumes increases, the associated forces tend to disperse outward from the center and become more random. However, in the case of mass, the inverse force becomes increasingly directed toward the singularity, leading to greater order. Eventually, this results in a significant concentration of mass at a single point—the center of mass of the 3D saddle. This is why it is termed the point of *singularity*.

Black holes are massive objects in the space-time of the universe, formed through the gradual collapse of stars and other celestial bodies. In this context, the inverse 3D saddles illustrated in this article may be regarded as idealized models of black holes. The center of these inverse 3D saddles (as shown in Figures 5 and 6) represents the singularity, as the entire mass of the 3D saddle either passes through or rests upon this central point.

Figure 10 illustrates how two inverse 3D saddles merge to form a larger inverse 3D saddle of greater mass, with the mass of the newly formed structure

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passing through a common center of mass—its singularity. Thus, the Figures 10a and 10b provide a conceptual model for the *black hole merger* phenomenon in the universe [10].

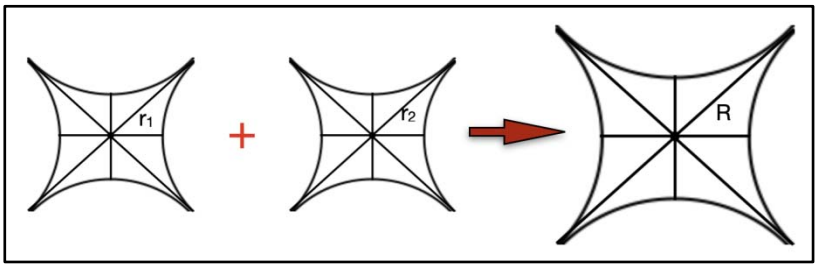


Figure 10a: Typical model of merger of 2 numbers of 2D saddles to form a larger 2D saddle

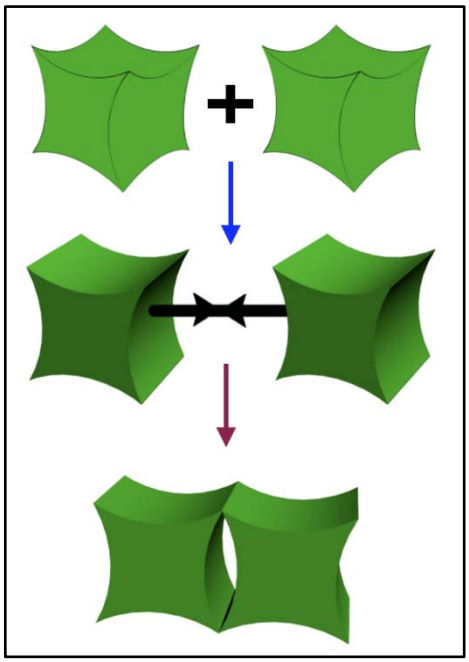


Figure 10b: Typical model of merger of 2 numbers of 3D Black Holes to form a larger 3D Black Hole

In figure 11, two numbers of two masses (2D saddles, A & B) do unite to each other and form a higher mass 2D saddle (C). If the radiuses of the smaller saddles be r_1 and r_2 respectively, and R be the radius of the saddle C, then following mathematical relation to hold among r_1 , r_2 and R,

$$[0.86\, r_1^2 + 0.86\, r_2^2] = 0.86\, R^2 \qquad (33)$$

Or,
$$R^2 = (r_1^2 + r_2^2) \qquad (34)$$

Or,
$$R = [\sqrt{(r_1^2 + r_2^2)}] \qquad (35)$$

As per the current quantum model, any inverse 3D saddle—or quantum of mass—existing in the *time-space* of the universe in isolation from its conjugate 3D spherical volume quantum is, in fact, a *black hole*. The existence of such inverse 3D saddles in isolation also represents the *dark masses* (not to be confused with *dark matter*) of the universe.

The geodesics representation of Anti De Sitter 'time-space' as being shown in Figure 10c [11] below is very much supportive to the model of 'Black – Hole merger' model and the concept of singularity as have been presented in Figure 10a and 10 b.

