Frontiers of Astronomy, Astrophysics and Cosmology, 2020, Vol. 6, No. 1, 1-13
Available online at http://pubs.sciepub.com/faac/6/1/1
Published by Science and Education Publishing
DOI:10.12691/faac-6-1-1

The Physical Meaning of the Gauss's Law

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Received February 02, 2020; Revised March 03, 2020; Accepted March 29, 2020

Abstract The paper explains that the Gauss's law is a direct consequence of the law of conservation of energy. Based on the physical meaning of the Gauss's law, it becomes clear that the consequence of the Gauss's law for a field source with a spherically symmetric spatial distribution of its main characteristic (mass for the gravitational field and charge for an electric field) about the potential distribution of a vector field outside the field source, inside the volume the field source and in its concentric cavity, adopted in vector analysis, is incorrect.

Keywords: *vector field, physical field, Gauss's law, gravitation, electrostatics*

Cite This Article: Alexey S. Belyaev, "The Physical Meaning of the Gauss's Law." *Frontiers of Astronomy, Astrophysics and Cosmology*, vol. 6, no. 1 (2020): 1-13. doi: 10.12691/faac-6-1-1.

1. Introduction

Gauss flux theorem is one of the basic principles of vector analysis. Vector analysis considers vector and scalar fields. A vector and scalar field is when each point of the selected area of space is assigned a certain vector, in the case of a vector field, and a certain value, in the case of a scalar field, i.e., at its core, it is an abstract mathematical apparatus. However, this abstract apparatus was historically developed to describe not an abstract, but a real physical object in a selected spatial zone. The basics of vector analysis can be found, for example, in the manual of Levich [1].

The simplest way to understand the meaning of a mathematical field is to associate it with matter. For example, a scalar field is the temperature or another characteristic distributed over the volume of the material body associated with the value at each spatial point of the body, and the vector field is the speed of each of the particles or other vector characteristics of the material object distributed over its volume.

However, the application of vector analysis to a physical field, the essence of which does not yet have a clear physical content, has turned the physical field into an abstract object, the integral property of which is a mathematical pattern described by vector analysis without taking into account the actual physical mechanisms these laws should be governed by.

Firstly, the type the physical field is still unclear, as is the case, for example, for the gravitational field. The nature of the gravitational field today is explained by parallel theories that coexist and are fundamentally contradictory to each other: the general theory of relativity and several varieties of the quantum field theory (the quantum theory for the gravitational field remains multivariant and not fully developed).

Secondly, the material essence of even concrete physical fields is very blurred. The fact of the materiality of physical field is commonly accepted, and it is impossible to find another opinion in the literature. To be more precise, in field theories this issue is most often simply bypassed or touched upon only briefly and is never raised as a separate topic. And the reason for this lies in the fact that the question is complex and does not have a specific detailed answer. The materiality of the field is stated but is never discussed or analysed. Moreover, although the materiality of the fields is affirmed, the theories created do not, in fact, imply materiality. For example, a relativistic gravitational field is not at all connected to something material. It was perceived as an ether only by the creator of the general theory of relativity – Einstein, who understood that metrics could not physically, i.e., in reality, influence material objects (despite the fact that the special theory of relativity previously created by him already eliminated the need for the existence of an ether). The theory of a quantum field, even a well-developed one as for an electromagnetic field, is also not directly related to something material, unless energy is considered a substance, as many scientists unconsciously do today. If you ask any scientist directly whether energy is material, the answer will be an unequivocal "no". After all, energy does not characterize the type nor the form of matter, but the state of matter and the physical fields that arise around it. However, the same scientists will say that mass and energy are equivalent to each other, and that mass was once formed from energy during the Big Bang. The form of energy that was used in the creation of the Universe and the form of energy a physical vacuum carries remain a mystery. It is fundamentally impossible to say in what form energy can exist in the complete absence of a substance, which has not yet formed (unless, for example, it is assumed that the electromagnetic field appeared before the appearance of the charge).

Such uncertainties of the physical essence of the physical field have turned the mathematical laws that describe the physical field into a physical entity without physical content. Nevertheless, it is useful to emphasize that although our knowledge of the fundamental nature of the surrounding world has not yet been fully formed, we must not forget that the physical field has always been considered not as a mathematical technique that simplifies the description of the interactions of field sources with each other, but as a real material object that carries with it the energy characteristic of each point in space. This is not an abstract mathematical apparatus, but an existing physical object that manifests itself in such a way that the observed mathematical laws are applicable to it.

Taking into account all that has been said earlier, a further analysis of the essence of the Gauss theorem is carried out under the assumption that the mathematical description of a physical field, although it is its unique characteristic, is nevertheless not its physical essence, but only reflects the mathematical laws of a real physical object (our world is characterized by fundamental constants, and any arbitrary physical object manifests itself through certain laws that are inevitably amenable to mathematical description). In other words, this paper assumes that the physical field is a material. And since the basic physical variables, such as energy, force, etc., were introduced into physics during the formation of the corpuscular theory, which today is associated with classical Newtonian mechanics, the analysis was performed at a mechanistic level. The analysis was carried out schematically, only to identify the basic principles based on the law of conservation of energy. How to transfer the findings and principles to real physical objects, including the theory of physical fields, taking into account the characteristic physical features and the physical nature of these fields, is the subject of future scientific research.

For a modern scientist, the use of theoretical constructions from "mechanical levers and gears" is considered primitive and unworthy. Physics has become an elegant science, devoid of mechanical piles. However, since the essence of basic physical variables has not changed (!), a preliminary application of the mechanistic approach can yield real results. Despite the fact that in many cases the mechanistic approach has become inapplicable, and Newtonian mechanics cannot cope with many tasks, nevertheless, the initial understanding of problems based on mechanics allows not only a deeper understanding of the essence of physical objects that are not amenable to a mechanistic description, for example, when describing the essence of degenerate structures in the work of Belyaev [2], or when discussing the nature of the vacuum in another work of Belyaev [3], but it also has heuristic power. In the work [2], mentioned above, before solving specific problems related to the directions of the evolution of stars, the meaning of the "mechanistic description" method is deciphered using the phrase "common sense" adopted in the 20th century when discussing this methodological issue. In this particular case, common sense helped to demonstrate the fallacy of the accepted statement in cosmology of the cooling of red and brown dwarfs, revealed the ability of small mass clouds not only to disperse, but also to contract under the influence of "weak" gravitational forces. Furthermore, in yet another work by Belyaev [4], common sense helped to identify the currently unknown physical phenomenon of spontaneous gravitational compression of a gas cloud in outer space with simultaneous cooling. Common sense also helps to identify the fallacy of certain existing theories, as was shown in Belyaev [5], which explained that the microwave cosmic background cannot be relict.

Based on the same common sense, Belyaev [6] touched on the topic of the presence of a gravitational field inside the concentric spherical cavity of an object with a spherically symmetric mass distribution, while a consequence of the Gauss theorem in this situation prohibits its presence. A similar conclusion allowed us to show that it is not necessary to introduce a new unknown category of "dark energy" to explain the accelerated scattering of matter in the Universe – the laws of classical gravity are quite enough to describe this phenomenon.

