E3S Web of Conferences **389**, 02006 (2023) https://doi.org/10.1051/e3sconf/202338902006
UESF-2023

On the similarity of electromagnetic and gravitational fields

Aleksandr Kanareykin[1*]

[1]Sergo Ordzhonikidze Russian State University for Geological Prospecting, 117997, Miklouho-Maclay St. 23., Moscow, Russia

Abstract. It is well known that gravitational quantities are in many ways similar to electromagnetic quantities. The masses that create a gravitational field are similar in this to electric charges. A gravitational static field, like an electrostatic field, is characterized by potential and intensity. Vortex and rotational movements of masses are often and quite justifiably compared with a magnetic field. According to existing concepts, there are four types of different fundamental physical interactions: strong, weak, electromagnetic and gravitational. Strong and weak interactions are manifested inside atomic nuclei and between elementary particles, electromagnetic – between charges, and gravitational acts between massive bodies, becoming the main one in the case of astronomical objects. The article presents a comparison of mechanical and gravitational quantities from the condition of their similarity to electromagnetic quantities. Visual systemically possible patterns involving field gravitational quantities similar to electromagnetic ones are given.

1 Introduction

The problem of combining electromagnetic and gravitational fields into one single field has been discussed since the end of the 19th century. It is characteristic that all these attempts were made on the way of constructing geometric models of physical interactions and interpreting physics as geometry in spaces of a larger number of dimensions. At the end of the 19th century, the German mathematician Felix Klein constructed the Hamilton-Jacobi theory as optics in the space of the highest number of dimensions. However, at that time his ideas were not developed. A new surge of interest in the problem of geometrization of physics was stimulated by the creation of the General Theory of Relativity. Attempts have been made to describe electromagnetism in geometric terms by analogy with gravity. Their authors did not try to create a new model, but tried to expand the existing scheme in one way or another. The most famous models were Kaluza and Klein. The works of Mandel and Fock should also be noted. It is characteristic that at the same time they had to use a 5-dimensional space. The problem of the physical interpretation of the fifth coordinate has not received a satisfactory solution.

In the future, many scientists, including Einstein, de Broglie, Gamow, Rumer, tried to develop these approaches, but they failed to get any interesting results. The reason is that

* Corresponding author: kanareykins@mail.ru

their work was based on formal generalizations of existing models, without involving new physical hypotheses.

Separately, we should mention the theory of gauge fields, as one of the directions of geometrization of physical interactions. Within the framework of this ideology, both electromagnetism, gravity, and other interactions are considered from a single geometric point of view. Later, in order to create a theory of elementary particles, a different approach to combining gravity with other interactions began to develop.

According to existing concepts, there are four types of different fundamental physical interactions: strong, weak, electromagnetic and gravitational. Strong and weak interactions are manifested inside atomic nuclei and between elementary particles, electromagnetic – between charges, and gravitational acts between massive bodies, becoming the main one in the case of astronomical objects.

Each type of fundamental interactions is attributed its own field and its own particle, which carries out the exchange between interacting bodies and is the material carrier of the field. In the case of strong interactions, such a particle is considered a meson or gluon, weak – a boson, electromagnetic – a photon, and gravity – a graviton. However, if mesons, bosons and photons have been discovered and studied experimentally, then neither gravitons, nor gravitons, nor any other gravity carriers have been found, although intensive searches are being conducted in this direction. The absence of material carriers of the gravitational field casts doubt on the very fact of its real existence.

If matter is one, then all interactions of material bodies must have a single nature. Therefore, persistent attempts are being made to combine all interactions and create a unified field theory. This work was started by Maxwell, who combined electric and magnetic interactions with his famous equations and proved the existence of a single electromagnetic field. Glashow, Weinberg and Salam reduced weak interactions to electromagnetic ones, creating a unified theory of electroweak interactions. Based on the model of particle exchange as the basis of any interaction, the "great unification" of electroweak and strong interactions is almost complete. However, a unified theory of all four fields, including the gravitational one, remains a distant dream of theorists.