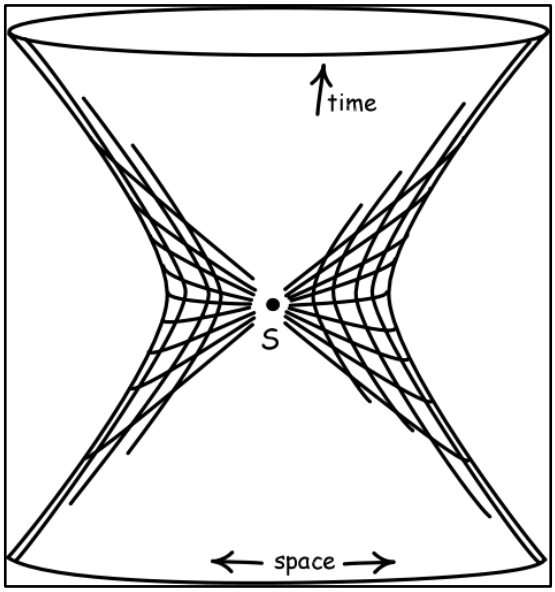


Figure 10c: The typical 2D presentation of 'Anti – De Sitter Space' showing the direction of flow of time and the point of 'singularity', 'S'

A very pertinent question may be raised: why can't these inverse dimensions (in the form of saddles) be observed using transmission electron microscopy (TEM) on a sample of a substance? The answer lies in the limitations of TEM resolution. In TEM studies, it is not possible to reach the ultra-high resolution required to observe atomic or molecular identities directly. What is typically observed are nanoscale aggregates or clusters of atoms or molecules, which appear as regular or irregular round-shaped images. Therefore, it is not possible to visualize individual molecules in their composite form—i.e., as a combination of volume (3D spheres) and mass (inverse 3D saddles).

However, when we observe at the quantum level, such as in the *capillary rise* of water in a glass capillary, an *inverse curvature* (concave upwards)

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meniscus is observed at the air–water boundary. Conversely, in the case of *capillary depression* of mercury in glass capillaries, the meniscus at the air–mercury boundary is found to be *convex upwards*. These phenomena serve as definitive proof of the existence of *reciprocal space* and *direct space* in conjugation within substances across the universe.

This topic of capillary rise and depression, and its connection to dimensionality, has been discussed in detail in a recently published research article. It is explained therein that capillary phenomena are not governed by *surface tension* alone. Rather, they arise from a combined effect of surface tension and the *geometrical* or *topological* configuration of quantum masses and quantum volumes.

III. Conclusion

This research fundamentally explores the phenomenon of symmetry breaking and introduces a new theoretical quantum model that offers deeper insights into the nature of space, mass, and energy. A key result of this model is the re-interpretation of the principle of *equipartition of energy*—demonstrating that energy is equally partitioned between a quantum of volume and a quantum of mass as space transitions from its direct to inverse (or indirect) form. Furthermore, the conventional understanding of the conservation of momentum is redefined through a novel framework that integrates physics, topology, and mathematics. It is shown that when a quantum of volume (V) interacts with a quantum of mass (m), a new entity—a *'t space* quantum'—emerges, governed by the invariant and dimensionless relationship $mV = constant$. This formulation represents a more fundamental law: the conservation of *mass–volume* in the universe. Additionally, a model for black hole mergers is proposed, offering fresh theoretical identities for both 'black holes' and 'dark masses.' Taken together, these findings pave the way for a new direction of inquiry in space physics, cosmology, and astronomy, potentially transforming our understanding of the fabric and evolution of the universe.

Dedication

This research article is dedicated to Ex-Professor B. M. Mandal & Late Professor S. N. Bhattacharya, Polymer Science Unit, Indian Association for the Cultivation of Science, Kolkata, West Bengal, India.

Declarations

Clinical Trial Registration: This study is not a clinical trial. Therefore, clinical trial registration details are not applicable.

Author Contributions: Chinmoy Bhattacharya conceived and led the research, developed the analytical framework, and performed all derivations and data analyses. Nishant Sahdev assisted in the interpretation of results, literature review, and manuscript preparation. Both authors reviewed and approved the final manuscript.

Ethics, Consent to Participate, and Consent to Publish declarations:
Not applicable.

Funding Declaration:
No funding was received for this research.

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A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

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.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

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 though 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 matter 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.



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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.



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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.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	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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