The topic of non-fulfilment of the corollary of the Gauss theorem for the gravitational field of objects with a spherically symmetric mass distribution was purposefully considered and in detail in Belyaev [7]. It demonstrated that replacing a space object with a spherical mass distribution with a point mass located in the center of mass of the object and equal to the total mass of the object, without taking into account the geometric factor, is unacceptable. It also showed that new approaches are required to determine the gravitational potential inside an object with a spatially distributed mass. Today, for example, for an object with a spherically symmetrically distributed mass, taking into account the corollary of the Gauss theorem, it is mistakenly assumed that the gravitational potential inside the object is determined only by the mass enclosed inside the concentric sphere passing through the point for which the potential is determined. This conclusion is closely interconnected with the generally accepted provision that there is no gravitational field inside the concentric spherical cavity of an object with a spherically symmetrically distributed mass. And the gravitational field inside the cavity exists according to the general theory of relativity and the theory of the quantum field; only the vector analysis allows this possibility, which today is considered an equal form of expression of classical gravity. It was demonstrated in [7] that, in the original historical form of classical gravity, using Newton’s law of universal gravitation and the principle of superposition, the gravitational field inside the cavity, as in the cases of the general theory of relativity and quantum field theory, also does not disappear. Moreover, this work even determined the value of the power of the distance to the cavity surface in the equation for the force of gravitational attraction of the test mass to the surface of a concentric spherical cavity inside an object with mass spherically symmetrically distributed in space. Since the results of vector analysis must coincide with the traditional classical approach, the question arises of what problem does the vector analysis have and why the consequence of the Gauss theorem leads to the wrong conclusion.

The conclusion obtained in [7] about the active gravitational influence of an object with a spatially distributed mass on the test mass placed in its internal cavity has direct consequences that clarify the observed astronomical phenomena. In particular, this work explains the reason for the formation of dense halo in individual galaxies at a great distance from the visible part of the galaxy. In other words, the possibility of the existence of a halo of the galaxy, consisting of hidden mass, becomes clear and acceptable. If we take into account the results of [2,4], which give an idea of the latent mass composition, it becomes obvious that it is premature to introduce a new physical entity, dark matter, into science. The possible processes associated with the formation of halos of galaxies at a certain stage in the evolution of the Universe will be discussed in a future work, planned for publication.

The listed works [2-7], methodologically based on common sense, form a completely new understanding of cosmological processes. In particular, the results obtained there were comprehensively used in considering the topic of the emergence and evolution of the Universe in the work by Belyaev [8]. The conclusions obtained in this work are revolutionary. But for the topic considered in this paper, it is not the results obtained in [8] that are important, but the demonstration of the fact that the new worldview structure was built on the basis of common sense. Moreover, as it already becomes clear from the above review, the Gauss theorem has a certain amount of weight in questions of the evolution of the Universe.

Thus, however strange it might seem, common sense helps make a meaningful cause and effect evaluation of physical phenomena as opposed to only using an abstract mathematical apparatus for its justification. Mathematics is needed, mathematics cannot be dispensed with, but it should not overpower physics. It should be used to deepen and strengthen experimental observations. All the constructions based on common sense must subsequently not only be mathematically justified, but also be expanded through mathematical predictions arising from the mathematical description of real physical processes and phenomena.

For example, a completely new and innovative approach to the description of the process of formation of a single stellar system, performed by Belyaev [9], cannot emerge from mathematical formulas. It can arise solely from an analysis of the situation based on common sense. However, in the future, when developing a model, firstly, mathematics cannot be dispensed with, and secondly, mathematical justification will not only provide a deeper understanding of physical processes, but may even lead to the discovery of new forms of existence of physical objects (in this particular case we are talking about the forms of existence of degenerate structures).

At the same time, although physics is impossible without mathematical justification, when describing physical processes, it is necessary to carefully consider which mathematical tools are acceptable for describing them and which are not. This analysis is the subject of the present work, which explains that vector analysis is not universal and has limitations when describing various physical phenomena and objects.

In this paper we will talk about potential fields, a static electric and static gravitational field, the field intensities of which are vector fields in three-dimensional space. The electric charge is the source of the electric field, and the mass is the source of the gravitational field. The intensity of a physical field at a specific point in space is the vector of static force of the physical field in question, acting on a field source with a basic unit characteristic, for example, per unit mass or per unit charge.

In this work, the physical field is an abstract perturbation of the abstract external environment around the sources of the field. That is a perturbation that accumulates potential energy, which balances the energy of the field sources that caused these disturbances in one way or another. In other words, the physical field seems to be distributed in the form of perturbations from the field sources in the abstract ether, i.e., field sources and the corresponding physical field are considered not by themselves, but in correlation. In this case, the ether is not assigned any specific physical properties, except for the general properties of its materiality, expressed in the ability of the ether to create a stable spatial structure that can accumulate elastic energy when it is excited.

It is important to note that the goal of this work is not to assert that the essence of electric and gravitational fields is a continuous ether. It is only to emphasize that these fields are material. The form of materiality is not yet clear. Nevertheless, even if the physical field arises not in an abstract continuous medium called "ether", but in an environment consisting of, for example, virtual particles that arise for a short time and disappearing, or flashing virtual spatial material pixels, or in any a different medium, general principles obtained for an abstract continuous medium, i.e., for an abstract ether, must be universal and integral for any physical field, whatever its material nature (this is discussed in more detail below).

The mechanistic description of the ether proposed in this work should be considered generalized, performed without specifying the varieties of forces and stresses that arise in the ether, but in compliance with the energy balance. Therefore, the principles identified below should, in the future, as the fundamental knowledge deepens, be described on the physical, and not on the abstract mechanistic level. That is, on the level that explains the real implementation of the principles obtained, and explains not only mathematically, but also logically.

Gauss's theorem states that the flux of vector intensity of the potential vector field over any hypothetical closed surface, surrounding a closed collection of field sources, is proportional to the total value of the source characteristics (total charge or total mass of a combination of sources) falling inside the surface. Moreover, the integral flux of the intensity vector through a closed surface does not depend on the character of the spatial and quantitative distribution of field sources inside this surface. Moreover, the principle of superposition is applicable for a set of field sources. The principle of superposition in the language of vector analysis means vector addition of fields (vector addition of intensities) from each element of the set of sources (the fields of individual sources do not interfere with each other). This is the mathematical essence of the Gauss theorem.

The physical nature of the Gauss theorem is usually not considered. For an incompressible liquid, the Gauss theorem from the physical point of view is a consequence of the law of conservation of mass (it is important to note here that the law of conservation of mass is not universal). What the Gauss theorem is for a physical potential field has never been discussed by anyone.

The Gauss theorem has corollaries. Those corollaries of the Gauss theorem, which will be discussed in this paper, have already been mentioned above and relate to the case of a spherically symmetric distribution of the characteristic of a set of field sources:

1. It is possible to replace the considered set of sources with one equivalent point source located at the center of symmetry and equal to the total characteristic of all sources (total mass or charge), while field intensities (field strengths) outside the spherical region with a set of field sources, including those close to it, coincide with the field intensities at the same points from an equivalent point source.

2. The field intensity (field strength) inside the concentric cavity, in which there are no field sources (there is no mass or charge), is equal to zero.

3. Field intensity (field strength) within the set of sources is determined only by the total characteristic (total mass or charge) of those sources from the considered set that are inside a concentric spherical region, the boundary surface of which passes through the control point. In this case, it is possible to replace the indicated set of field sources with an equivalent point mass or charge, and the influence of other sources that are outside the selected spherical region will be zero.

