WHAT DO WE KNOW ABOUT THE GRAVITATIONAL CONSTANT G?

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Abstract: *the gravitational constant (Newton's constant) is a fundamental physical constant, a constant of gravitational interaction.*
The gravitational constant is the basis for converting other physical and astronomical quantities, such as the masses of planets in the Universe, including the Earth, as well as other cosmic bodies, into traditional units of measurement, such as kilograms.
The article substantiates the dependence of the proportionality coefficient in the equation of the law of universal gravitation on the value of the gravitational field.
Keywords: *gravitational constant, dark matter, gravitational field, gravity law.*

ЧТО МЫ ЗНАЕМ О ГРАВИТАЦИОННОЙ ПОСТОЯННОЙ G?

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Аннотация: *гравитационная постоянная (постоянная Ньютона) - фундаментальная физическая постоянная, константа гравитационного взаимодействия.*
Гравитационная постоянная является основой для перевода других физических и астрономических величин, таких, например, как массы планет во Вселенной, включая Землю, а также других космических тел, в традиционные единицы измерения, например, килограммы.
В статье обосновывается зависимость коэффициента пропорциональности в уравнении закона всемирного тяготения от величины гравитационного поля.
Ключевые слова: *гравитационная постоянная, тёмная материя, гравитационное поле, закон всемирного тяготения.*

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Introduction. The equation describing the law of universal gravitation, in addition to the interacting masses and the distance between them, also includes a coefficient of proportionality. It is recognized as a fundamental physical quantity, since it plays a key role in cosmology, astrophysics, etc. According to the established opinion, this coefficient, designated "G", is a constant, as evidenced by the name assigned to it - the gravitational constant.

Relevance. To successfully solve many scientific problems, it is necessary to determine the numerical value of this coefficient as accurately as possible. Therefore, experimental work on the measurement of the gravitational constant "G" has been conducted continuously for more than two hundred years. Its meaning was originally determined based on experience by the British physicist Henry Cavendish in 1798 [1]. Over the next hundred years, about two hundred more experiments were conducted to refine the resulting "G" value. In addition to determining the value, it is also important to make sure that it remains unchanged.

Methods. The "G" value was determined in various ways, but most often an improved torsion scale was used, the principle of operation of which did not differ from the torsion scales at Cavendish's disposal. After 2000, experiments were conducted using atomic interferometric methods based on the quantum nature of matter [2]. Unfortunately, different and fairly accurate measurements made taking into account the impact of the smallest factors (for example, minimizing the gravitational interaction with the walls of the laboratory or holding the equipment in a vacuum with a temperature fluctuation of no more than one hundredth of a degree), did not allow to dramatically improve the accuracy of the "G" coefficient estimation. Currently, the error in determining "G" is significantly higher by several orders of magnitude than the errors of other fundamental physical quantities. At the same time, its immutability over time is emphasized.

However, we would like to draw attention to the following... One factor, perhaps very significant, was not taken into account in all these experiments – the determination of "G" occurred under almost constant external gravitational field, that is, in terrestrial conditions and at levels close to sea level.

Scientific innovation. Let's imagine a cube of solid material with a length of edges of one unit. One of the properties of the cube will be the geometric dimensions that determine its volume, the numerical value of which is equal to one at normal atmospheric pressure. However, when the pressure increases (for example, when submerged in water), the numerical value of the volume decreases, because the property of the cube (its geometric dimensions) has changed.

Probably, this analogy can be extended to the proportionality coefficient "G", which numerically expresses some property (or set of properties) of space. Therefore, if an increase in the gravitational field deforms space (similar to the deformation of the cube from water pressure in the previous example), it is logical to assume that the properties of space and, accordingly, the value of the proportionality coefficient "G" change. Conversely, it is unnatural to assume that a coefficient that depends on the properties of space will remain unchanged when these properties change. Here, perhaps, it should be further noted that the deformation (curvature) of space from the influence of the gravitational field has found practical confirmation.

The expected effect can be formulated as follows: the value of the proportionality coefficient in the law of universal gravitation depends on the size of the gravitational field.

Results. The presence of such an effect will allow us to find an explanation for one of the mysteries of cosmology - an abnormally high action of gravitational attraction forces, which is not proportional to the observed quantity of substance.

The first signs of this anomaly were identified in the thirties of the last century by astronomer Fritz Zwicky. His calculations showed that in the cluster of galaxies he observed, the total mass is not enough to keep them apart from each other, although in reality such a separation does not occur. In the next few decades, the refinement of the observed masses using x-ray and radio telescopes, taking into account special types of matter (neutrinos, black holes, cosmic rays, etc.) did not eliminate this deficit and only confirmed this anomaly. Moreover, it was found that this is typical for most clusters, and in some of them the lack of mass exceeds the 50% mark [3].

If the existence of the effect depends on the aspect ratio (here call it the gravitational constant is meaningless) the law of universal gravitation on the strength of the gravitational field takes place, then the problem is the abnormally high force of gravitational attraction, is not commensurate to the observed amount of substance, is explained without bringing in the notion of "dark matter", as you have to do now. That is, a unit of mass of matter in the area of action of the increased gravitational field, due to the increased coefficient of proportionality, creates a force of gravitational attraction, which, if the coefficient were unchanged, could only be created by a mass with a value greater than one. That is why, if the proposed effect is rejected, it is necessary to introduce" dark matter " to compensate for the resulting lack of mass. And it has to be introduced the more, the more in the area of objects with extremely high gravitational fields (neutron stars, "black holes", "white dwarfs"), where the effects of the proposed effect are more pronounced.

Conclusions. Is it possible to experimentally confirm or deny the presence of the claimed effect? In my opinion, there is enough data to theoretically develop a reliable model of the dependence of the coefficient of proportionality on the value of the gravitational field. Then, based on this model, it will be possible to quantify whether the practical verification of the existence of this effect is in the capabilities of experimenters, or Vice versa, even hypothetical ways of conducting such work are not visible.

In parallel, if this is feasible, it makes sense to try an experiment to determine the coefficient under different external gravitational fields, for example, at the foot of a mountain and at its top. Perhaps this difference in gravity will be sufficient to detect this effect [4,5].

Conclusion. The coefficient of proportionality in the law of universal gravitation is essential and therefore it is very important both to clarify its value and to confirm or disprove its dependence on changes in the gravitational field.

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