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Decisions at the time of Big Data

Quantum Behavior of Solar System

Highlights

Systematic Modification of $E=mc^2$

Gravitating Sphere in Near-Earth Space

Discovering Thoughts, Inventing Future

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Decisions at the Time of Big Data

By Franco Pavese

Abstract- Two worldwide events opened novel reflections in a highly vast scientific literature concerning a universal concept like that of "data", namely as the results of observations, either experimental or human-mind generated: the "big data" and the universal use of informatics, related to each other and both in exponential increase.

The capacity and speed of modern computers allowed us obtaining such immense amounts of data, both from experimental setups or from the elaboration of algorithms, either human-built or through AI. Their handling too is necessarily operated via informatics means, considered distinct from mathematical means. Apparently, these facts have disconnected data evaluation from traditional fields, not only science but also the way to take decisions based on them.

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The paper contains reflections on the properties and meaning of the data in their-self, specifically as the vehicle of information almost universally necessary to make decisions, the latter being a frame that is mixed and often prevalent in the literature about big data.

Keywords: *decisions, data, big data, dataism, informatics, science.*

I. Introduction

Two worldwide events opened novel reflections in a highly vast scientific literature concerning a universal concept like that of "data", namely as the results of observations, either experimental or human-mind generated: the "big data" and the universal use of informatics, related to each other and both in exponential increase.

The capacity and speed of modern computers allowed us obtaining such immense amounts of data, both from experimental setups or from the elaboration of algorithms, either human-built or through AI. Their handling too is necessarily operated via informatics means, considered distinct from mathematical means. Apparently, these facts have disconnected data evaluation from traditional fields, not only of science but also in the way to take decisions based on them.

The paper contains reflections on the properties and meaning of (numerical) data in their-self, specifically as the vehicle of information almost universally necessary to make *decisions*, the latter being a frame that is often prevalent in the literature about big data.

In particular, it will tackle the issue of the concept of "uncertainty" in some of the new frames, necessarily related to the "quality" that also must be associated to the *decisions*, [1] as what is commonly called *risk*.

II. From A Single Datum to the Big Data

The reflections in the paper will be restricted to data arising from the information acquired from the "external" world, i.e. each datum will be considered here to be the exclusive elementary component of human *knowledge* in its numerical form. In Section 3, its distinct origin is considered, of being the result of a mind reflection generating, e.g., scientific theories, the above two being the basic frames of our (limited) knowledge.

A datum, obtained from the observation of the external world, is commonly considered a "fact", meaning an *objective* piece of *information*—further, most often expressed by a number—as opposed to a mind reflection, taken as *subjective*. The interested reader is directed to a previous author's paper on the limits of this distinction. [1]

Each datum is an element of a "series", which can be of different nature and kind according to a well-established set of classifications. [2] The first kind is typically obtained "experimentally", i.e. from an "observation" expressed most often—exclusively in the following—in numerical form. These data are treated by a discipline called "measurement science" setting "a process intended to share common ways to transmit the knowledge to the Community that is not limited to a single generation of scientists and practitioners, and is intended to obtain the necessary consensus". [3] Different tools are used, one of the foremost being statistics.

Big data are series of data, in principle of both origins, so much more extensive than the "historical series" that they can only be treated and analyzed by employing informatics, primarily since the available modern ones are exceptionally performing from the point of view of speed and memory capacity. As a consequence, they can only (also) be elaborated with informatics, a discipline that in many respects is presently considered by many of its users as distinct from measurement science. Such a distinction is certainly true as to the technicalities and the apparatuses. Additionally, it is a fact that most of the activities of experimental science are today based on computers.

Big data are apparently a collation of *raw data*, meaning for *raw* that no specific "qualification" is

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[1] Decision is "a conclusion or resolution reached after consideration".

associated with each datum, but only the source of the complete series is provided. A consequence, in what one can find in the literature, is, e.g., the fact that the discussion on the big data is limited to a mere analysis of the dataset, very seldom on their "quality".

III. Data from Models *vs.* Empirical Data

With the rapid diffusion of informatics, the use of computer *models* has rapidly grown—becoming one of the preferred tools in Internet socials for "informing" people. This preference for *models* has pushed an increasing number of scientists—namely economists—to exercise in their use. However, that is a field potentially risky, namely because in it the limit between science and economics/politics is almost invisible, certainly quite uncertain.

Typically, "*data* is interpreted and processed by *a priori* established models", [4] assumed to be based on them. On the other hand, the models might, conversely, also be considered an important generators of big data, especially when concerning simulation: a (generally) mathematical modeling of a phenomenon. Conversely, modeling can be directly based on existing databases (extended or not) and are customarily used for the prediction of future behavior of an observed phenomenon. However, since prediction does not usually make use of random types of mathematical representations— a forecast is mainly aimed to address *decisions*—but of deterministic functions, the future trends obtained from these functions cannot be considered as independent datasets.

Instead, the big datasets of empirical data tend today to even replace analytical models. Due to that, "the predictive capabilities of such models entirely lies in data itself" [4] a form of *dataism* (see later). In this respect, such a tendency concerning prediction often masks a critical misunderstanding about the meaning and the use of data. [5]

In fact, the expected validity duration of a prediction depends first of all on the observed and estimated "law(s)": in the case of mechanics, e.g., of the orbit of the sky big bodies like the Earth, a forecast can confidently be provided for extremely long periods. The same level of confidence is not available for thermodynamics in physics, basically dominating natural events or for economics.

Problems may arise from the fact that no (set of) mathematical function used as a model is indefinitely "flexible", i.e. apt to "correctly" interpolate *any* cluster of data—namely the less when less are the parameters of the function(s). There is a vast literature on this subject matter, for example, to detect a "changing point" in a trend. Fitting is considered a good technique when merely is a reasonable balance between the best "copying" of behavior with time (like when the function has to match a given profile) and a satisfactory "averaging" of the behavior supplied by experimental values—and the more the more extended is the period and without "masking" of changing points.

As a consequence, usually, a sort of balance should always exist between the number of data *already* available—plus the length of the period during which they were taken—and those collected in a future period. Only in that case the function so obtained is apt to be "safely" extrapolated, and considered providing a sufficiently good forecast—i.e., by remaining accurate without the support of any constraints, except those (purely mathematical) set by the function. Big data could partially compensate for their more extensive number of data, but *only* when related to a short extension in time of the extrapolation.

For example, if the "safe" *observation* time is considered to be 30 years, it is hardly possible to assume any sensible extrapolation to a further period of the same length—the shorter the shorter is the reference period. In fact, for the more rapidly increasing (or decreasing) of the function derivatives—or for non-simple shapes of the function—the more the variation in the extrapolated period becomes problematic.

Further, a qualification that is often absent in the information supplied together with the extrapolations is the *quality of the available dataset*. Instead, the existing data uncertainty—whose information must always be provided as it determines quality—must be taken into consideration, since the *quality* of the fitting on the available data is vital for the *quality* of the subsequent extrapolation. Again, the *size* of big data series has in itself *no influence* on data precision. There are even instances where original data quality is so low that is already sufficient to make one understanding that their fit would be unreliable and the extrapolation meaningless. [2]

Accordingly, the forecast almost always consists of a *trend area* (typically increasing its width with time) where the future determinations are assumed to fall within an *assigned* probability. Most often, the trend is monotonic because usually *changing points cannot be predicted*, but, in a few cases, the extrapolation may also show a change in sign of the first or/and of the second derivative—e.g., for trend causes foreseen to become exhausted, or instead be born in future.

[2] Frequently, supplying the results from more than one model is preferred, as a multiplicity can be able to allow an indirect evaluation of the possible variability of the forecast. The comparison of models can certainly mitigate the risk of false extrapolations, if made with different fitting (set of) equations—and of different complexity—on the same data, but places other problems—such as the choice of the "best" model, and the fact that all are, in general, deterministic functions

IV. Dataism *vs.* Measurement Science

The existence of big data induced the creation of a new frame called “dataism” by the New York Times journalist that created it in 2013, David Brooks. [6,7] Subsequently, a discussion started, especially on Internet sites, considering it as a replacement for “humanism” or even thinking that a scientific revolution has taken place. Also in the frame of philosophy of science the issue raised some interests regards to the concept of “measurement” when “data science” is pretended to replace measurement science. [4,8]

According to [8], dataism: (italics added)

“– perceives the entire world as a flow of data;

– believes that data provide a fair and exhaustive representation of *reality*;

– has unconditioned confidence in data and bases their everyday judgments *only on data*;

– believes that *artificial intelligence* will overcome human intellect”.

It looks like a new form of “objectivism” (the belief that certain things/situations exist independently of human knowledge or perception of them), certainly contrasting (current) modern science/economic theory.

Even without reaching such an extreme, in the field of data expressed in numerical form one can observe in the scientific/economic literature how the information about the data *origin* is more and more omitted. In other cases went lost in procedures based on informatics, even though with the consciousness of the importance, in particular, of the fact that each dataset has a quality that must remain explicit. However, what is going frequently lost is the fact that to *each* datum the *uncertainty* is associated *since its first record* having an influence of the whole dataset. Then, in order to be reliable, each datum should have been obtained in strict compliance with the rules established by science.

V. Metrological Analysis of Big Data

The notable and peculiar issue in the big data literature is that, in the discussion about the set, terms are used based on several disciplines, namely intended for decision taking, more concerning the discipline of economics than that of measurement science.

Another peculiar characteristic, found in the elaborations of big data, was that, basically, only the dispersion of the values with respect some kind of smoothing or fit is reported to characterize the “quality” of the set—and/or to discuss the role of dataset quality in respect to *decisions* to be taken by using them. [9]

However, dataism should not mean that the big data analysis could start from the recorded numerical values, omitting first the analysis of their *quality* and assigning to each or group or set of them a degree of confidence – and an analysis of their uncertainty components bringing to the overall quality. Increasing the number, or the frequency, of observations, cannot in itself be sufficient for mitigating uncertainty. The increase of the number of observations or their acquisition frequency does not ensure an increase in the *quality* of the collected information.

Therefore, dataism neither can mean an overestimation of the importance of basing science (and suggestions/decisions) on data, including their use in the economic discipline: they are to be treated as *partial* knowledge, though often the most reliable available but often also far from being univocally meaningful. They cannot replace theory. [9]

In fact, the information content of data, the only important one, should be evaluated in terms of its “quality”, a property that is *not intrinsic* in any data but that has to be verified. According to [4] (italics added):

“The dimensions of *information quality* include (and is valid for any discipline):

1. *Consistency*: the condition that data is within the assumed value domain and is not duplicated;
2. *Availability*: the fraction of time that data is made available by the system that stores it;
3. *Currency and timeliness*: the degree to which data is updated and readily available for use, respectively;
4. *Specificity*: a condition related to the quantity of syntactical information: stating, e.g., that a length is in the interval (10.5 ± 0.1) m is more specific, and therefore of better quality, than stating that it is in the interval (10 ± 1) m; when referring to measurement results, specificity is also called *precision*;
5. *Trueness*: a condition related to the faithfulness of semantic information: were, e.g., 10.55 m the value of a length provided by the best independent method, stating that the length is 10.50 m is truer, and therefore of better quality, than stating that it is 10.40 m as synthesized in terms of *accuracy* in metrology”. [2, 10]

In the big data literature, almost all scientific terms are lacking, decorating the meaning of the term “uncertainty” and “quality”, still commonly used in it though often related only to the *decisions* to be taken.