As already mentioned, the consequences of the Gauss theorem for a collection of sources with a spherically symmetric distribution in space their characteristics (mass or charge) are incorrect (see [6,7]).

2. Purpose of This Work

The main aim of this work is to build, without reference to the nature of the physical field, such a generalized model that would clarify the essence of the Gauss theorem. Then, based on the obtained result, it is first necessary to understand the physical reason why the corollary of the Gauss theorem is not applicable for a set of field sources with a spherically symmetric distribution of mass or charge (other types of symmetry are not considered in this paper), and after that indicate the error in its mathematical justification.

3. A Schematic Diagram of the Physical Field

To accomplish the tasks set in this paper, we first need to understand whether it is acceptable to describe the potential physical field, not characterized by non-linear Yang – Mills equations, as an ether in order to determine its general principles for appearance (we are talking about free physical fields without self-interaction or interaction with other fields, i.e., about fields for which the principle of superposition is valid), regardless of the nature of the field and only taking into account that it is material.

To answer the question posed, first it is necessary to formulate the main characteristic features of the physical field and see if the ether can provide them. Then, in the case of a positive answer, it should be accessed whether the mechanical model is applicable for the generalized description of the ether. And after that, in order to achieve the goal set in this work, one should construct the possible mechanical scheme of the physical field.

The main characteristic features of the physical field have already been identified above. The first characteristic is its materiality. The concept of "materiality" means not just the distribution of energy in three-dimensional space, but also the stability of this distribution. Stability here is the ability to preserve the potential energy distributed in a certain way in space for an indefinitely long period of time.

The second characteristic feature is the mandatory presence of a field source: if there is a source, there must be a field; no source, means no field. However, in modern science there is uncertainly in the accepted position on this issue. On the one hand, the physical field is completely determined by the source of the field. On the other hand, the field is considered an independent object, which, although generated only by the source of the field, can be described without a source. Having once been generated, the field can exist further without a source. The basis for this understanding was the theory of the electromagnetic field, in which it is accepted that not only an electric charge, but also a magnetic field can generate an electric field. In order not to go into complex polemics that deserve separate detailed consideration, in this paper we consider only static potential fields for which the presence of a field source is an indispensable mandatory requirement.

The third characteristic feature of the potential static field has not yet been identified in the text above – it is its infinity.

The ether is perfectly capable of providing such general properties inherent in a potential physical field. Therefore, the generalized conclusions obtained for the ether will also be binding for the physical field, whatever its true nature.

In turn, the ether is easily amenable to a mechanistic description. Let the infinite ether consist of some, not necessarily the same, structural particles, robustly resistant to change in their spatial position. Then neighbouring ether particles can be considered as springs connected to each other. The springs, like structural particles, also do not have to be the same. Their purpose is to ensure the equilibrium position of the particles, and in the case of forced violation of the equilibrium spatial arrangement of the particles, to accumulate energy.

To simplify the generalized reasoning, it is convenient to take the initial ether scheme with identical spherical structural particles uniformly distributed in space. Furthermore, the coefficients of elasticity of similar equivalent springs, resisting changes in the distances between the particles, do not depend on the axial directions of the deformation of the springs (tension or compression). In the absence of a field (in unperturbed ether), the tension-compression of all springs is equal to zero. The accepted mechanical principle does not prohibit the physical field from having any essence with any, even unknown to date, fundamental forces.

Let us first consider the mechanics of spring assemblies without the ether model. Let us take a set of identical completely elastic springs, the ends of which are equipped with plates of equal area, located perpendicular to the axis of the mechanical spring. If these springs are sequentially assembled into a semi-infinite assembly along the length, i.e., in the form of a ray; then the application of a force to the outermost plate of the last spring, which forms the beginning of the ray of the spring assembly, for its axial displacement by any finite specified distance, at first glance, should not cause compression of the links of the spring assembly, but will simply make, due to the absolute elasticity of the springs and the infinity of the assembly, as well as due to the lack of axial stops (brakes) and friction, all the links of an infinite row to move by the amount of displacement produced. In figurative terms, the infinity of the endless part of the beam will lengthen, even though it is already infinite. However, this is only at first glance. In reality, compression will nevertheless occur, but by an infinitesimal amount for each link due to the small displacement of the outermost plane (hereafter called "thrust plate") in comparison with the infinite size of the spring assembly. Why this happens is not completely trivial and will become clear from further analysis. In this case, a semi-infinite spring assembly will not create resistance to displacement along the assembly axis of the thrust plate: the stiffness coefficient of the spring assembly will tend to zero, and it will be possible to move the thrust plate with an infinitesimal force to an arbitrary finite distance. This means that the work needed to move the thrust plate will be infinitely small.

Now imagine that each subsequent assembly link leading away from the thrust plate is equipped with not one, but an increasing number of springs assembled in parallel. For example, the number of springs in each subsequent assembly link grows n times (in a geometric progression). The coefficient of stiffness of assembly links will then increase in the same geometric progression.

At first glance, it seems that, as earlier for assembly with single-spring links, when a force is applied to the thrust plate, there will be no compression of the links at all (the entire semi-infinite chain of springs will shift entirely to infinity, and the required amount of force for this displacement will be infinitesimal), or each link will be compressed by an infinitesimal amount, the sum of which will give the total displacement of the thrust plate (if each link was compressed by an infinitely small amount, then an infinitesimal force would be sufficient for its implementation). However, in this case, the situation will be completely different: in reality, a "support" would appear, opposing the thrust plate, located along the axis of the spring assembly opposite the thrust plate, between which only part of the spring assembly will compress, even though the plates are not specially fixed in place in order to limit the axial displacements.

The fact is that, firstly, the total stiffness coefficient of the spring assembly will be greater than zero (but not more than the stiffness coefficient of a single spring). Secondly, no physical effects are transmitted through the material medium with infinite speed. A spring assembly or whatever it models will transfer the force acting on the thrust plate at a finite speed. This means that the first link of the spring assembly, before it transfers the force acting on it to the second link, will have time to contract or stretch to a degree (this is for springs, and for media simulated by a spring assembly, accumulate energy in one way or another) and will continue to deform, while the force will be transmitted to subsequent links. However, the degree of deformation of the remote links of the spring assembly with a high stiffness coefficient will become negligible. Therefore, it is possible to accept that the last plate of an almost incompressible link will turn into a support, which counteracts the thrust plate using part of the spring assembly between them, although no special instruments have appeared for restricting axial displacements. It is clear that there can be no rigorous definition of the length of the compressible part of the semi-infinite spring assembly with this approach. In this case, the force required to move the thrust plate to a predetermined distance will no longer be infinitesimal, and the deformations of the links nearest to the thrust plate will be significant.

It is very important to make the following remark regarding the spring assembly with an increasing coefficient of stiffness of the links: the force acting on the thrust plate must also remain after the thrust plate comes to rest due to the elastic reaction of the assembly springs. Otherwise, the thrust plate will return to its original position.

It is also useful to pay attention to two more nuances inherent to semi-infinite spring assemblies with increasing stiffness coefficient of the links leading away from the beginning of assembly.

The first nuance is connected to the fact that, due to absolute elasticity and the absence of losses, the compressive forces of each assembly link are exactly the same. This means that the force acting on the support of the spring assembly is exactly the same in size as the one acting on the thrust plate, but opposite in direction. The same axial forces act on the end plates of any middle link.