2000 years ago, Aristotle introduced the concept of ether. Physicists have used the concept of ether for various states of space, both theoretically and experimentally. The French scientist Renaud called it a thin ether. M. Faraday most reasonably introduced the concept of "thin ether" on the example of his experience, and J. Maxwell applied the "thin ether" to his theory of electromagnetic fields using the equations of elasticity theory. The concept of "elastic ether" was ridiculed by the luminaries of that time, to such an extent that a printed treatise on the electromagnetic fields of space was published only in 1873, and its author was excommunicated from science. At this time, many researchers around the world began to confirm the existence of the theory of elasticity, and it received full recognition and practical application. For 100 years, the way of life of mankind has changed: microwave, mobile communications, TV, computer, Internet, etc., there is not a single theory that would so comprehensively confirm its practical application. At the beginning of the 20th century, the theory of SRT (special theory of relativity) by A. Einstein appeared. And in the theory of gravity, the techniques and equations of the theory of elasticity were used. His work aroused the interest of scientists, Lawrence and Poincare began to do this, and by the way, Poincare believed that Lawrence and many other experimental scientists who were engaged in interferometry of celestial bodies laid the basis of the physical part of the theory of relativity. In the middle of the 20th century, L.D. Landau and E.M. Livshits wrote the book "Field Theory", where everything is devoted to the equations of equilibrium in space and the equations of joint deformations, which suggests the great role of the theory of elasticity.

If matter is one, then all interactions of material bodies must have a single nature. Therefore, persistent attempts are being made to combine all interactions and create a unified field theory. Maxwell, who combined electric and magnetic interactions with his famous equations and proved the existence of a single electromagnetic field, started this work. We have shown the possibility of completely excluding magnetic interactions from the fundamental ones and reducing them to purely electrical ones. Glashow, Weinberg and Salam reduced weak interactions to electromagnetic ones, creating a unified theory of electroweak interactions. Based on the model of particle exchange as the basis of any interaction, the "great unification" of electroweak and strong interactions is almost complete. However, a unified theory of all four fields, including the gravitational one, remains a distant dream of theorists.

In the days of Michael Faraday and J. Maxwell's world was dominated by an "elastic" space - ether. And if the first was a great experimenter, then the second was a theorist who built the theory of electromagnetic fields using the theory of elasticity, which is confirmed and will continue to be confirmed by practitioners and experimenters over 150 years of hard hard work. Based on Jung's discoveries, the theory of electromagnetic fields, J. Maxwell for the first time obtained the modulus of elasticity of space, which is thousands of times higher than the modulus of elasticity of metals (steel, copper, brass, cast iron, etc.) It struck the imagination of the luminaries of that time. And the creator of the theory of the electromagnetic field was betrayed to ridicule and mockery. He was excommunicated from science for a long time and removed from work. Only after 12 difficult years, J. Maxwell was returned to the scientific world.

Currently, when considering the three main four-dimensional elasticity equations: gravity, elastic electromagnetic field, thermomechanical field, a complete mathematical analogy of all three theories [1-3] has been found with accuracy up to the time deformation coefficients in space.

Interestingly, in addition to the elastic space, the value of the elastic space modulus itself was obtained. Many scientists, considering the 3-dimensional space when comparing their equations, concluded that they are the same, except for the constant coefficients of the fields under consideration. Since all three equations are identical and differ only in coefficients, some feature of one solution can be used for the other two theories, modelling is also used to obtain a similar effect.

2 Main Part

The model explaining the pulsation of longitudinal electrons (gravitons) keeps the entire space in an elastic state. More J. Maxwell in 1861, finishing his theory of the electromagnetic field, used the basic equations of elasticity. In 1862, the Airy elasticity function-F appeared, which was included in the equations of various theories, for the prostate of perception of the congested mathematical pages of many scientific fields, now in quantum theory, the Hamilton operator is present in all biharmonic equations

$$\nabla^2 F = \nabla\nabla F \tag{1}$$

In Newton's theory, rewritten in modern terms, the mass density ρ, generates a scalar field φ, as follows

$$\varphi = 4\pi\rho \tag{2}$$

Newton answered the question about the causes of gravity: "I do not invent hypotheses." His followers were not so scrupulous in this matter and put forward many mechanical versions of the explanation of gravity. Among the modifications of the Newtonian theory, the Lesage theory (corpuscular model) and its modifications are distinguished. Poincare (1908) compared all the theories known at that time and concluded that only Newton's theory is correct. The remaining models predict very large superluminal speeds of gravitational interaction, which in turn would lead to a very rapid warming of the Earth, which is not observed. However, the latest modifications of Lesage's theory of gravity make it possible to avoid the need to introduce superluminal gravitational velocities.