VI. Types of Decisions and Examples of Possible “Dataism-Syndrome” in Big Data Analyses and Use: Some Consequences in Taking Decisions

According to the previously provided base definition of “decision”, decisions can be technical (rarely strictly scientific) or strictly economic or rather more political, i.e. related to the concern about local/general Society.

As basically a scientist, the author cannot pretend to be an authority in all the above fields, but he

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has been for several decades personally involved in the societal position of his profession in the Italian Society, and consequently he also got some expertise about social and economic aspects, either in a Society or in the World.

In all instances, measurement science is *multidisciplinary*, so that many of its scientific evaluations can be performed irrespective to their specific kind or origin.

One field where immense data collations exist today is the one concerning Earth parameters, especially in the current period where the climate became a dominant and critical activity of vast Communities of scientists. It mainly involves the disciplines of physics and chemistry—meteorology and environment being part of them—but many of the relevant observed effects then need decisions of political and economic nature. A couple of examples are taken in the following from fields that the author recently has already partially explored from his metrologist's point of view. One is the Global Mean Surface Temperature (GMST) —temperature metrology being one of the specific professional expertise of the author. [11, 12]

The GMST is probably the most popular climate *parameter* that is commonly used to support decisions recommended by International Organizations, namely the IPCC, HadCRUT, etc. It is computed from the data obtained by the meteorological stations of the WMO network, amounting to millions, whose distribution on the Earth's surface is however quite non-homogeneous [13]. The resulting database can be considered a big data one consisting of the recorded numerical values of surface air temperature according to the WMO protocol for the meteorological stations.

The only direct statistical information that the database supplies is obtained in the literature by the *fitting* of datasets with a suitable function in order to obtain the trend for a period: the information one gets basically consist in the *dispersion* of the data (through the parameter standard deviation or similar). However, that is *not the uncertainty* of the dataset, but only one of the *several* uncertainty components of the collected data.

Instead, the IPCC, e.g., only describes by words the statistical/informational procedure used to get the final evaluation of the GMST, in the total absence of the resulting values of each *single uncertainty component* of the data used, before and after several data manipulations: sampling, interpolation where data are lacking, normalization, adaptation, smoothing, homogenization, etc.

It is scholarly known that, with sufficient and competent statistical methods, it is possible to get an estimate of a set of sparse values having a resulting much lower dispersion and higher coherence/consistency. However, each of the required many manipulations (not only methodological/computational, though today computer-based, requiring *choices*) and assumptions, add an uncertainty component to the final precision: each and all contribute to the *overall* uncertainty.

In this case, one has even billions of data, produced by temperature sensors (of medium-low quality, of both of the contact or radiation types) affected by an original uncertainty and all placed in *different and distant locations* of the Earth. One is metrologically unable to mitigate or reduce their *original* uncertainty, arising from *calibration/traceability* (two pillar procedures of measuring science) and from the measuring-system uncertainties. Instead, the above analysis does not include this initial step. The above means that, to get a $\pm(0.05\text{-}0.1)$ °C overall uncertainty—values published by IPCC—most uncertainty components would need to be at a level of 0.01 °C or less, which sounds be simple impossible to occur. Thus for the GMST, the probably *most difficult parameter to evaluate*, also because it is based on *local* information, an uncertainty as the above one today—and of a few tenths of a degree one Century back —is by far *not* representing the metrological capabilities nor the status of the meteorological stations in most of regions/countries of the World, by a factor not less than ×10, often more.

Having studied the literature and examined some of those databases [14], no evidence of application of the basic metrological requirements were found, *namely supported by a published Budget of Uncertainty*, applied to the immense work done by the hundreds of authors involved in that frame.

The consequences of a lack in trust are heavy and even possibly unexpected: examples follow about forecast.

It is difficult to disagree that a forecast is less reliable when the uncertainty of the to date available data is higher. Consequently, forecasts of 80 years ahead for the GMST, are assumed to be safe in showing an increase from the present one +0.12°C to +(2–3)°C, are certainly much less reliable and credible if the *supporting* data are affected, at best, by an uncertainty of ± (0.5–1)°C—especially when also using data decades-old—considering their further quick increase in uncertainty, having the progress of thermometry and meteorology been relatively recent (in addition, not even the uncertainty arising from the forecast modeling had been considered).

The GMST record from 1850 is reported in Fig. 1. Its trend is not a simple one even not considering the clear effect of the II World War, and becomes a clear rise only after ≈1970 (but from year ≈1950 human population increased from 2 to 8 billion). Notice that the HadCRUT (14) (SQUARE BRACKETS) value indicated value of the standard deviation (s.d.) for a confidence level of 97.5% was ±0.12°C: the author of this paper, for the 1970-2021 fit of the same data, got, again for the 97.5% confidence level, a s.d. of ±0.27°C. For the GMST values computed for the IX century, 1850-1900, the uncertainty indicated in Fig. 1. 0.5-0.7°C (apart some very high sparse values during a limited number of initial years), while the author's fit of the same data in the same period for the GMST change of –0.32°C, brings to ±0.36°C again for the 97.5% of confidence level, rather optimistic in *both cases* for that period where the imprecision of the temperature measurement was certainly much higher (and the World-data availability certainly quite lower). Note that the above reported s.d. values are only meaning the reproducibility, *not* the quite larger precision, of the GMST trend.

A similar attitude concerning the reliability of the forecasts was found concerning other climate parameters. For example, the author recomputed a parameter linked to the forecast about the *melting of the ice* on the Earth's surface, the ice/snow annual coverage in the past 20 years, from a NASA public source. [15] While the results of the retrieval from the original video were consistent with the overall estimate made by the official bodies, it was found no evidence of a claimed acceleration in time of the ice melting speed—incidentally, in the Report of the EEA, the responsible body for Europe, the uncertainty of the data in their website is not reported and uncertainty was labeled "not applicable".

Linked to the former parameter is the forecast of the future increase of the mean water level in the oceans.

The current estimated increase is about +10 cm, with no uncertainty associated to this value. In this case, two decades of previous forecasts are available, reported here in Fig. 2, showing a forecast reduction of the increase by 7 times. More recently, the forecast has been pushed to 2300 (Fig. 3), where the estimate is of a rise up to *50 times* with respect to the present one—according to the tallest indicated models. What is evident is that such a formidable extrapolation is totally depending on the mathematical properties of the adopted model, because the present data trend looks quite irrelevant—physical models are also by definition a forecast.

VII. Final Remarks

The massive increase of data bringing to the very extended databases called "big data" forced the users to concentrate on the informatics methods concerning not only the storage an retrieval but also the complementing of the traditional tools used in science, for qualifying and making use of the information that they supply be means of totally informatics ones. Actually, most of the literature on big data comes just from the informatics discipline and from Institutions dedicated to it, instead from metrological Institutions.

That feature favored the expansion of the use of terms of the latter discipline, in most cases, replacing the traditional in measurement science. The critical issue put in evidence in this paper is that, in too many cases, the scientific terms used in the latter discipline, which define the way a measurement can be conducted and then analyzed in a scientifically reliable way, are ignored, or at least omitted.

That way to deal with data does not only involve and affect the *credibility* of the analyses performed on the data, but also the *frame of decisions*, which is, in most cases, the main reason of the analyses. A decision should obviously be based as much as possible on credible information, but that can be maximized only by increasing the reliability of the data on which the decision is taken.

Data do not fit a "purpose" but a need. The need is not to proof a position but to reach the understanding of a situation or the reason of the need. They are supposed to *describe*, to *support* or to *disclose* a situation or a scenario needing a decision, e.g., social or economic or both.

Consider the case of an emergency, e.g., as the recent COVID pandemia: were the big data useful to make provisions and to resolve or accelerate a mitigation of the related problems? Similarly, can the big data on climate help in understanding if its variations are significant toward a mitigation of the related problems? Are the big data useful as a guidance concerning local/World Communities in advising about a new sustainable economy?

Dataism assumes that data directly *originate from reality*: this is a *too strong* assumption, as, in fact, political inference can instead be dominant with respect to "neutral" technical aspects. Trust on data cannot turn to become a kind of "faith" on data: faith is not science.

The above is a too frequent misunderstanding that arises from blind confidence in the data as *objective facts*—when not even replacing the decision tool as the dataism do. However, a lack of complying with the rules of decision-taking cannot be mitigated *by* the amount of data available—often in a short time.

Data uncertainty is not ignored, but the discussion on it, in general, omits resorting to most important fundamental parameters of measurement science. In a word, it is enough to summarize the situation with the *fact* of the total absence of published quantitative "uncertainty budget". [5]

VIII. Conclusions

In western tradition, decisions come from evidence of facts, at least non-strictly, or not necessarily, in political or economical frames like, e.g., in social frames.

The present big-data frame has no reasons in itself for derogating from the above context/foundation.

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However, it might happen that it makes easier false manipulations if not correctly and strictly handled according to scientific standards.

In that respect, big data do *not* deserve a higher authority in taking decisions with respect to previous critically-formed datasets of more limited extensions. They are a mere technicality. *Big* does not mean necessarily *better or more powerful* with respect to *qualified* information, also concerning *decisions*.

Figure Captions

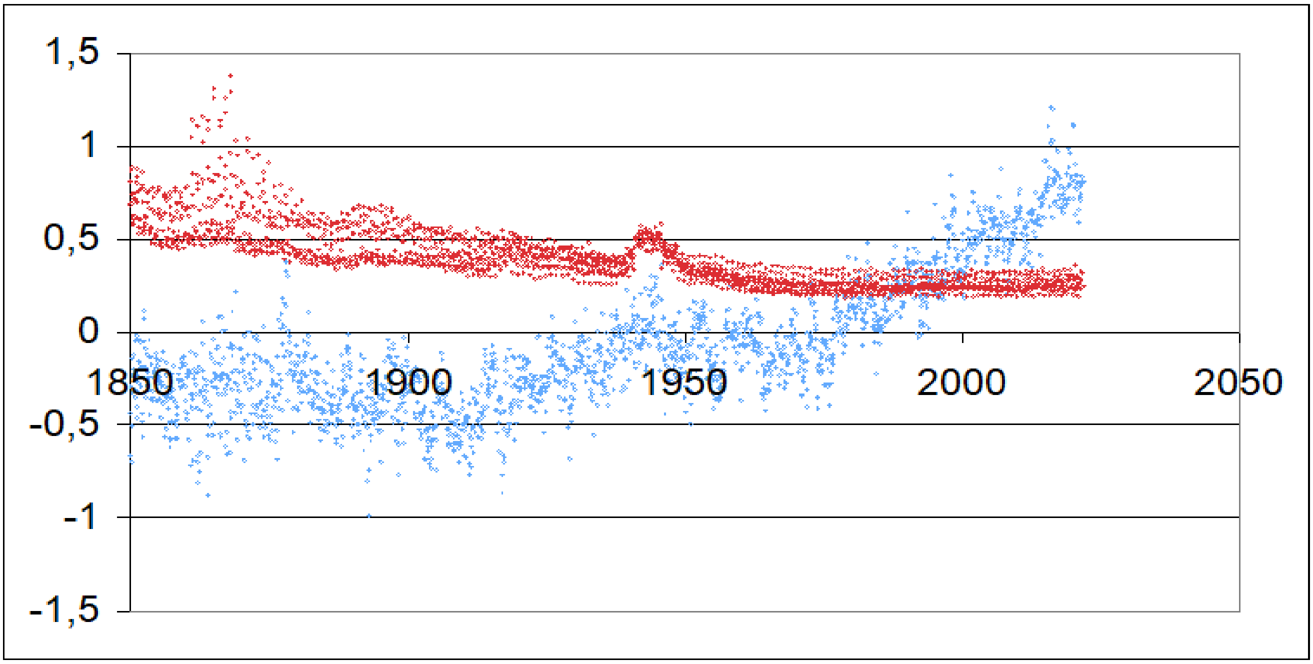

Fig. 1: GMST behavior (blue dots) between 1850 and 2021 according to HadCRUT (database downloaded and analyzed by the author). [14] The red dots are the upper and lower values of the standard deviation for a confidence level of 97.5%. Notice the clear effect of the II World War. Note also that $T(1850) \approx T(1970)$ across two World wars