The second nuance is connected with the fact that as the distance from the thrust plate of each subsequent link increases, not only does the number of springs grow, but also the total area of the plates. Accordingly, the pressure on the end plates of the distant links is reduced.

Since the parameters of the spring assembly were chosen arbitrarily, the conclusions obtained for a semi-infinite spring assembly with an increasing stiffness coefficient of the links are universal. They do not depend on the growth rate of the number of springs in the links, the size of the plate area (it simply has to have a finite value), the length and the stiffness coefficient of the spring. Depending on the specific parameters of the spring assembly, the support may be closer to or further away from the thrust plate. But the basic principle is the same: the force acting on the support is equal to the force applied to the thrust plate, but the pressure on the support is reduced to zero. However, even for assemblies with specific parameters, the spatial location of the support is very arbitrary.

Now the time has come to decide whether the combination of the described spring assemblies is applicable to describe the physical field in an abstract ether. Let us assume that one of the structural units of the ether has increased in diameter (for example, as if it were inflated under the pressure of a batch injection of gas). Then the particle that has increased in size must do work in order to create a disturbance in the environment around it (at this stage we disregard any internal work, for example, against the forces of elasticity of the shell or by increasing the forces of surface tension, against the internal forces of any other nature; in the next chapter it will become clear why this can be done). To be more precise, in this interpretation, work will be done by the gas which inflates a structural particle. At this stage, it does not matter how and why the work was done: whether the gas did the work, or everything happened somehow differently. The main thing is that the magnitude of the work done will be equal to the value of the stored internal energy of the environment, which is resisting the effect exerted on it and exerting a reverse effect on the enlarged structural particle, which, as it now becomes clear, automatically turns into a source of a physical field distributed in a medium, surrounding the resulting particle, i.e., in an abstract ether.

It is important to understand that an increase in the structural unit is only a visual interpretation of the appearance of a field source. In reality, this is simply equivalent to the appearance of some kind of formation, some form of inclusion in the structure of the ether. It is inevitable to do work in order to introduce something into a homogeneous medium with structural units that elastically interact with each other. The work done will be equal to the elastic energy, resisting its perturbations, arising in a homogeneous medium. In turn, this elastic energy of the external environment would not have turned into potential energy if the resulting inclusion had not supported the static picture, i.e., if the inclusion did not resist the environmental impacts on it.

All the characteristic features of a physical field have been outlined in the presented description: there is an infinite medium, there is a field source, the field source is able to affect the infinite medium, which is able to accumulate energy and create a response to the field source. Moreover, it is important to emphasize that we are not talking about continuous ether, but about the material field of any nature.

Now imagine that all the structural units of the ether are the end areas of springs connecting adjacent structural particles. Then the surface of the enlarged spherical structural particle will be assembled from displaced thrust plates of the set of semi-infinite spring assemblies that were once located at the center of this particle (the initial particle, as it were, is a thrust plate for all radial directions emanating from it simultaneously). We do not know what is inside the formed spherical surface, but we do know that the thrust plates are being mechanically impacted upon in radial directions, holding them on the surface of the sphere. The thrust plates of the assemblies, that constitute the shell of the particle, exert pressure on the single springs of the first links of the assemblies. However, due to the geometric factor (the area of the sphere grows in proportion to the square of the radius), the second links of the radial spring assemblies can no longer be single springs: each structural particle of the abstract ether adjacent to the field source will in turn affect several structural particles in the radial direction. Of course, the location of these particles will inevitably be different from the chosen ray of the radial direction (the medium is assumed to be homogeneous). Nevertheless, in a schematic analysis the arrangement of springs with their increasing number in each new link can be considered approximately parallel to each other. Moreover, with such an enlarged (principal) analysis, it is possible to assume that the stiffness coefficients of all springs remain the same. Such assumptions inherently mean a small spatial distance between the structural particles of the abstract ether in comparison with the size of the field source (an enlarged structural particle that has performed mechanical work against the resisting ether), i.e., the adoption of the "thinness" of the structure of the ether in comparison with the size of an elementary particle or elementary charge. In other words, it is assumed that each radial direction corresponds to an infinitesimal spacial angle, covering the structural particles of the ether related to this direction. This approach allows each radial direction around the field source to schematically compare a semi-infinite spring assembly with an increasing number of springs in the links moving away from the source (with increasing stiffness coefficients of the links) and with the increasing area of the end plates of these links.

Thus, we get a generalized mechanistic description of the physical field at a qualitative level (in the philosophical sense), built on the basis of the abstract mechanical scheme of the system "field source – physical field". In the radial directions from the center of the field source, the ether perturbations, associated with its elastic deformation, decrease, i.e., the field weakens (each of the springs reduces the degree of its deformation and the amount of stored energy). However, the force transmitted from the field source along the radial directions in the sections of the infinitesimal radial spacial angles is not attenuated.

In the remote areas of the spring assemblies, their links become supports, and the choice of the location of the support along the radial direction is quite arbitrary. The only fact that remains adherent is that the pressure created on the support is characterized by an infinitely small value. The appearance of a support is a conditional schematization: only for a semantic description of the method of accumulation of mechanical energy by the spring assembly; it is not real. The field source acting on the thrust plates has internal energy that supports the deformations of the radial spring assemblies created by it. And the deformations themselves are created, as it were, due to the emergence of supports.

In other words, the source of the field supports perturbations of the ether, and the perturbations of the ether form a physical field. Various clarifications of the proposed scheme, like various adjustments to the characteristics of spring assemblies, including individual adjustments for various parts of the assembly, do not matter for the grotesque (general) analysis.

4. The Physical Essence of the Gauss Theorem

Thus the Gauss theorem establishes that the integral flux of the field intensity vector over a closed surface surrounding the field source always remains unchanged, regardless of the size and shape of the chosen surface.

It is very important to note that the physical field is not described qua field per se, but through interaction (the interaction of the source under consideration with a test source located at various spatial points relative to the considered source is being investigated). Such a portrayal is inherently an indirect description, a picture of the manifestation of the field, and not a description of the true distribution of energy in space. However, there is no other way to describe the field through experimental data, because the physical field manifests itself solely through the interaction of sources of this field.

Nevertheless, as mentioned above, the scheme for realizing the interactions of field sources with each other is not yet clear. Therefore, a test point source with a small intrinsic physical field in comparison with the field under consideration is used in order to study the physical field. It is assumed that the intrinsic physical field of the test point source, which describes the field of the source under consideration, does not violate or distort it. Nonetheless, one must understand that all the same, it is not the field itself that is described, but its manifestation in the interaction.

At the same time, at this stage of the analysis, the principle of the interaction of field sources with each other is already becoming clear, regardless of its physical realization. It is obvious that the interactions occur through the inverse effect of the physical field on the field sources. When a solitary field source is considered in an inertial frame of reference, it is in equilibrium with the physical field it creates. In this case, the physical field is static, unchanged at its spatial points, relative to the source. The addition of a new source, static relative to the one being studied, does not violate or change the existing individual physical field of the original source. However, the new source also has its own independent physical field, and these fields become combined in one way or another. Therefore, a new configuration of the total physical field arises, different from the individual fields of the two sources. For this reason, the individual equilibrium states of each of the field sources with their fields are violated. The resulting physical field causes the field sources to move relative to each other to achieve a new equilibrium state between the entirety of these two sources and the environmental disturbances created by them.