Currently, there are also various "vortex" and "etherodynamic" theories of gravity, and sometimes electromagnetism. The same Poincare objections can be applied to them, so most scientists consider such attempts currently insufficiently convincing.

In the theory of compression of the Universe, an attempt is made to explain all gravitational phenomena by changing the speed of light, and to link the parameters of scales, some constants, including the gravitational constant, with a change in speed. Adding the cosmological constant Λ changes Newton's equation (2)

$$\nabla^2\varphi - \Lambda\varphi = 4\pi\rho \tag{3}$$

It is well known that gravitational quantities are in many ways similar to electromagnetic quantities. The masses that create a gravitational field are similar in this to electric charges. A gravitational static field, like an electrostatic field, is characterized by potential and intensity. Vortex and rotational movements of masses are often and quite justifiably compared with a magnetic field. The gravidynamic constant μ0, an analogue of the magnetic constant from electromagnetism, takes part in the system regularities given. The known conservation laws are systemically expressed as the relations of kinematic physical quantities involving spatial volume and the gravidynamic constant, which, according to the system, is less than the known gravitational constant G squared, explains why the manifestations of the force interaction of moving masses are so small and invisible in the macrocosm, and the manifestations of inertia and the laws of conservation of momentum and angular momentum are equally powerful. The ratio of the constant μ0 to the gravitational constant G has the form

$$\mu = \frac{4\pi G}{c^2} \tag{4}$$

The gravitational field, like the electric field, has an unlimited radius of action, decreases with distance from the body inversely proportional to the square of the distance, proportional to the amount of matter in the body, although expressed not by the charge, but by its mass. Therefore, the idea of the electric nature of gravity has long arisen.

Along with the similarity, the gravitational and electric fields have significant differences. Firstly, gravitational forces act between any bodies, and electric forces act only between charged ones. Secondly, gravitational forces are incomparably less than electric ones and manifest themselves mainly in the presence of astronomical objects with a huge mass. Thirdly, in gravity there are only attractive forces, whereas in electricity there are also repulsive forces. Fourth, electric forces depend on the velocities of bodies (magnetic interaction), and this is not known in gravity (however, perhaps due to the smallness of the velocities). Finally, the fifth difference is that a conductive screen shields the electric field, whereas there are no gravitational screens. Any electrical model of gravity should explain these differences.

A. Einstein was engaged in the unified theory of electromagnetic and gravitational fields for most of his life. He proceeded from the fact that any field is a curvature of multidimensional space-time and is described within the framework of Lobachevsky-Riemann geometry. The efforts of Einstein and his followers were unsuccessful, and even if successful, they would not have found out the physical nature and material basis of the unified forces.

3 Conclusions

Thus, the article presents a comparison of mechanical and gravitational quantities from the condition of their similarity to electromagnetic quantities. Systemically possible regularities involving field gravitational quantities similar to electromagnetic ones are considered. According to the ideology of the expanded space model, the unification of electromagnetic and gravitational fields arises because the interaction of particles and fields changes their mass. Including the photon, falling into the medium, or into the external field, acquires mass. At the same time, an important role is played by the fact that photons have mass, and in addition to the electromagnetic interaction, there is also a gravitational interaction between photons and the external environment. There are systemic reasons to assume gravity as the causal basis of the inertia of material bodies, as well as the laws of conservation of momentum and angular momentum.

References

1. M. Agop, C.Gh. Buzea, B. Ciobanu, arXiv:physics/9911011 **1**, 10 (1999)
2. S. Walter, J. Renn, The Genesis of General Relativity. Berlin: Springer **3**, 193–252 (2007)
3. R. Lang, *Experimental foundations of general relativity* (2002)