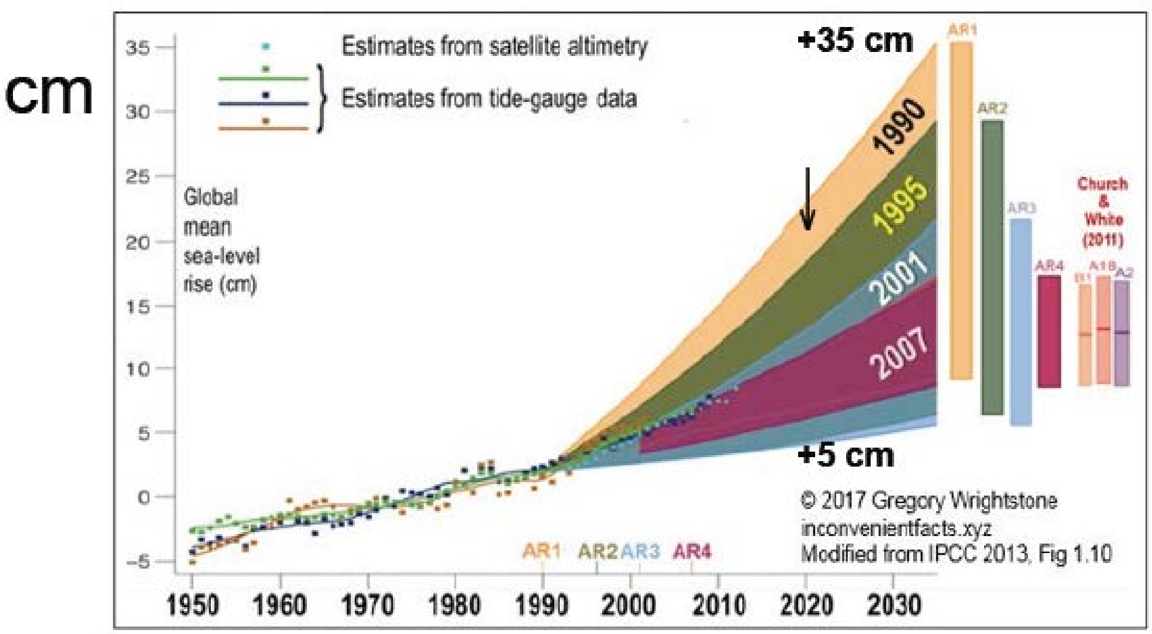

Fig. 2: Sea mean level forecasts for years from 1990 to 2017 [15]: for 2020 +5 cm; current estimate for 2020: +10 cm.

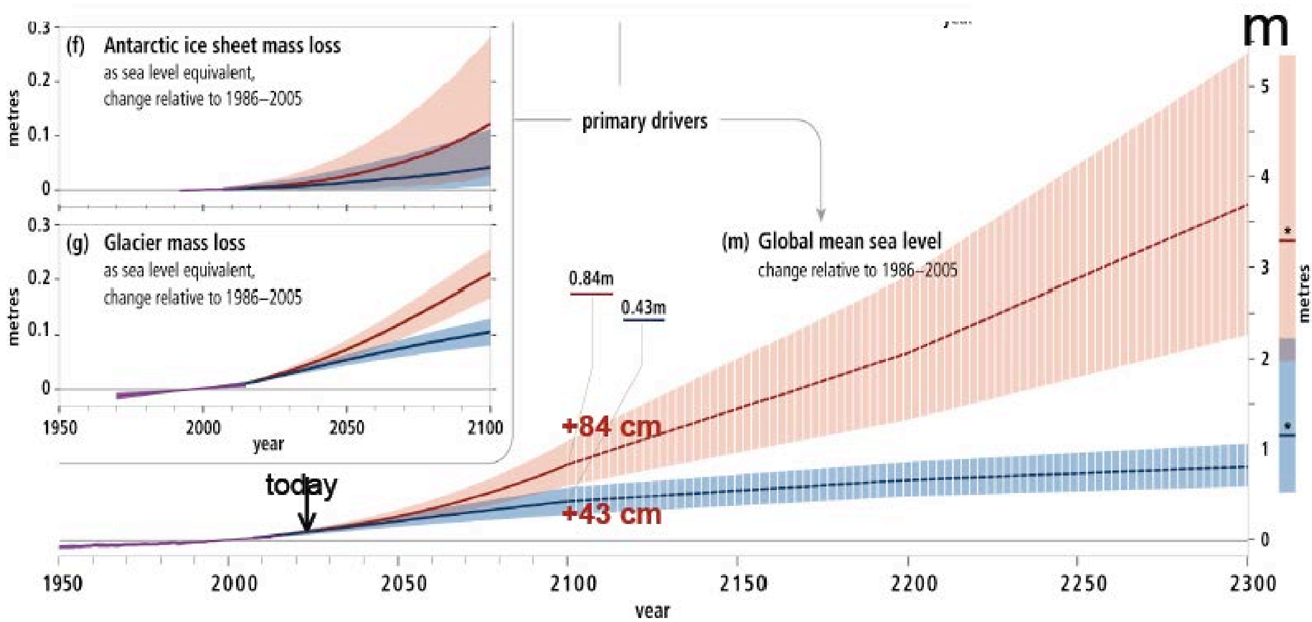

Fig. 3: Same in AR5 [16] up to year 2300: the max +35 cm in year 2035 (Fig. 2) is not anymore included in the forecast; the current forecast is +43–84 cm for 2100—while the 2300 forecast is +(85 ± 25) to +(550 ± 130) cm

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Zhong-Cheng Liang [α] & Ling-Hai Xie [σ]

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I. Introduction

The wave-particle duality is a fundamental assumption of quantum mechanics. Since its inception in the early 20th century, quantum mechanics has undoubtedly achieved great success, but the binary paradox of quantum has always puzzled humans. Is quantum a wave or a particle? The debate over this question has risen from the field of physics to the metaphysical level and has reached philosophical heights.

As is well known, the particle in classical mechanics is a spatially discrete mass point. The mass point is an idealized mathematical model whose defining feature is it has mass but no spatial extension and can be called a pseudo particle. The particle in quantum mechanics is a wave-particle duality, possessing both the continuity of a wave and the discreteness of a particle, and is simply called a quantum. Realism advocates, represented by Einstein, insist on the existence of objective entities behind the quantum representation, so they do not recognize the completeness of quantum mechanics [1]. Empiricists, represented by Bohr, believe there is no need to delve into the existence of the entity behind quantum, and the binary paradox of quantum does not affect the effectiveness and completeness of quantum mechanics [2]. Recently, the author's established theory of real particles provides a realistic interpretation of the essence of quantum. The real-particle theory is an axiomatic system [3–11] including the field theory of real particles [3–8], the theory of matter states [3–5, 9, 10], and the thermodynamics of clusters [3–5, 10, 11]. A real particle is defined as a particle cluster with intrinsic attributes including mass, volume, and shape, and their prototypes are elastic particles in the real world. The mass point, quantum, and cluster have different motion characteristics and represent three different theoretical paradigms of the classical physics, modern physics, and real physics, respectively.

The motion of the solar system is an exemplar in classical mechanics. Astronomical observations show that planets orbit the sun under the influence of the sun's gravity, forming a stable cluster. In classical mechanics, the solar system is abstracted as a system of mass points consisting of the sun and planets, and the motion of the planets follows Newton's laws of motion. This paper studies the motion property and quantum behavior of the solar system based on the theory of real particles, starting from Kepler's laws. By mapping the classical orbit equation onto complex space, we obtain the quantum state function for describing the statistical behavior of the cluster and thus derive the Schrödinger equation for the motion of the earth/solar system. Through the realistic interpretation of cluster's quantum behavior, this paper demonstrates the unity of physical laws in the macroscopic and microscopic worlds.

II. Motion of Solar System

a) Real particle model

A mass point has only mass but no volume and is a fictitious pseudo-particle. The curvilinear motion of a mass point includes three modes: real translation, pseudo rotation, and pseudo vibration. Real translation is the positional movement of the mass point, pseudo rotation is the circular motion of the mass point around the center of curvature, and pseudo vibration refers

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to the variation in curvature radius during the position movement. A real particle is a cluster containing multiple particles and has the attributes of mass, volume, and shape. The motion of a cluster includes three modes: real translation, real rotation, and real vibration. The real translation is the displacement of the cluster's barycenter, real rotation is the sum of the pseudo rotations of particles within the cluster, and real vibration is the superposition of the pseudo vibrations of particles within the cluster. The real rotation of a cluster is also known as self-rotation (spin), and the real vibration is also known as self-vibration (elastic vibration). In three-dimensional real space, a mass point has only three degrees of freedom for real translation, while a cluster has nine degrees of freedom for its three real modes of motion. The real-particle model is one of the fundamental assumptions of real physics, and the perspective of real-particle motion is the primary starting point of real-particle theory.

b) Kepler's laws

Kepler proposed the laws of planetary motion based on astronomical observations. According to these laws, the orbits of the planets around the sun are elliptical, with the sun at one focus of the ellipse. In classical mechanics, the solar system is abstracted as a system of mass points: the mass of the sun, denoted as m_0, is located at the center of mass O_0, while the mass of the planet, denoted as m_1, is located at the center of mass O_1. The motion trajectory of planet O_1 is shown in Fig. 1, which is an ellipse with the sun O_0 at one of the foci F of the ellipse. Taking $O_0(F)$ as the origin, the equation of the elliptic orbit represented in polar coordinates (ρ, θ) is given by

$$\rho(\theta) = \frac{a(1-e^2)}{1+e\cdot\cos\theta}. \tag{1}$$

In the above equation, a is the ellipse semi-major axis, e is the eccentricity, and $d = ae$ is the focal distance. The polar radii of the planet's perihelion P and aphelion A are given by $\rho_p = a - d$ and $\rho_a = a + d$.

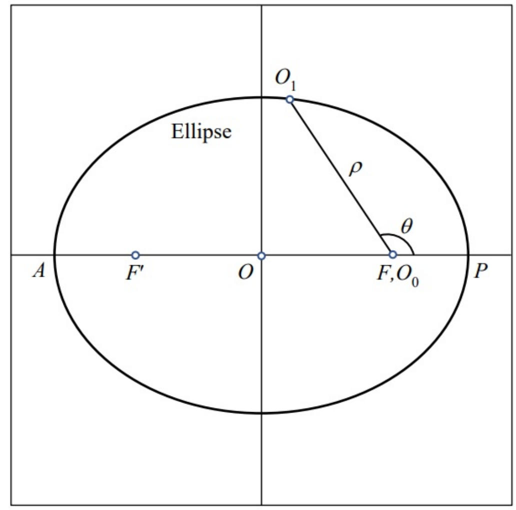

Fig. 1: The elliptic orbit is represented in polar coordinates (ρ, θ). The motion trajectory of planet O_1 is an ellipse with the sun O_0 at one of the foci F of the ellipse.