Regardless of what the physical nature of the physical field would ultimately turn out to be, such interpretation introduces the physical meaning of the physical interaction of the sources with each other through the physical field created by them. The mechanisms for implementing the interaction for different physical fields will be different, but the principle will remain the same for any physical field: by establishing an equilibrium between the resulting physical field and the sources that create it. The main thing in this scheme is the materiality of the physical field. This is the only possible interpretation of the physical interaction of material objects with each other through a material physical field. This is true physics, the foundation of our universe. All mathematics is only an auxiliary tool for identifying the forms of manifestation of the emerging interaction and for creating a more individual picture, which has characteristic features. The proposed description of the implementation scheme of interactions of field sources among themselves is based solely on the recognition of the materiality of the physical field. This is the case not only for a continuous ether. Moreover, at this stage there is no established link to any mechanical scheme. It is about materiality. But the form of materiality remains to be identified and clarified in the future.

If we return to the mechanical model in which the physical field is modelled by spring assemblies, then, given the above, it is valid but only for understanding the description of the field, not more, to consider the influence on the test field source as the effect on the plate of the link at the spatial point in question of the spring assembly that originates in the center of the field source under study and passes through the point in question. It is obvious that the force of interaction with the test point source is not equal to the force acting on the structural element of the ether at the spatial point at which the test source should be. But currently there is no other possibility to theoretically characterize the field of the studied source at a qualitative level (i.e., to understand its meaning).

Taking into account the small size of the spatial angle for an arbitrarily chosen radial direction, any surface of a finite radius of curvature outside the field source that the spatial angle intersects, regardless of the inclination and convexity (concavity) of the area cut off from the considered surface, can be conventionally taken as the end plate of the spring assembly link. The "zigzag" option, when the spatial angle crosses the surface several times (if the surface is closed and circumscribes the source of the field, then the intersection will occur an odd number of times), can simply be ignored at this point in time. This assumption means that the end plates of the springs of the radial spring assemblies are capable of simulating an arbitrary circumscribing surface.

If the physical field intensity at a particular point in space determines the action (force) of the field from the field source being studied on the infinitely small test point source located at the point under consideration, then the flux of the physical field intensity as if determines the resulting force acting on the site made up of trial field sources. If the concept of field intensity is replaced by a new criterion: the force acting from the field source on that ether element where the test point source would be located; then the flow of intensity will correspond to the resulting force from the source to the ether surface, over which integration is performed. For this reason, in the considered interpretation, which serves, in fact, to describe the physical field of the studied solitary field source, and not to describe its interaction with the test field source, the flow of the intensity vector should be understood as the resulting force acting on the set of end plates of the radial spring assemblies that make up the surface over which the integration of the intensity vector is performed.

Of course, it is important to understand that a force can only be applied to a point, and that it is not the resulting force that acts on the surface, but a distributed force, i.e., pressure. Moreover, when integrating the distributed force over a closed surface for thermodynamic systems (the thermodynamic systems are characterized by pressure), the resulting force, due to the vector nature of the distributed force, will be equal to zero.

Nevertheless, if we ignore the strict approach, the general idea of the Gauss theorem, its subtext, as it were, will remain the same: the total force of the field source on the layers adjacent to it, is equal to the force of reaction from the environment, no matter how and at what distance from the source this counter force is located (we draw the source of the field and the environment into point objects).

However, this conclusion is incorrect; it is made only for the visualization of the issue under consideration. In this particular case, we should talk not about the resulting force, but about energy.

Indeed, for each radial direction, the work done by moving the thrust plate of the spring assembly is equal to the part of the internal energy that holds this particular thrust plate at the equilibrium point. In turn, it is equal to the potential energy of the spring assembly, trying to return the thrust plate to its original position. For the consolidation of the spring assemblies that characterize the field source in an abstract ether (the totality of thrust plates of all assemblies forms the surface of the field source), the total internal energy will be equal to the sum of the potential energies of all radially located assemblies. More generally: the internal energy of a field source is equal to the external energy of the physical field created by it. This is a very important nuance, which, on the one hand, is not something new, but, on the other hand, has never been independently highlighted in literature and textbooks as a significant factor carrying a meaningful weight. The fact that the potential energy of a physical field is equal to the internal energy of the field source has never been discussed before. The physical field was never perceived as a display of resistance of the external environment towards the disturbance introduced into this medium by the field source. In other words, the physical field was always only formally considered material, characterized by energy distributed in space, but the physical nature of the materiality of the field was never considered.

It is possible that for an elementary particle with mass m_0, its internal energy $E_0 = m_0c^2$, where c is the speed of light in vacuum, determines the total potential energy of the gravitational field distributed around the elementary particle. It is only a possibility, since we still do not know the distribution of energy during the formation of pair of elementary particles, and, in this case, we are not talking about all the internal energy, but only about one of its components, which determines the energy of the gravitational field around the emerging particle and antiparticle. It is most likely, however, that this energy determines only the gravitational component. Firstly, the mass which appears in the expression for internal energy is a macro characteristic that defines the physical manifestation of an elementary particle as a corpuscle (the reason for the equivalence of gravitational and inertial masses is not discussed at this point), and secondly, the presence of an electric charge of any sign in an elementary particle most likely, changes its mass and therefore does not affect the gravitational (and inertial) essence of an elementary particle.

As for the electric field, there are currently no formulas for its total energy distributed in space, as well as for the internal "electric" energy of a charged elementary particle, expressed using the electric charge. There is a concept of "energy density of the electric field", referring to the energies at certain points in space. However, the total energy of the electric field is determined only for special cases, for example, for a flat capacitor.

The main result of the analysis is as follows: the energy of the physical field distributed in the abstract ether is equal to the characteristic component of the internal energy of the field source. This is precisely what the Gauss theorem indirectly indicates: the potential energy of an external environment for a field source that seeks to eliminate this source is always equal to the internal energy of the field source that maintains the elastic perturbation environment created by it. The term "elastic perturbation" should not be considered a specific term for the accepted mechanical model, but a universal one: regardless of the nature of the physical field, it should not only be created by the source of the field, but also be supported by it (because the field is characterized by energy unevenly distributed in space, so there is inevitably a need for its maintenance, regardless of the nature of the field). This is a very important conclusion, which determines the physical essence of the Gauss theorem.

Understandably, until we know the physical nature of physical fields, it is premature to present them in the form of an abstract ether consisting of any structural particles. However, it is difficult to imagine, something theoretically material but different in its structure. In any case, the law of conservation of energy for the Universe is the most fundamental and so far the most undeniable of all existing physical laws. Therefore, as long as the physical field is material, the source of the field must possess some form of internal energy equivalent in magnitude to the energy distributed around it in the form of a field.

The presented interpretation of the Gauss theorem helps to understand its meaning not only for a point source of a field, but also for a set of sources. Since the choice of a closed surface in the Gauss theorem is arbitrary, all point sources of the field that fall into the internal spatial zone which is cut off by the selected surface retain their integral flux of the intensity vector (hereinafter, the term "integral flux" will be understood to mean only complete integrals over the closed surface) through this surface as well. Therefore, from a mathematical point of view, when determining the total integral flow of the set of field sources through an arbitrary closed surface under consideration, all individual integral flows of the intensity vector from each source can simply be algebraically added. This is the mathematical interpretation, though somewhat different from that which is accepted in literature form, of the Gauss theorem for a set of point field sources. In familiar words, it should be voiced a little differently: the result of the Gauss theorem for a set of point field sources does not depend on their spatial distribution inside the selected closed surface. This is the mathematical essence. From a physical point of view, the Gauss theorem for a set of point field sources means a simple summation of the energies of individual fields of point sources to determine the energy of the total resulting field.