As shown in Fig. 2, in the Cartesian coordinate system with the ellipse center O as the origin, the circle with radius a is called a rotating circle, the azimuth angle ϕ is called a rotating angle, and the ellipse orbit can be expressed by parameters (a, ϕ) as [12]

$$\rho(\phi) = a - d\cdot\cos\phi. \tag{2}$$

The relationship between polar angle θ and rotating angle ϕ is

$$\tan\frac{\theta}{2} = \sqrt{\frac{a+d}{a-d}}\tan\frac{\phi}{2}. \tag{3}$$

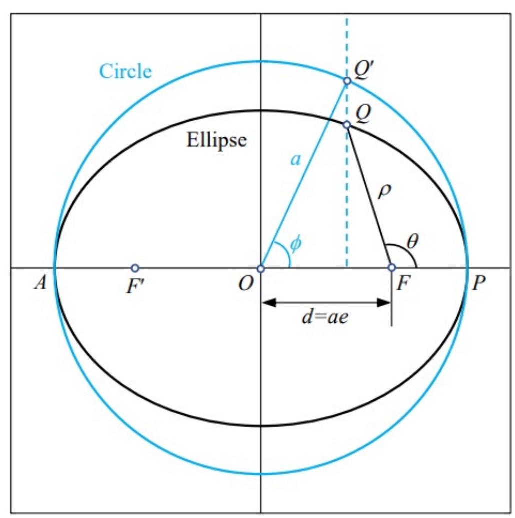

Fig. 2: The elliptic orbit is represented by parameters (a, ϕ). Point Q' on the circle is a mapped image of point Q on the ellipse.

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Thus, the elliptic orbit can be decomposed into two modes: pseudo rotation and pseudo vibration. In one period T, the polar angle θ and the rotating angle ϕ change by 2π, which is the pseudo-rotation mode. The average angular frequency of rotation is $\bar{\omega} = 2\pi/T$, with the direction perpendicular to the orbital plane and determined by the right-hand screw rule. In one period, the amplitude of the change in polar radius is d, which is the pseudo-vibration mode. The vibration frequency is equal to the rotation frequency $\bar{\omega}$.

The motion of a planet on an elliptic orbit can be viewed as that of a rotating vibrator with a length of ρ. One end of the vibrator is fixed at O_0, and the mass m_1 is concentrated at the other end at O_1, with an equilibrium length of a. The rotating vibrator rotates about O_0 at the frequency of ω in a plane (like a rotor) and vibrates along its length direction (like an oscillator). The rotating and vibrating frequencies are ω, and the vibrating amplitude is d. The speeds of rotation and vibration are given by

$$u_\phi = a\frac{\mathrm{d}\phi}{\mathrm{d}t} = a \cdot \omega, \quad u_\rho = \frac{\mathrm{d}\rho(\phi)}{\mathrm{d}t} = d \cdot \omega \cdot \sin\phi. \tag{4}$$

The stiffness of the vibrator is

$$s_1 = m_1\omega^2. \tag{5}$$

Therefore, the rotational energy and vibrational energy of the planet are, respectively

$$K = \frac{1}{2}m_1 u_\phi^2 = \frac{1}{2}m_1(\omega a)^2,$$

$$H = \frac{1}{2}s_1 d^2 = \frac{1}{2}m_1(\omega d)^2. \tag{6}$$

Because $\omega = \mathrm{d}\phi/\mathrm{d}t$ may not be constant, the oscillation of the rotating vibrator is not a simple harmonic motion. If the rotation period T is used as the unit of time, then $\omega = \bar{\omega} = 2\pi/T$. It is known that the masses of the sun and the earth are $m_0 = 1.9891 \times 10^{30}$kg and $m_1 = 5.9722 \times 10^{24}$kg respectively, the rotation period of the earth is $T = 365.256 \times 86400$s, the equilibrium distance between the earth and the sun is $a = 1.49598 \times 10^{11}$m, and the vibrating amplitude is $d = 2.49957 \times 10^9$m. Therefore, the rotation energy of the earth is $K = 2.6491 \times 10^{33}$J, the vibration energy is $H = 7.3956 \times 10^{29}$J, and the vibrator's stiffness is $s_1 = 2.36739 \times 10^{11}\mathrm{kg} \cdot \mathrm{s}^{-2}$.

c) Two-body cluster

Now, let's discuss the two-body problem starting from Kepler's laws based on the perspective of real-particle motion. Assuming that the center of the planet/sun cluster is at the barycenter O', the reduced mass of the cluster μ is defined as

$$\mu = \frac{m_0 m_1}{m_0 + m_1}. \tag{7}$$

If the distance from the sun O_0 to the planet O_1 is D, then the spaces from the barycenter O' of the cluster to O_0 and O_1 are, respectively

$$\rho_0' = \frac{\mu}{m_0}D, \qquad \rho_1' = \frac{\mu}{m_1}D. \tag{8}$$

It can be proven that both O_0 and O_1 move around the barycenter O' in elliptic orbits.

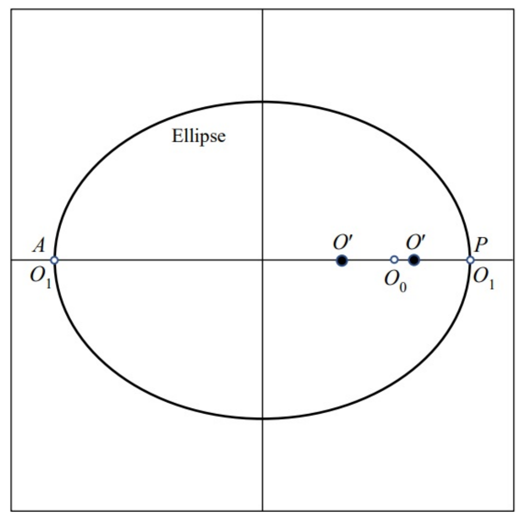

Fig. 3: The motion of a two-body cluster. When planet O_1 is located at the perihelion P and the aphelion A, the barycenter O' is situated to the right and left of O_0, respectively. Both O_0 and O_1 move around the barycenter O' in elliptic orbits.

As shown in Fig. 3, when planet O_1 is located at the perihelion P and the aphelion A, the barycenter O' is situated to the right and left of O_0, respectively. When O_1 is at the perihelion, $D = \rho_p$, and the spaces from O' to the sun and the planet are ρ_{0p}' and ρ_{1p}', respectively. When O_1 is at the aphelion, $D = \rho_a$, and the spaces from O' to the sun and the planet are ρ_{0a}' and ρ_{1a}', respectively.

$$\rho_{0p}' = \frac{\mu}{m_0}\rho_p, \quad \rho_{1p}' = \frac{\mu}{m_1}\rho_p;$$

$$\rho_{0a}' = \frac{\mu}{m_0}\rho_a, \quad \rho_{1a}' = \frac{\mu}{m_1}\rho_a. \tag{9}$$

The rotating radius and vibrating amplitude of the sun's orbit are given by

$$a_0 = \frac{1}{2}\left(\rho_{0a}' + \rho_{0p}'\right) = \frac{\mu a}{m_0},$$
$$d_0 = \frac{1}{2}\left(\rho_{0a}' - \rho_{0p}'\right) = \frac{\mu d}{m_0}. \tag{10}$$

The rotating radius and vibrating amplitude of the planet's orbit are given by

$$a_1 = \frac{1}{2}\left(\rho'_{1a} + \rho'_{1p}\right) = \frac{\mu a}{m_1},$$

$$d_1 = \frac{1}{2}\left(\rho'_{1a} - \rho'_{1p}\right) = \frac{\mu d}{m_1}. \tag{11}$$

Where a and d are the rotating radius and vibrating amplitude of O_1 for O_0 as the origin, and they have the following relationship

$$a = a_0 + a_1, \quad a_0 m_0 = a_1 m_1 = a\mu;$$

$$d = d_0 + d_1, \quad d_0 m_0 = d_1 m_1 = d\mu. \tag{12}$$

Therefore, the two-body cluster can be viewed as two pseudo-rotating vibrators with the rotating radii of a_0 and a_1 and the masses of m_0 and m_1. They rotate and vibrate at the same frequency ω relative to the barycenter O' with a fixed phase difference of π.

At this point, the pseudo-rotation energy and pseudo-vibration energy of the sun and the planet are, respectively

$$K_0 = \frac{1}{2} m_0 (\omega a_0)^2 = \frac{(\mu\omega a)^2}{2m_0},$$

$$H_0 = \frac{1}{2} m_0 (\omega d_0)^2 = \frac{(\mu\omega d)^2}{2m_0};$$

$$K_1 = \frac{1}{2} m_1 (\omega a_1)^2 = \frac{(\mu\omega a)^2}{2m_1},$$

$$H_1 = \frac{1}{2} m_1 (\omega d_1)^2 = \frac{(\mu\omega d)^2}{2m_1}. \tag{13}$$

Therefore, the real-rotation energy $K = K_0 + K_1$ and the real-vibration energy $H = H_0 + H_1$ of the two-body cluster can be expressed as

$$K = \frac{1}{2}\mu(\omega a)^2 = \frac{1}{2\mu}p^2, \quad p = \mu\omega a;$$

$$H = \frac{1}{2}\mu(\omega d)^2 = \frac{1}{2}sd^2, \quad s = \mu\omega^2. \tag{14}$$

Where p is the cluster's rotating momentum, and s is the cluster's stiffness. At this point, we call the two-body cluster a real rotating vibrator, and K and H are the self-rotation energy and self-vibration energy, respectively.

In this case, $V = H - K$ is the potential energy of the cluster. Since $a > d$ and $K > H$, we have $V < 0$. It indicates a bound state and a necessary condition for cluster stability. The self-vibration energy $H = K + V$ is the system's Hamiltonian.

Given the reduced mass of the earth/sun system as $\mu = 5.9721 \times 10^{24}$kg, we can calculate $K = 2.6490 \times 10^{33}$J and $H = 7.3955 \times 10^{29}$J according to formula (14). Since $m_0/m_1 = 333060 \gg 1$, we have $K_1 \gg K_0$ and $H_1 \gg H_0$, so the cluster's energy mainly comes from the earth's motion.

d) *Multi-body cluster*

Consider a multi-body cluster consisting of the sun and planets, where the mass of the sun and each planet are denoted by m_0 and $m_i\,(i \neq 0)$, respectively. Taking the sun's center O_0 as the reference point, the orbital equation for the planet is given by

$$\rho_i(t) = a_i - d_i \cdot \cos(\omega_i t + \phi_{i0}), \quad i = 1, 2, 3, \cdots \tag{15}$$

Where $a_i, \omega_i, d_i, \phi_{i0}$ are respectively the rotating radius, angular frequency, vibrating amplitude, and initial phase of the planet to the reference point O_0 of the sun.

The system can be regarded as n real-rotating vibrators, and each vibrator consists of a planet and the sun. The center of the i-th vibrator is located at O'_i and has a reduced mass of

$$\mu_i = \frac{m_0 m_i}{m_0 + m_i}. \tag{16}$$

According to formula (14), the rotation energy and vibration energy of the i-th vibrator K_i and H_i are, respectively

$$K_i = \frac{1}{2}\mu_i(\omega_i a_i)^2, \qquad H_i = \frac{1}{2}\mu_i(\omega_i d_i)^2. \tag{17}$$

The rotation energy and vibration energy of a cluster containing n planets are given by

$$K = \frac{1}{2}\sum_{i=1}^{n}\mu_i(\omega_i a_i)^2, \quad H = \frac{1}{2}\sum_{i=1}^{n}\mu_i(\omega_i d_i)^2. \tag{18}$$

Table 1: The orbital parameters and motion energies of eight major planets. The orbital data are quoted from Wikipedia.

	m_i 10^{24}kg	ω_i 10^{-9}rad/s	a_i 10^6km	d_i 10^6km	K_i 10^{32}J	H_i 10^{29}J
1. Mercury	0.3301	826.677	57.9091	11.9079	3.7826	159.94
2. Venus	4.8675	323.639	108.208	0.73100	29.848	1.3622
3. Earth	5.9722	199.099	149.598	2.49957	26.490	7.3955
4. Mars	0.6417	105.858	227.956	21.3055	1.8683	16.321
5. Jupiter	1898.2	16.7849	778.478	37.8785	1618.9	3832.8
6. Saturn	568.34	6.75904	1433.53	80.9750	266.71	850.99
7. Uranus	86.820	2.36968	2870.98	135.415	20.091	44.698
8. Neptune	102.41	1.20811	4498.41	38.8950	15.123	1.1306

The relationship between K_i and ω_i is called the rotation spectrum of the cluster, and the relationship between H_i and ω_i is called the vibration spectrum.

Table 1 lists the data of mass, angular frequency, rotating radius, and vibrating amplitude of the eight major planets. The rotational and vibrational energies are calculated according to equation (17). Fig. 4 shows the rotational energy spectrum, and Fig. 5 shows the vibrational energy spectrum of the solar system.

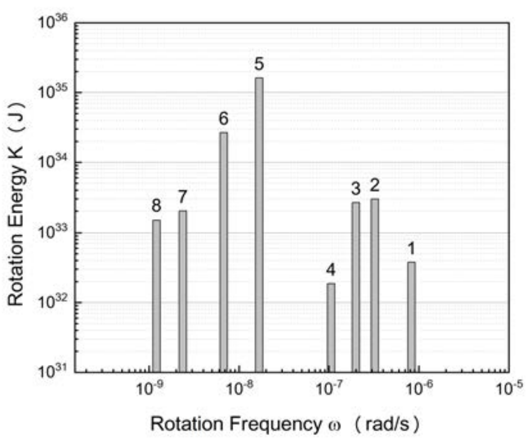

Fig. 4: Rotation spectrum of the solar system.

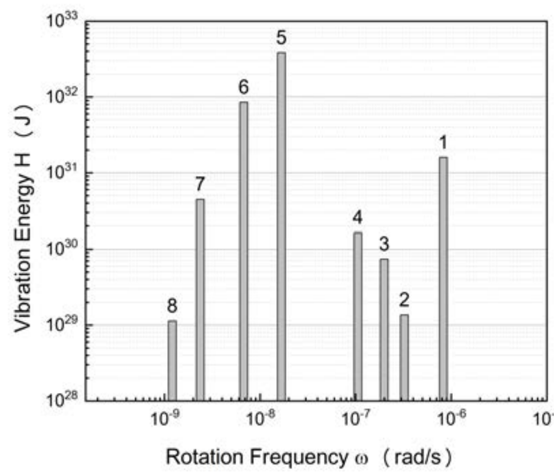

Fig. 5: Vibration spectrum of the solar system.

III. Quantum Theory of Cluster

a) Scale and quantum

Physical quantities in real physics are expressed using real quantities. The form of a real quantity q is $q = q_s \cdot \tilde{q}$ $(0 < q_s < \infty)$, where q_s is the scale and $\tilde{q}$ is the digit. The principle of objectivity in real physics requires that physical formulas must satisfy the following conditions

$$z = f(x,y) = z_s \cdot \tilde{z}; \quad z_s = f_s,\ \tilde{z} = f(\tilde{x},\tilde{y}). \tag{19}$$

In the above formulas, the scale relation $z_s = f_s$ stands for the covariance of physical units, and the digital relation $\tilde{z} = f(\tilde{x},\tilde{y})$ stands for the invariance of mathematical relation. The number of independent scales (base scales) is limited to three by the covariance condition. Scale is a generalization of the concept of unit and quantum. The essential difference between classical and modern physics lies in using different scale bases.

Classical mechanics adopts the base scales: mass m_s = kg (kilogram), space r_s = m (meter), and time t_s = s (second). Other scales can be derived based on covariance: velocity $u_s = r_s/t_s = \mathrm{m}\cdot\mathrm{s}^{-1}$, *momentum* $p_s = m_s u_s = kg \cdot m \cdot s^{-1}$, *angular momentum* $h_s = p_s r_s = \mathrm{kg}\cdot\mathrm{m}^2\cdot\mathrm{s}^{-1}$, and energy $E_s = m_s u_s^2 = \mathrm{kg}\cdot\mathrm{m}^2\cdot\mathrm{s}^{-2}$. It can be seen that scale covers the concept of physical units. The International System of Units (SI) specifies the quantity values of basic units, and derived units are invariant.

Quantum mechanics adopts the base scales: velocity $u_s = c$ (speed of light), angular momentum $h_s = h$ (Planck constant), and frequency $\nu_s = \nu$ (variable). Derived scales include: time $t_s = 1/\nu$, space $r_s = c/\nu = \lambda$, momentum $p_s = h_s/r_s = h/\lambda$, mass $m_s = h_s/(r_s u_s) = h/(\lambda c)$, and energy $E_s = m_s u_s^2 = h\nu$. Since c and h are constants, there are the scale uncertainty relations: $\lambda\nu = c$ and $p_s r_s = E_s t_s = h$. Because the frequency scale is variable in base scales, the derived scales are also varying. Systems containing varying scales are generalized quantum systems.

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Relativistic mechanics adopts the base scales: mass m_s, time t_s, and velocity $u_s = c$ (speed of light). The constancy of the speed of light is the fundamental assumption of relativity, $r_s = ct_s$ shows the effects of time dilation and length contraction, and $E_s = m_s c^2$ indicates that the essence of the mass-energy relationship is a scale relationship.

A reasonable choice of independent scales can facilitate analysis and calculation. For example, specifying base scales $\{u_s, r_s, m_s\}$ as

$$u_s = c, \quad r_s = d = \frac{1}{n}\sum_{i=1}^{n} d_i, \quad m_s = \mu = \frac{1}{n}\sum_{i=1}^{n} \mu_i \quad (20)$$

we have the derived scales $\{t_s = r_s/u_s = d/c,\ \omega_s = c/d,\ E_s = \mu c^2\}$. Because $\{\mu_i = \mu \cdot \tilde{\mu}_i,\ \omega_i = (c/d) \cdot \tilde{\omega}_i,\ a_i = d \cdot \tilde{a}_i,\ d_i = d \cdot \tilde{d}_i\}$, the energy of the solar system can be calculated using the following equation

$$\begin{aligned} K &= \frac{1}{2}\mu c^2 \cdot \sum_{i=1}^{n} \tilde{\mu}_i (\tilde{\omega}_i \tilde{a}_i)^2, \\ H &= \frac{1}{2}\mu c^2 \cdot \sum_{i=1}^{n} \tilde{\mu}_i (\tilde{\omega}_i \tilde{d}_i)^2. \end{aligned} \quad (21)$$

b) State function

The relationship between the position and time of the rotating vibrator can be written as

$$\rho(t) = a - d \cdot \cos(\omega t). \quad (22)$$

According to equation (3), the rotating frequency of the vibrator is

$$\omega = \frac{\mathrm{d}\phi}{\mathrm{d}t} = \sqrt{\frac{a-d}{a+d}} \left[\frac{\cos(\phi/2)}{\cos(\theta/2)}\right]^2 \frac{\mathrm{d}\theta}{\mathrm{d}t}. \quad (23)$$

The formulas (22) and (23) are the classical state functions of the rotating vibrator.

Consider the following questions: As $t \gg T$, what is the probability distribution of finding the earth in the orbital plane? Are there any other stable orbits for the earth in the solar system? Are the energies between these orbits continuous? These questions do not have support from observational data, but can be theoretically analyzed and statistically answered.

Let's take the base scales of the system as $\{r_s, t_s, h_s\}$, then, the derived scales are $\{\omega_s = 1/t_s,\ u_s = r_s/t_s,\ p_s = h_s/r_s,\ m_s = h_s t_s/r_s^2,\ E_s = h_s\omega_s\}$. At this point, the digital equation corresponding to the physical equation (22) can be written as

$$\tilde{\rho} + \tilde{d} \cdot \cos(\tilde{\omega}\tilde{t}) = \tilde{a}. \quad (24)$$

Mapping the left end of the digital equation to the complex plane and representing it with a complex function $\varPsi$, we have

$$\begin{aligned} \varPsi(\tilde{\rho}, \tilde{t}) &= A_{\tilde{p}}(\tilde{\rho}) e^{2\pi j(\tilde{p}\tilde{\rho} - \tilde{E}\tilde{t})} = \psi_{\tilde{p}}(\tilde{\rho}) e^{-2\pi j \tilde{E}\tilde{t}}, \\ \psi_{\tilde{p}}(\tilde{\rho}) &= A_{\tilde{p}}(\tilde{\rho}) e^{2\pi j \tilde{p}\tilde{\rho}}. \end{aligned} \quad (25)$$

The j in $\varPsi$ is the imaginary unit. The complex function $\varPsi(\tilde{\rho}, \tilde{t})$ is called the quantum state function of the rotating vibrator, $\psi_{\tilde{p}}(\tilde{\rho})$ is called the stationary state function, and $A_{\tilde{p}}(\tilde{\rho})$ is called the probability amplitude. The mapping relation is

$$f : \{\tilde{\rho} \to \tilde{\rho};\ \tilde{t} \to \tilde{t};\ \tilde{\omega} \to \tilde{p}, \tilde{E};\ \tilde{d} \to \tilde{E};\ \tilde{a} \to A_{\tilde{p}}\}. \quad (26)$$

The conversion from (24) to (25) is not a one-to-one mapping and cannot be expressed as a functional relation. The parameters hidden in the quantum state function are the frequencies, focal length, and semi-major axes of the elliptic orbit. The quantum state function contains information about the cluster's self-rotation and self-vibration and is a description of the state of motion of the cluster.