At this point, it is very important to pay attention to one mathematical nuance, which does not depend on the choice of the physical model. Since it is the individual integral flows of the intensity vector (complete integrals over a closed surface) that must be added, then, from a mathematical point of view, all field sources of the considered set, located inside the spatial zone cut off by the integration surface, must be small enough and not too close to each other, so as not to shade the integration surface for each field source arbitrarily selected from the set. Indeed, the integration surface must be exhibited by each and every field source in the same way, just as when there are no other sources. In other words, all field sources in the selected system must be point sources and located far enough from each other. Adding an extended source to the system will violate the existing superposition of fields from existing point sources.

From the point of view of the chosen mechanical model of the ether, the distance between the field sources should (probably) exceed the length of the part of the radial spring assembly, for which the possibility of a hypothetical introduction of a support has not yet appeared, which has not yet "worked out" the impact of the thrust plate, i.e., it is not yet long enough. It is fundamentally impossible to say how large must the actual distance be, without understanding the true nature of the physical field and, most importantly, the mechanism for realizing the interaction between the field sources. But this is not important for the general analysis; the basic conclusion reached under any circumstances will remain immutable: it is unacceptable to switch to the infinitesimal mathematical quantities characterizing these distances. Or in another way: it is unacceptable to use integral calculus when describing the resulting physical field of a set of field sources without taking into account the geometric factor characterizing the sizes of the field sources and the distance between them, as well as the geometric location of the control point relative to the considered set of field sources.

For example, if we make a closed surface shell from point field sources adjacent to each other and located at infinitesimal distances, then select a control point, for which we want to know the field intensity created by the whole shell, close enough to its surface, then, in the case of a mechanical scheme of a physical field, only "few-springs" and easily deformable parts of assemblies near located field sources will converge at this control point, and field disturbances from distant point sources will be "extinguished" by nearby sources of these fields (certain radial spring assemblies of point field sources will counter-compensate each other). Moreover, if for simplicity and clarity, a spherical closed surface is chosen, then, despite the compensation of the effects on the control point of ether from remote field sources, the field potential will be higher in comparison with the potential created by an equivalent point source located in the center of the sphere (spring deformations in the control point region will be larger near the sphere, and not when it is replaced by a remote equivalent point source).

This effect is not characteristic of only a mechanical scheme. With any mechanism of the spread of a physical field from a field source, field sources that are closely interconnected with each other will inevitably screen the fields of distant field sources to some extent, and sources close to the control point will have a dominant effect on it, i.e., you will need to consider the effects of "shadow" and short-range. In other words, this nuance, which is universal for a physical field, whatever its nature, can be expressed as follows: differential calculus, operating with infinitesimal quantities, is not always applicable to describe a physical field created by a combination of sources. With certain geometric relationships between the sizes of the sources, the distances between them and the distances to the control points at which it is necessary to determine the parameters of the resulting field, the ability to sum individual integral flows of individual field sources is lost.

It is useful to once again draw attention to the aspect already mentioned above. The fact that in the previous example only parts of spring assemblies with "few-links" converge into the control point does not in itself speak of a large field intensity. While the mechanism for the implementations of interactions is not known, it is impossible to link the degree of perturbation of the abstract ether to the field source with its impact on the test field source. Moreover, it does not matter with respect to the force on the ether; whether the control point is located at the farthest or nears link of the assembly. The presented mechanical model did not bring us closer to understanding how the interaction between the field sources is carried out. We guess from experience that the more perturbed the abstract ether (or something else that replaces the ether) at the point in question, the greater the effect it has on the test point source placed at this point, i.e., the more is the absolute value of the field intensity at the control point. However, this assumption is not enough (and it is not always true). This paper is not about comparing the perturbation of the ether with the field intensity. Replacing the force acting from the field source on the test field source with an effective perturbation force by the ether excited field source at the control point where the test field source is supposed to be located is possible only because the main characteristic of the test field source is infinitely small. With a strict approach, this replacement is unlawful, but, nevertheless, it does not seem to distort reality much and allows one to realize the general principles inherent in a physical field of any nature. Moreover, the cases of non-fulfilment of the corollary of the Gauss theorem will be associated not with the violation of the principles obtained, but with the replacement in the studied interaction of the test field source with a real extended source with a finite value of its main characteristic (instead of an infinitesimal one).

5. Corollary of the Gauss Theorem for a Field Source with a Spherically Symmetrically Distributed Characteristic (Mass or Charge)

So, a material field (gravitational or electric) always arises around the source of a field (mass or charge) located in empty space (in a vacuum). The field source has internal energy, which is equivalent to the field energy distributed in space. This is confirmed by the Gauss theorem, which determines that the amount of energy distributed in space does not depend on the choice of a closed surface around the field source, which is used to determine the field energy, but depends only on the value of the internal energy of the field source. However, this does not mean that the distribution of the field potential along the selected closed surface does not depend on its shape. The Gauss theorem determines not the spatial distribution of energy, but only the total balance: the invariability of the integral index over a closed surface.

Moreover, it is rather naive to expect that the field potential inside the volume allocated by an arbitrary closed surface outside the field source, will be equal to zero. The flow of the intensity vector will indeed be zero. But the force lines inside the considered volume will not disappear, the intensity of the physical field does not depend on whether we mentally select a closed surface surrounding the chosen point. However, such an obvious conclusion, which does not require special comments, is for some reason ignored for a concentric spherical cavity of a field source with a spherically symmetric distribution of its characteristic (mass or charge).

The flow of the intensity vector, for any closed surface inside the concentric cavity of a field source with spherical symmetry is indeed equal to zero. However, this does not mean that the field intensity at each point in space of a cavity is equal to zero. Moreover, the field intensity will not even be the same for all geometric points of the cavity, and the test field sources located inside the concentric cavity will interact both with each other and with the walls of the cavity (a corollary of the Gauss theorem denies both).

Since in this case we are considering a set of sources rather than an isolated source of the field, it will already be necessary to create a scheme for establishing the resulting disturbance of the external environment by this set of sources in order to visualize what was said above. In this case, the end plates of the links (structural units of ether) will simultaneously belong to the spring assemblies of all sources of the system in question. Therefore, in order not to complicate the presented mechanical model, we will assemble a spherically symmetric set of field sources from symmetrical equal-arm dipoles pairs and consider only spring assemblies in the segment connecting the field sources in the dipole. These are sections of abstract ether that are key to understanding the subject. All other spring assemblies of ether will interact with each other in some way (the proposed scheme cannot describe the interactions of assemblies that are not located on one straight line), but, as will become clear from further considerations, they will not have a fundamental impact on the created picture of ether perturbations.

In a dipole with symmetrical shoulders, identical spring assemblies directed towards each other at the midpoint compensate for counter forces. The support for both assemblies is located at this midpoint. Furthermore, even if the pressures from two sources acting on the support platform will compensate each other, they will still to be finite. In this case, the deformations of the springs of both spring assemblies, including the supporting links, will take place and will not be infinitely small. The remaining radial directions from the dipole sources will not intersect the straight line on which the dipole is located, and, accordingly, will not affect the described picture in the area between the sources.