From the scale-free equation (24), it can be seen that $|\varPsi| = \tilde{a}$ should be finite. In addition, the state function is required to be square-integrable over the entire space, that is

$$\int_0^\infty |\psi_p(\rho)|^2 \,\mathrm{d}\rho = \int_0^\infty \psi_p(\rho)^* \psi_p(\rho) \,\mathrm{d}\rho < \infty. \quad (27)$$

In this case, there is a distribution function

$$P(\rho) = |\psi_p(\rho)|^2 \,\mathrm{d}\rho \left(\int_0^\infty |\psi_p(\rho)|^2 \,\mathrm{d}\rho\right)^{-1}. \quad (28)$$

$P(\rho)$ represents the probability of finding the particle in the range $\rho \to \rho + \mathrm{d}\rho$, and this is the statistical interpretation of the quantum state function. Physics requires statistical descriptions like the state function because it is impossible to obtain unknown orbital parameters of the earth and electronic orbital data in all atoms.

c) State equation

The quantum state function of the cluster, represented by the real quantities, is

$$\Psi(\rho,t) = A_p(\rho)e^{j(p\rho - Et)/\hbar_s} = \psi_p(\rho)e^{-jEt/\hbar_s},$$

$$\psi_p(\rho) = A_p(\rho)e^{jp\rho/\hbar_s}. \tag{29}$$

Where $\hbar_s = h_s/2\pi$. We define the operators as follows

$$\hat{\rho} = \rho, \quad \hat{p} = -j\hbar_s\nabla, \quad \hat{p}^2 = -\hbar_s^2\nabla^2;$$
$$\hat{H} = j\hbar_s\frac{\partial}{\partial t}, \quad \hat{K} = \frac{\hat{p}^2}{2\mu}, \quad \hat{V} = V(\rho). \tag{30}$$

The symbol $\nabla = \partial/\partial\rho$ represents the gradient operator, and $\nabla^2 = \partial^2/\partial\rho^2$ represents the Laplace operator. $\hat{p}$ is the momentum operator, $\hat{K}$ is the kinetic energy (rotation energy) operator, $\hat{H}$ is the Hamiltonian (vibration energy) operator, and $\hat{V}$ is the potential energy operator.

According to the energy relation $H = K + V$, the following operator equation must hold

$$\hat{H} = \hat{K} + \hat{V}, \quad j\hbar_s\frac{\partial}{\partial t} = -\frac{\hbar_s^2}{2\mu}\nabla^2 + V(\rho). \tag{31}$$

The differential equation obtained by applying the operator equation to the state function is as follows

$$\hat{H}\Psi = \hat{K}\Psi + \hat{V}\Psi, \quad j\hbar_s\frac{\partial\Psi}{\partial t} = -\frac{\hbar_s^2}{2\mu}\nabla^2\Psi + V(\rho)\Psi. \tag{32}$$

Formula (32) is called the quantum state equation. Substituting $\Psi(\rho,t) = \psi_p(\rho)e^{-jEt/\hbar_s}$ into the quantum state equation yields the time-independent stationary state equation

$$-\frac{\hbar_s^2}{2\mu}\nabla^2\psi + V(\rho)\psi = E\psi. \tag{33}$$

The above equation, $\hat{H}\psi = E\psi$, is the eigen equation with eigenvalue E. The eigen solution represents the time-averaged effect of the system, and each eigenstate corresponds to one possible orbital configuration. Equations (32) and (33) have the same form as the Schrödinger equation and can be generalized to three dimensions and multi-body systems.

The quantum state equation is a linear differential equation, and its general solution can be expressed as a linear combination of all eigenfunctions

$$\Psi(\rho,t) = \sum_n c_n\Psi_n(\rho,t) = \sum_n c_n\psi_n(\rho)e^{-jE_nt/\hbar_s}. \tag{34}$$

The function ψ_n is the normalized eigenfunction with energy E_n, and $|c_n|^2$ represents the probability of the occurrence of the state ψ_n. The above superposition principle requires a complete set of eigenstates and is not valid for partial state superpositions.

If $A_p(\rho) = A_p$ does not depend on ρ, i.e., $\Psi_0 = A_pe^{j(pp-Et)/\hbar_s}$, it can be verified that $\hat{H}\Psi_0 = \hat{K}\Psi_0 \mapsto E = p^2/2\mu$. This shows that Ψ_0 is the image of $V = 0$, i.e., $f : \{V(\rho) = 0 \to A_p(\rho) = A_p\}$. When $V(\rho) \neq 0$, there must be $A_p = A_p(\rho)$. Thus, solving the state function from the potential energy is a kind of mapping $f : V \to \Psi$, where V is the original image, Ψ is the mapped image, and the quantum state equation is the mapping relation f.

The quantum state function is a probabilistic description of the time-avareged effect of the cluster, not the instantaneous behavior of individual particles. To emphasize this fact, we usually refer to the quantum state as the cluster state and the quantum state equation as the cluster state equation. The parameter μ in the state equation is the reduced mass of the system, and the angular momentum scale h_s is a system constant, not a universal constant. The value used in quantum mechanics is $h_s = h = 6.62606896 \times 10^{-34}\mathrm{J\cdot s}$. If the angular momentum of the earth/sun system is taken as the base scale, then $h_s = 2.66104 \times 10^{40}\mathrm{J\cdot s}$.

d) Plane central force Field

The universal gravitational field and the Coulomb field are both central force fields, and the gravitational potential V_g and Coulomb potential V_e have similar forms. Taking the plane coordinates (ρ, ϕ) as an example, it has

$$V_g = -g\frac{m_0m_1}{\rho}, \qquad V_e = -\frac{|q_0q_1|}{\epsilon\,\rho}. \tag{35}$$

Where $g = 6.6742867\times10^{-11}\mathrm{N\cdot m^2\cdot kg^{-2}}$ is the universal gravitational constant, $\epsilon = 4\pi\epsilon_s$, and $\epsilon_s = 8.8541877\times 10^{-12}\mathrm{C^2\cdot N^{-1}\cdot m^{-2}}$ is the vacuum permittivity. In real-particle field theory [6], the potential includes a mass potential and a momentum potential. The mass potential is a spatial convolution of mass density, which causes an attractive interaction. The momentum potential is a spatial convolution of momentum density, which causes a repulsive interaction. The repulsion between particles arises from relative motion and does not require particles to have opposite charge signs. If the charges are all positive, then charge and mass are equivalent. It is known that the electron charge is $e = 1.6021765 \times 10^{-19}\mathrm{C}$ and the electron mass-charge ratio is $\beta = 5.6856296 \times 10^{-12}\mathrm{kg\cdot C^{-1}}$. By introducing the transformation coefficient $\sigma = \epsilon g$, the relation be-

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tween charge and mass is $q = (\sigma\beta)m$, and the relation between the Coulomb potential and the gravitational potential is $V_e = (\sigma\beta^2)V_g$.

The hydrogen atom and the earth/sun system are both two-body clusters with only one particle outside the kernels, and their energy eigen equations are given by

$$-\frac{\hbar_s^2}{2\mu}\nabla^2\psi - \frac{e_0^2}{\rho}\psi = E\psi. \tag{36}$$

where $e_0^2 = gm_0m_1$, and the Laplace operator is

$$\nabla^2 = \frac{\partial^2}{\partial\rho^2} + \frac{1}{\rho}\frac{\partial}{\partial\rho} + \frac{1}{\rho^2}\frac{\partial^2}{\partial\phi^2}. \tag{37}$$

According to the theory of quantum mechanics, the eigenfunction of the two-body cluster is [13]

$$\psi_n = C_n\rho^{-1/2}v_n(\rho)e^{jm\phi}, \quad m = \pm1, \pm2, \cdots \tag{38}$$

Where $v_n(\rho)$ is the eigensolution of the following equation

$$\left[-\frac{\hbar_s^2}{2\mu}\frac{\partial^2}{\partial\rho^2} + \frac{(m^2-1/4)\hbar_s^2}{2\mu\rho^2} - \frac{e_0^2}{\rho}\right]v(\rho) = Ev(\rho). \tag{39}$$

The second term at the left end of the above equation is the repulsive potential which is caused by the pseudo-motion modes of the particle outside the kernel. The energy eigenvalue of the system is

$$E_n = \frac{-e_0^2}{2a_0(n-1/2)^2}, \quad n = 1, 2, 3, \cdots \tag{40}$$

where $a_0 = \hbar_s^2/(\mu e_0^2)$. Therefore, we conclude that the probability of finding the earth on the orbital plane is proportional to $v_n^2(\rho)/\rho$. The stable orbits of the earth in the solar system are not unique, and the energies of different orbits are quantized.

IV. Conclusions

Mass points are fictional pseudo-particles. They have only mass but no volume and cannot explain the quantum properties of spin and wave-particle duality. Real particles are clusters that have mass, volume, and shape as well. The vibrational and translational modes of the clusters exhibit the quantum's wave-particle duality, while the rotational mode reflects the quantum's spin. A cluster is an actual entity corresponding to quantum and is a cross-level concept of matter structure. Atoms and the solar system are both clusters composed of low-level particles with similar structures and following unified laws of motion.

A two-body cluster is a rotating vibrator, and its orbit equation maps to a complex plane to form a quantum state function. The mapping from classical states to quantum states is a complicated cross-dimensional mapping, and its implicit variables are the classical orbit parameters. The quantum state function contains information on the rotation and vibration of the cluster. It is a probabilistic description of the long-term behavior of the clusters rather than the instantaneous behavior of individual particles. The state of the cluster is constrained by particle interactions and satisfies the equation of quantum wave mechanics. Solving the state function from the potential energy function is also a mapping, and the Schrödinger equation is a mapping algorithm. The statistics of cluster motion are the reality basis of quantum mechanics.

The scale concept is a generalization of physical units. Scales can be constants or variables, and systems with less than three constant scales are generalized quantum systems. The scale theory is the mathematical basis for describing cluster physics, and the principle of scale covariance fully reflects the unity of physical laws. The scale theory indicates that quantum is the natural unit of a physical quantity, but the objective entity represented by quantum is not the smallest element of matter. The peculiar behavior of quantum belongs to the aggregation effect of low-level particles or the emergence phenomenon of a high-level particle system.

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By Stanislav Konstantinov

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GRAVITATINGSPHEREINNEAREARTHSPACEANDHERROTATION

Strictly as per the compliance and regulations of:

Gravitating Sphere in Near-Earth Space and her Rotation

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I. Introduction

The presence of an additional gravitating sphere in near-Earth space was discovered in experiments with artificial Earth satellites equipped with magnetometers and clocks in 1997. Using magnetometers, it was possible to detect the rotation of the globe, while the satellite's velocity relative to the sphere was determined by changing the magnetic field strength. The experiments were carried out at the Military Space Academy A.F. Mozhaisky in the 90s of the 20th century under the guidance of the deputy head of the academy for scientific work, Professor V. Fateev. The discovery of the Earth's rotating ethereal sphere was presented to the scientific community by employees of the Military Space Academy in 1997 Colonels V.L. Groshev and V.B. Kudryavtsev [1]. In reports dated November 12 at a workshop at the Physical or Society of St. Petersburg and December 10 at a seminar by Professor P.V. Parshina "The Universe" in the House of Scientists of St. Petersburg, the speakers reported that from analysis the accumulated scientific data, the military is not able to create a satisfactory physical model and seek help from the scientific community so that the necessary theory.

II. Torsion Gravity

In 1922, the French mathematician E. Cartan put forward a hypothesis according to which the space around a rotating substance must also rotate [2]. In this case, Riemannian geometry, allowing torsion to take its place in it, will be called the Riemann-Cartan geometry. Today, "The fundamental theory of torsion gravity" by Professor Luca Fabbri is the most complete theory describing the dynamics of space-time, and since torsion is associated with spin in the same spirit in which curvature is associated with energy [3]. However, there is still controversy about the role of torsion other than curvature in gravity, and there may be several reasons for this. The single most important of these may be that the successes of Einstein's theory of gravity at the beginning of the 21st century were already too great to make anyone think about modifying it. At the beginning of the 20 st century, spin was not yet discovered and Einstein, while developing his theory of gravity, adopted the Ricci tensor with zero torsion, because when the torsion disappears, the Ricci tensor is symmetric and, therefore, it can be consistently associated with the symmetric energy tensor, realizing the identification between the curvature of space-time and its energy content, expressed by Einstein's field equations [4]. The left side in Einstein's field equation describes the curvature of space-time, while the right side describes the distribution of matter:

$$R\mu\nu - \frac{1}{2} g\mu\nu = \frac{8\pi G}{c^4} \mathrm{T}\mu\nu \qquad (1)$$

Where $R\mu\nu$ is the Ricci tensor, $g\mu\nu$ is the event space metric tensor, $\mathrm{T}\mu\nu$ is the energy-momentum tensor of matter.

Einstein is talking about free space, which means there is no matter there, not even the electromagnetic field; consequently the right hand side (1) should be zero. So the equation is simplified to $R\mu\nu - 1/2\ g\mu\nu = 0$, which is equivalent to a more concise form $R\mu\nu = 0$, which is also known as "Vacuum Einstein Field Equation" [4]. However, now physicists say that instead of studying space, they can create a Bose-Einstein condensate and study the physical vacuum. In June 2020, the Bose-Einstein condensate was successfully recreated in Earth orbit on the International Space Station (ISS) . Only there it was possible to create all the conditions for the appearance of the quantum fifth state of matter within a few seconds, but this was enough for scientists to get an idea of how exactly dark matter moves and why we cannot see and feel it [5]. The last discovery by astrophysicists of the rotation of space-time around a white dwarf in the PSR J1141-6545 binary star system is interpreted by them as a new proof of the correctness of Einstein's theory [6]. The rapidly spinning white dwarf pulls has caused the pulsar's orbit to change its orientation slowly over time. That prediction is a phenomenon known as frame dragging, or the Lense-Thirring effect. It states that space-time will churn around a massive, rotating body, although, of course, it is not

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space-time that rotates, but a sphere of dark matter together with a star. Satellite experiments have detected frame dragging in the gravitational field of rotating Earth, but the effect is extraordinarily small and, therefore, has been challenging to measure. Objects with more powerful gravitational fields, such as white dwarfs and neutron stars, offer better chances to see this phenomenon. Study lead author Vivek Venkatraman Krishnan, an astrophysicist at the Max Planck Institute for Radio Astronomy in Bonn, Germany, told that the researchers measured when pulses from the pulsar arrived at Earth to an accuracy within 100 microseconds over a period of nearly 20 years, using the Parkes and UTMOST radio telescopes in Australia. This allowed them to detect a long-term drift. The scientists detailed their findings in the journal Science [6]. The last discovery by astrophysicists relatively of the rotation of space-time tissue around a white dwarf in the PSR J1141-6545 binary star system [6], in the in my theory "Torsion gravity" is explained by the rotation of the ethereal sphere, formed by the halo of dark matter [7]. In the theory "Torsion Gravity" I introduced complete environment for modern physics with potential applications wherever spin effects can be important, from quantum mechanics to elementary particle physics and cosmology [7]. Here it is necessary to clarify the question of what revolves around galaxies, stars and planets. Recent astrophysical data indicate that that the ethereal sphere around galaxies, stars and planets is formed by a halo of dark matter [8]. The interplanetary circumsolar plasma environment mainly includes the solar wind, the interplanetary magnetic field, cosmic rays (high-energy charged particles), and neutral gas. Today, this list can be supplemented by a super fluid medium of dark matter, which has the property of gravity and forms halos around galaxies, stars, and planets [5]. The density of dark matter in the vicinity of the Sun is estimated by Professor S. Garbary from the University of Zurich to be 0.85 GeV/cm^3 $\sim 12\times10^{-25}$ g/cm^3. At the same time, the density of baryonic matter is estimated to be 3.8 GeV/cm^3 $\sim 50\times10^{-25}$ g/cm^3.

In the article i will cite bring an exhaustive explanation for the absence of a shift in the interference fringes in the Michelson-Morley experiments of 1881-1887 due to the presence of a halo of dark matter (ether) rotating with the Earth. Michelson's experiment (Fig. 1), was aimed to detect earth's motion with respect to the fixed ether and it was performed on the surface of the earth. The device Michelson designed, later known as an interferometer, sent a single source of white light through a half silvered mirror that was used to split it into two beams travelling at right angles to one another. After leaving the splitter, the beams travelled out to the ends of long arms where they were reflected back into the middle on small mirrors. They then recombined on the far side of the splitter in an eyepiece, producing a pattern interference fringes. If the Earth is traveling through an ether medium, abeam reflecting back and forth parallel flow ether take longer than beam reflecting perpendicular ether because time gained from traveling downwind less than lost traveling upwind, what result be delay in one of light beams that could be detected when beams were recombined through interference. Any slight change spent time would then observed, as shift in positions interference fringes. If a ether were stationary relative the Earth, then would be detected produce shift 4% size single fringe. In Michelson-Morley experiment, the light was repeatedly reflected back and forth along the arms of the interferometer, increasing the path length to 11 m. At this length, the drift would be about 0.4 size single fringe. In both cases, as in all subsequent more accurate experiments, the result was negative, i.e. the absence of a shift in the interference fringes says that there is no ether.

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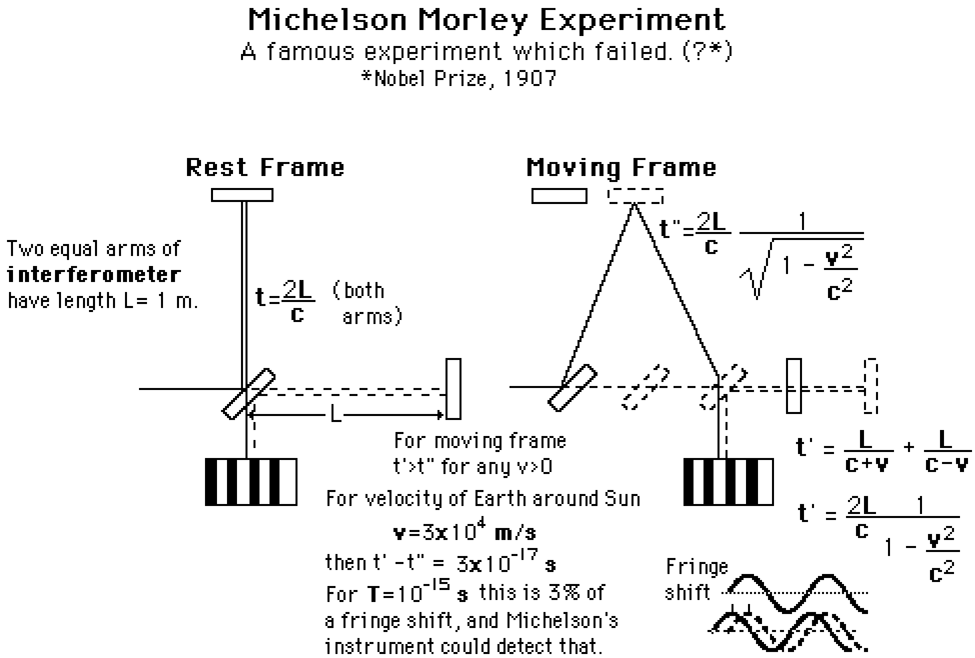

Figure 1: Michelson-Morley experiment

But who says the ether would be at rest on the surface of the earth? He can move with the earth like the atmosphere. Observations astrophysicist Vivek Venkatraman Krishnan have proven this January 30, 2020 and buried Einstein's Special and General Relativity theory. Like the Earth's atmosphere, the halo of dark matter rotates counterclockwise with the planet — from west to east. Due to rotation, it, like the Earth, takes the form of an ellipsoid, that is, at the equator its thickness is greater than at the poles.

In the new cosmological model, the gravitational well described by the spatial curvature of Albert Einstein can be replaced by a gravitational funnel created in the space environment (dark matter) around a rotating celestial body of astronomical dimensions [7] (Fig. 2)

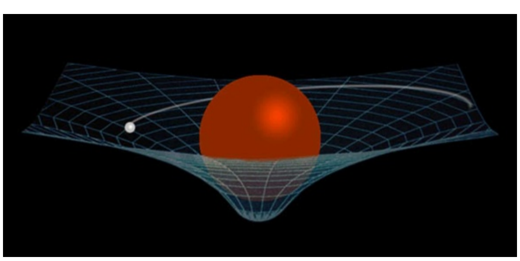

Figure 2: Gravity funnel

The axial rotation of black holes, stars and planets in the dark matter halo is possibly due to the formation of strong magnetic fields around them. So, for black holes the magnetic field reaches a monstrous value of 2000 Tesla, for the Sun the magnetic field reaches 10 Tesla, and for the planet Earth the magnetic field reaches 5 • 10^{-5} Tesla. Taking into account all the properties of the magnetic field in real electrodynamics makes it possible to detect, in addition to the well-known transverse Lorentz forces, also the longitudinal magnetic field forces rotating black holes, stars and planets acting at an angle to the axis of rotation of the gravitational funnel [9]. The stability of the funnel is imparted by rotation. The elastic model of a gravitational funnel lends itself easily to mathematical analysis. Any "curvature" of the quantized vacuum (dark matter) when massive celestial bodies are placed in it, is associated with two types of deformation: compression and tension, accompanying each other in elastic media, as two balancing components. The stability of the funnel is imparted by rotation. Having determined the dimensions of the funnel with the help of space probes, and knowing the mass of the planet and its volume, it is possible to estimate the compression and expansion coefficients of the space medium. It has been experimentally established that the radius of the Earth's gravitational funnel is approximately 900,000 km, and the distance from the Earth to the Sun is 150,000,000 km. In the solar system, the action of the gravity of the sun and the gravity of the planets are delimited! Planetary gravity funnels have finite dimensions and do not reach the sun. The practice of interplanetary flights shows that there is no smooth transition from the region dominated by solar gravity to the region dominated by planetary gravity. At the moment the spacecraft crosses the boundaries of these areas, there is an abrupt change in the "true" speed of the spacecraft. Moreover, for the correct calculation of interplanetary flight, the "true" speed of the apparatus within the planetary gravitational funnel should be counted only in the planetary centric frame of reference, and in interplanetary space - only in the heliocentric frame of reference. A jump in the speed of the ship (by tens of kilometers per second) when entering the gravitational funnel of Mars or Venus it is an experimentally confirmed physical effect [10]. The consequence of this jump is an unexpected Doppler shift of the carrier frequency during radio communication with the device and a change in the type of its trajectory. For this reason, a number of Soviet and American vehicles were lost during the first flights to Venus and Mars. The fact of delimiting the gravitational planetary funnels naturally follows from the hypothesis of gravitation, which is based on the excitation of the cosmic environment (dark matter) by bodies of astronomical size.