If we place a set of similar dipoles around the midpoint that will form a sphere of field sources, the situation will remain the same: the center of the sphere will be the support of all the axial spring assemblies under consideration, but the springs of all axial spring assemblies will inevitably be deformed, even if this deformation is symmetrical. The remaining directions of individual field sources, which do not coincide with the directions of the axes of their dipoles, due to central symmetry, will not fundamentally change the picture, but only strengthen the observed pattern, regardless of how the interaction of intersecting spring links that do not lie on one straight line are modelled.

In other words: if we increase in size ("inflate") not one structural particle, turning it into a field source, but the all structural particles forming a spherical field source inside an abstract ether, then the ether zone internal to the sphere will inevitably be deformed (if we are talking about a mechanical model, if not, then simply "excited"). And work done by the field sources on the structural elements of the ether will cancel each other out only at the central point of the sphere. In this case, ether deformations (or the perturbations of another already existing medium, or the unevenness of the medium created by sources) will also occur in the vicinity of the central point, but, nevertheless, the field potential will still be zero. This once again demonstrates that the relationship between the ether perturbation and the field intensity still needs to be established.

Thus, we now have a visual representation of the fact that there is an uneven physical field inside the concentric cavity of spherically symmetrically located field sources. And it is quite obvious that two test field sources located in a similar cavity will be able to interact with each other through their physical fields. And these are not speculative conclusions, which should be treated with caution, but ones that can be easily verified through experiments: two concentric spheres composed of a uniformly distributed mass or charge will inevitably create a gravitational or electric capacitor, while a corollary of the Gauss theorem for field sources with spherical symmetry prohibits the existence of such a capacitor.

With a broader, but consecutive view, there is a clear inconsistency in the existing theoretical conclusions associated with this issue. For example, despite the existence of consequences of the Gauss theorem, a recognition of the presence of a gravitational or electric field inside a spherical space with a mass or charge uniformly distributed in it appears unexpectedly. Or, it is easy to replace a spherically symmetrically distributed mass or charge with an equivalent point mass or charge, even if we consider the field intensity on the surface of the zone where the field sources are distributed, forgetting that gravitational and electric forces at short distances increase infinitely.

At first glance, all the arguments provided in support of the indicated prohibited substitution are faultless. If we choose an arbitrary control point outside the surface layer of a set of spherically symmetrically distributed identical point sources of the field (to simplify the argument – evenly distributed), including those located in the immediate vicinity of the set, then through the concentric sphere passing over this point, the flux of the intensity vector will be equal to the product of the modulus of the intensity vector (it will be the same for all integration points, and the vector itself will always be perpendicular to the surface integration) and the integration surface area (area of the sphere that passes through the reference point). On the other hand, the flux is proportional to the total characteristic of a spherically symmetric field source (total mass or charge). And since the integration surface area is expressed in terms of the square of the distance to the control point, the expression for the intensity at the control point from the set of field sources obtained as a consequence of the Gauss theorem (from a comparison of two expressions for the intensity vector flux) completely coincides with the expression for the point source with the spatial location in the center of symmetry and with the total characteristic of the field sources obtained either in a similar way as a consequence of the Gauss theorem for a point source, or in the form of Newton's or Coulomb's law for point mass and charge.

However, if the obtained expression for the field intensity at the control point is correct for a point source of the field, then it should be used carefully and cautiously for a set of field sources, with an introduction, if necessary, of some restrictions and corrections, the need for which arises due to the facts mentioned above: the considered field sources should not "screen" each other. Accordingly, in general mathematical calculations only operations for summation of the effects from discrete field sources are permissible, and the integration operation should only be looked at when this becomes possible.

Unfortunately, the "screening" effect of gravitational and electric fields is not taken into account by modern physics. Despite the fact that, for example, replacing discrete electric charges with a continuous distribution function in the framework of theoretical physics brings real positive results, we must not forget that in practice the charges cannot form a continuous series, therefore, such a replacement must be treated carefully and with understanding that it cannot be universal.

Let us consider an electrically charged sphere. A control point A is selected from the outside of the sphere and the test unit charge e is placed in it (see Figure 1). Let the sphere consist of uniformly distributed discrete identical point charges q_i. Usually, the set of such charges is mathematically characterized by the surface charge density σ, furthermore, in this case $\sigma = const$. A corollary of the Gauss theorem states that the intensity at point A will be the same as that from a point charge placed at the center of symmetry (at point O) with the quantity charge $Q = \int \sigma dS$, where Q is the total charge of the sphere, dS is the elementary area of the sphere.

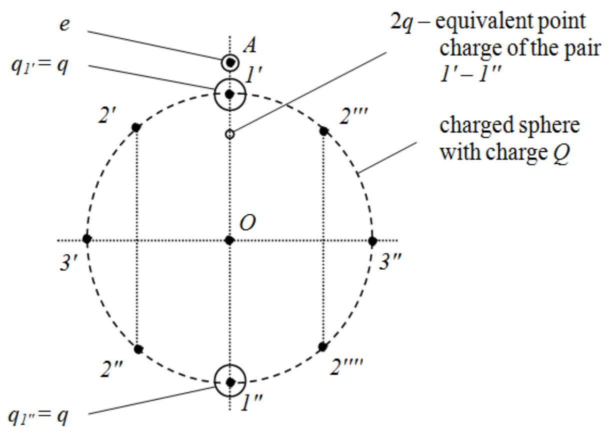

Figure 1. Scheme of interaction of a charged sphere with a charge $Q = \Sigma q_i$ and a test charge e

We will show that in reality the electric field intensity at point A will be larger in magnitude, and when replacing the set of discrete point charges q_i with an equivalent point charge $Q = \Sigma q_i$, it will be necessary to place it not at point O, as in the case of a uniformly charged sphere with surface density charge σ, when $Q = \int \sigma dS$, but on the segment $[OA]$ closer to the test charge e.

First, in the framework of classical electrostatics, we consider the replacement of a $1' - 1''$ dipole by an equivalent point charge with a charge of $2q$. Obviously, the equivalent charge will not be located at point O, but on the radius of the circle lying on the straight line (OA), closer to the circle (the closer the point A is to the circle, the closer the equivalent point charge will be to the circle). Now let us estimate the replacement of dipole pairs $2' - 2''$ and $2''' - 2''''$ symmetric with respect to the straight line (OA) by an equivalent point charge with a charge of $4q$. Clearly, the equivalent charge will also be located on a radius lying on the straight line (OA), and as the pairs of dipoles closer to the points $3'$ and $3''$ are selected, the equivalent charge will approach the point O. For a dipole $3' - 3''$ the equivalent point charge with a charge of $2q$ will again be on the radius belonging to the straight line (OA), but it will be at a point closest to the point O, striving, as the control point A approaches the circle, to coincide with the point O.

The summation of the effects of all the dipoles and pairs of dipoles on the test charge e, for which individual equivalent point charges are located on the radius of the circle lying on a straight line (OA) and do not coincide with point O, will inevitably lead to the resulting picture with a displaced arrangement of the resulting equivalent point charge Q ($Q = \Sigma q_i$, not $Q = \int \sigma dS$) in the direction towards point A along the straight line (OA). How the degree of this displacement depends on the proximity of control point A to the circle is not important at this point. The main result is the fact of the displacement of the location of the equivalent charge from the point predicted by the corollary of the Gauss theorem. The result indicating that the summation of discrete effects is different from the result obtained by integration.