The torsion theory realized the identification between the curvature of the gravitational funnel in the quantum vacuum (dark matter) and its energy content in the polarization theory of electrogravidynamics of RAS professor V.L. Dyatlov [11] and the identification between torsion and its spin content in the Dirac spin or field theory [12]. The area of quantum vacuum (dark matter), in which energy accumulates, Vyachislav Dyatlov called a domain. The hypothesis of the existence of an inhomogeneous quantum vacuum (dark matter) in the form of rotating vacuum domains (spinors) allowed Professor Vyacheslav Dyatlov to combine Maxwell's electrodynamics and Heaviside's gravidynamics. This made it possible to determine the energy of a quantum vacuum domain (VD) in electric, gravitational, magnetic and spin fields [11]. Based on this, Dr. Vyacheslav Dyatlov suggests calculating the energy of a vacuum dipole (VD) as a four-dipole in four fields (E - electric, M - magnetic, G - gravitational, S - spin) in the following form:

$$W = W_E + W_G + W_M + W_S \qquad (2)$$

Where
$$W_E = -\mathbf{dE}_0; \qquad W_G = -\mathbf{d}_G\mathbf{E}_{0G};$$
$$W_M = -\mu_0\,\mathbf{l}_M\mathbf{H}_0;\ W_S = -\mu_{0G}\,\mathbf{l}_S\mathbf{H}_{0S}.$$

μ_0, μ_{0G} - magnetic and magnetospin permeabilities

$\mu_0 = 1.257 \cdot 10^{-6}$ m·kg· s^{-2}·A^{-2}

$\mu_0 = 1.257 \times 10^{-6}$ m· kg· c^{-2}·A^{-2} $\mu_{0G} = 0.9329 \times 10^{-26}$ m · kg^{-1}

Generally speaking, the fields E_0, E_{0G}, H_0, H_{0S} depend on spatial coordinates, but they can be approximately considered constants within the domain. Therefore, the dipole forces acting on the quantum vacuum domain, guided by the work of Academician Tamm [13], can be determined as follows:

$$\mathbf{F}_{DE} = -\nabla W_E; \qquad (3)$$

$$\mathbf{F}_{DG} = -\nabla W_G; \qquad (4)$$

$$\mathbf{F}_{DM} = -\nabla W_M; \qquad (5)$$

$$\mathbf{F}_{DS} = -\nabla W_S; \qquad (6)$$

where

FDE is the force acting on the VD as an electric dipole;

FDG is the force acting on the VD as on the gravitational dipole;

FDM is the force acting on the VD as on a magnetic dipole (magnetic moment);

FDS is the force acting on the VD as a spin dipole (spin moment)

∇ is the gradient operator [11]

The combined theory of Dyatlov's electrogravidynamics and asymmetric continuum mechanics (Cosserat continuum) by Professor V. Merkulov [14] made it possible to explain the nature of tornadoes and tropical hurricanes. A tornado originates from a mother cloud and descends down to the Earth in the form of a long trunk, inside which the air makes a rapid rotational movement at a speed that sometimes reaches the speed of sound. The mother cloud, which is a small tropical hurricane, has a so-called eye, in which there is a dead silence, and has a spiral structure. The inner cavity of the tornado has a significantly reduced pressure. Self-luminous formations exist both in a relatively large tornado cloud and in a relatively small tornado funnel. It is known that a tornado emits electromagnetic waves, both in the light range of electromagnetic waves and in the radio range in the form of high-intensity white noise. The presence of an electric field in a tornado is evidenced by a large number of ball and linear lightning flashes accompanying the tornado. It was found that the trunk of a tornado-tornado has a magnetic field corresponding to an electric current of hundreds of amperes. The incredibly intense rotational motion in a tornado-tornado can only be caused by a distributed moment of forces. This effect is explained by the fact that the spins of domains (spinors), in a polarized medium of a quantum vacuum in the region of electric discharges, initially oriented arbitrarily, under the action of a magnetic field acquire a predominant orientation in the direction of the field. And if in the initial state the total angular momentum of all spins was equal to zero, then in a magnetic field it acquired a certain value. According to the momentum theorem, this will cause the air masses to rotate in the opposite direction to the spins. Thus, we see in the phenomenon of tornadoes and tropical hurricanes all the physical properties that indicate the presence of vacuum domains (spinors) there. It should be pointed out that the behavior of vacuum domains in a tornado is completely identical with the behavior of ferromagnetic domains in the Einstein - de Haas experiments in a constant magnetic field. A Spin polarization in the Einstein-de Haas effect is the rotation of the liquid volume at $dS / dt \neq 0$, where S is the total spin of the extracted liquid volume. Such spin polarization of vacuum domains in an electrified thunderstorm atmosphere can suck huge air masses into a terrible whirlpool of tornadoes and tropical hurricanes [14].

III. Analysis of Experiments the Military Space Academy Staff Named After is Considered A.F. Mozhaisky in Near-Earth Space

In 2004 researcher V.Kh. Hoteev published the results of experiments the Military Space Academy staff named after are considered A.F. Mozhaisky with artificial Earth satellites made it possible to detect an additional gravitating sphere in near-Earth space [15]. Academy staff found that in areas of tectonic faults, where there is intense electromagnetic and gravitational energy interaction between the liquid magma of the Earth with the near-Earth dark matter halo are formed toroidal luminous vortices with sizes ranging from micro particles to tens of meters (rotators, spinors, hadrons) [1]. With the help of magnetometers, it was possible to detect moving vortex quantum spinors in the near-earth medium having the form of tangential cylinders, with axes parallel to the axis of rotation of the Earth. It can be assumed that spheres formed in this way, should exist around other planets, stars and galaxies. This discovery allowed researchers to amend the law of universal gravitation of Newton and propose a new formula for calculating time on artificial satellites of the Earth instead of the relativistic Einstein-Lorentz formula. Now when calculating the motion of a spacecraft according to Newton's law of gravitation, it is necessary to take into account and the additional variable mass of dark matter that forms a sphere around astrophysical bodies. When the spacecraft leaves the planet, the position of the center of gravity of the masses in the planetary system Earth - the sphere will constantly shift in accordance with the flight of the ship due to dark matter [15]:

$$F = G\frac{(Me + Md)m}{R^2} \tag{7}$$

where Me is Earth's mass,
Md is variable mass of dark matter in near-Earth space,
(Me + Md) is effective mass,
m is spacecraft mass,
R is distance between the ship and the center of gravity of the system.

Availability of a sphere formed by dark matter near the sun can explain the strange acceleration, marked by American scientists in removing automatic interplanetary station “Pioneer 10” and “Pioneer 11” from the Sun at a distance of more 20a.e. when solar radiation effects has practically disappeared. Pioneer 10 and 11 were launched in the early 1970s and explored the outer solar system. But in 1980, mission scientists noticed that spacecrafts have unexpectedly drifted off course. Both spaceships experienced a slightly stronger force of attraction to the sun than expected, and since their launch, they have drifted off course by hundreds of thousands kilometer. Coherent radio Doppler data generated by the Deep Space Network with the Pioneer 10 and 11 spacecraft show an anomalous, constant, frequency drift that can be interpreted as an acceleration directed towards the Sun of magnitude $(8.74 \pm 1.33) \times 10^{-10}$ $m{\cdot}s^{-2}$ at distances between 20 and 70 AU (Anderson et al., Phys. ... Rev. D 65, 082004). But this is not the only problem regarding the trajectories of distant spacecraft. “Galileo”, NEAR (sent to the asteroid Eros), “Rosetta” (to comet Churyumov – Gerasimenko), “Cassini”, “Messenger” (to Mercury) - all of them at different times performed an accelerating maneuver near the Earth, using its gravity, in order to get energy and to accelerate or slow down, and in all experiments the acceleration / deceleration was anomalous, not quite consistent with the indicators of both Newtonian (which is natural) and Einstein’s physics. The Voyager 1 and Voyager 2 spacecraft, which in 2012 gone even further from the Sun than the Pioneers, weren't a helpful as might have been expected in contributing to the investigation of the Pioneer anomaly because of the way in which they are stabilized. Unlike the Pioneers, which are spin-stabilized, the Voyagers have what is known as three-axis stabilization. This results in an greater uncertainty in the spacecrafts' theoretical positions. The uncertainty was great enough to mask any deceleration similar in magnitude to that seen in the Pioneer probes.

In the article “The Conflict between the Unitary Quantum Theory and the Special and General Theories of Relativity”, Professor Lev Sapogin criticized Einstein's relativism with devastating criticism [16]. So, regarding the Lorentz transformations, in the interpretation of SRT and GR of Einstein, Sapogin claims that time does not slow down and does not accelerate in different frames of reference, but simply the speeds of all processes change equally under the influence of a changing gravitational potential. As a result, in near-Earth orbit, on the international space station, high-precision measurements using atomic clocks showed time dilation. In addition to gravity, the rate of nuclear processes is affected by the polarization of the quantum vacuum (dark matter). Satellite experiments conducted at the Military Space Academy. A. F. Mozhaisky, made it possible to establish that the course of time depends not only on the gravitational potential on the satellite, namely on the height of its orbit, but also on the angle of inclination of the orbit to the plane of the Earth's equator. It turned out that time does not depend on the relative speed of the satellite and the ground observer, as required by the Einstein-Lorentz formula:

$$\Delta ts = te\,(\frac{Us - Ue}{c^2} - \frac{\upsilon^2 s - \upsilon^2 e}{2c^2}) \qquad (8)$$

where Us, υs is gravitational potential and velocity associated with the satellite;

Ue, υe is gravitational potential and velocity associated with the ground chronometer.

That is, if the period of time measured by clocks between known events on the Earth's surface is equal to Δte, the same time measured by clocks on the satellite Δts is not determined by the relative speed of the satellite and the ground observer, but, violating relativistic locality, does not depend on the location of the observer and satellite on the geographic map of the Earth:

$$\Delta ts = \Delta te\,\frac{\sqrt{1 - \frac{\upsilon^2}{c^2}\,(1 - \cos\alpha)^{\,2}}}{1 + (Ue - Us)\,/\,c^2} \qquad (9)$$

where: υ is the orbital speed of the satellite relative to the Earth and the sphere rotating with it;

α is the angle of inclination of the satellite's orbit to the plane (magnetic) of the Earth's equator;

Ue, Us is the gravitational potentials on the Earth's surface and in the satellite's orbit.

If the satellite is moving perpendicular to the equator, it will have a maximum speed relative to the outer sphere rotating with the Earth equal to its orbital speed. The greater the speed of the satellite relative to the sphere, the greater will be the polarization of the space medium forming the sphere and the greater will be its influence on all processes occurring on the satellite, including the time between events [1].

IV. Conclusion

The article presents the results of studies of near-Earth space, carried out back in the 90s of the last century the Military Space Academy staff named after are considered A.F. Mozhaisky which discover a near-Earth sphere rotating with the Earth. This discovery of Russian scientists went unnoticed by world science and was re-described after 30 years by Germen an astrophysicists relatively of the rotation of the sphere around a white dwarf in the PSR J1141-6545 binary star system [6].

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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.

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:

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

Introduction:

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

The following approach can create a valuable beginning:

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

Approach:

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

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

Procedures (methods and materials):

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

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

Materials:

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

Methods:

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

Approach:

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

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

What to keep away from:

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

Results:

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

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

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

Content:

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

What to stay away from:

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

Approach:

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

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

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

Figures and tables:

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

Discussion:

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

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

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

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

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

Approach:

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

Describe generally acknowledged facts and main beliefs in present tense.

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.

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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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