The spatial displacement of the equivalent point source of a physical field with the total charge or mass from the center of spherical symmetry of the set of field sources looks quite logical. Since symmetry is maintained with respect to the line connecting the control point source of the field with the center of symmetry of the extended field source, the equivalent point source with the total characteristic of the extended field source will be on a straight line of symmetry. In this case, the equivalent point source with the total characteristic of an extended source will inevitably shift along a straight line in the direction of the control point source. But as soon as the distance between the control point source of the field is removed from the extended source of the field is such that all the straight lines connecting the elements of the extended source with the control point source are approximately parallel to each other, it becomes possible to replace the extended source of the field with an equivalent point source located at any point in space of the extended source, in particular, at its center of symmetry. Of course, the nature of the spatial distribution of the characteristics of an extended field source (its mass or charge) will also be important here.

6. Conclusion

Since the physical field is characterized by energy distributed in space, and static electric and gravitational fields can maintain an uneven distribution of energy in space for an unlimited time, it is generally accepted that the physical field is material. However, at this point there is not enough theoretical knowledge to be able to fully realize the essence of the concept of "materiality" for the physical field. This work is a small step in this direction.

This work shows that even if a physical field is formed due to the emission of something by the field source, in order for the field configuration with unevenly distributed energy and the field source itself to exist infinitely long, the existence of an external material medium for the field source is required. It is explained that the concept of "external environment" does not have to be identified only with a continuous ether.

At the same time, the observed spherically symmetric field propagation around point mass and charge indicates the homogeneity and isotropy of the media in which gravitational and electrostatic fields are created. At the same time, the created fields manifest themselves as static physical fields due to disturbances of the medium's homogeneity by field sources (potential energy is laid in stock under the influence of field sources in the external environment). However, it is still too early to talk about the homogeneity and isotropy of the medium with the transition to infinitesimal values at this stage.

The Gauss theorem, which states that the value of the complete integral of the field intensity over a closed surface is preserved for any form of a closed surface, is the first step in confirming the "finesse" of the structure of the external environment.

The second step is also related to the Gauss theorem. The consequence of the materiality of the physical field is that the field sources are capable of screening (shielding) each other. However, since the experimental data does not demonstrate screening, the Gauss theorem hints that the sizes of the field sources significantly exceed the sizes of the structural elements (or effects) of the external medium for the field sources.

To simplify the discussion, we consider only static potential fields (gravitational and electric), for which the presence of a field source (mass or electric charge) is mandatory (there will be no gravitational or electric field without mass or charge). Whether there is an active exchange of any elements between the source and the external environment or not, the essence of the physical field is one: the physical field, in the case of its materiality, is a certain form of perturbation of the external environment that creates a stable, i.e., static, energy distribution; and the disturbance of the medium creates exactly the source of the field.

It follows from the indicated nature of the physical field that the source of the physical field must have internal energy that supports the perturbations it creates in its environment, and the energy of these perturbations is the potential energy of the physical field (gravitational or electric), equal to the internal energy of the field source. In this paper, it is shown that the mathematical apparatus associated with the Gauss theorem is applicable to the description of a physical field because of the provided interpretation: the internal energy of the field sources determines the energy distributed around them in the form of physical fields. In other words, the Gauss theorem proves (!) the materiality of physical fields. The observed independence of the spatial distribution of the characteristics of the field source (mass or charge) inside the closed surface from the obtained result is related to the energy interpretation of the Gauss theorem: the energy distributed in space by physical fields from the set of field sources is equal to the algebraic sum of the energies of individual fields, which are completely determined by the internal energy of the field sources, i.e., mass or charge.

Since the Gauss theorem is a purely mathematical apparatus, it can be non-universal when used in describing physical reality. This paper discusses a particular question: the failure of the Gauss theorem in its consequences for the spherically symmetrically distribution of the main characteristic of field sources (mass or charge). The failure to fulfil the consequences of the Gauss theorem is confirmed by the classical field theory, when the result is obtained not as a consequence of vector analysis, but as a consequence of the fulfilment of basic law (the law of universal gravitation or Coulomb's law) in combination with the principle of superposition. In addition, the consequences of the Gauss theorem contradict quantum field theory and general theory of relativity. And, no matter how strange it may seem, the violations indicated of the consequences of the Gauss theorem, indicated in this work, once again confirm the materiality of the physical field.

The fact is that even the screening effect has not yet been detected through experiments because of the "finesse" of the structure of the external environment; nevertheless, it must exist in the case of the materiality of the physical field. And, as the failures in the Gauss theorem demonstrate, it really does exist. Moreover, the shielding is created by the field sources themselves as spatial objects that break the continuity of the environment external to other field sources by their very presence. In this case, the effects in the external medium away from the field sources are created by each field source individually (the principle of superposition is observed).

For a better understanding of all these aspects, this paper presents a generalized mechanical model of a physical field without reference to its real physical nature, but only assuming that the physical field is material. This model takes into account the small spatial distances between the structural units of the external environment in comparison with the size of the field source. Such a mechanical model, in order to approximate it to existing reality, may become more complicated, detailed, or even completely replaced by a non-mechanical model, but the conclusions obtained for the generalized model under consideration should be considered universal.

Abstract

Vector analysis is an alternative way of presenting classical gravity and electrostatics, based, in combination with the principle of superposition, on the laws of Newton and Coulomb, respectively. The Gauss theorem is among one of the basic principles of vector analysis. However, in

an already published work by Belyaev, it was shown that a consequence of the Gauss theorem for a collection of field sources with a spherically symmetric distribution of their main characteristic (mass or charge), indicating the absence of a field inside a concentric cavity and the universal possibility of replacing the considered set of field sources with one equivalent a point source located in the center of symmetry and equal to the total characteristic of all sources, is not satisfied. This paper is an attempt to understand the cause of non-compliance.

Materiality is taken as the main characteristic of the field. First, the signs of materiality are presented, then a generalized mechanical model is constructed that can account for these signs of materiality. With the deepening of fundamental knowledge about the nature of fields, the generalized mechanical model should be replaced by highly specialized non-mechanical models, but the principles obtained in this paper should accompany new models. It is shown in the paper that the Gauss theorem is the direct consequence of the law of conservation of energy. Moreover, the conclusion obtained not only follows from the assumption that the physical field is material, but, in turn, actually proves its materiality. The non-universality of the corollary of the Gauss theorem for describing the resultant field of a set of spherically symmetrically located field sources is related to the violation of the continuousness of individual fields by other nearby sources of the field of the set. Moreover, the continuity of the individual field of an arbitrarily selected source is violated not by the individual fields of other sources, but directly by the sources themselves. Differential analysis becomes inapplicable in case of disruption of continuity.

In theoretical terms, this work shows that the corollary of the Gauss theorem for spherically symmetrically located field sources contradicts not only the conclusions of quantum field theory and the general theory of relativity, but also the historically classical approach, i.e., vector analysis cannot always serve as an alternative interpretation of the traditional classical description of the field. The results of the work allow us to explain the reason for finding the hidden mass at a great distance from the visible part of the galaxy, and in a particular case they explain the reason for the possibility of the existence of spherical capacitors, which as the consequence of the Gauss theorem cannot exist. From a practical point of view, the results of the work can increase the accuracy of determining the Lagrange points and much more.

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