Journal of High Energy Physics, Gravitation and Cosmology, 2024, 10, 918-929
https://www.scirp.org/journal/jhepgc
ISSN Online: 2380-4335
ISSN Print: 2380-4327

Newton's Law of Universal Gravitation Explained by the Theory of Informatons

Antoine Acke

Retired Professor Kaho Sint-Lieven, Now Faculty of Engineering Technology, KU Leuven, Ghent Campus, Gent, Belgium
Email: ant.acke@skynet.be

How to cite this paper: Acke, A. (2024) Newton's Law of Universal Gravitation Explained by the Theory of Informatons. *Journal of High Energy Physics, Gravitation and Cosmology*, **10**, 918-929.
https://doi.org/10.4236/jhepgc.2024.103056

Received: March 19, 2024
Accepted: June 25, 2024
Published: June 28, 2024

Abstract

In the context of classical physics, Newton's law of universal gravitation describes the attraction between two mass particles separated in space. In the same context a vector field $\boldsymbol{E}_g$, that is not associated with anything substantial, has been introduced as the entity that mediates in the gravitational interactions. In this article, we will show that $\boldsymbol{E}_g$ is the mathematical quantity that—at the macroscopic level—fully characterizes the medium that makes the interaction between particles at rest possible. We identify that medium as "the *gravitational field*". To define the nature of the gravitational field, we will start from the hypothesis that a material object manifests itself in space by the emission—at a rate proportional to its rest mass—of mass and energy less granular entities that—relative to an inertial reference frame—are rushing away with the speed of light and that are carriers of information referring to the position of their emitter ("*g-information*"). Because they transport nothing else than information, we call these entities "*informatons*". We will show that the expanding cloud of g-information created by the continuous emission of informatons by a mass particle at rest can be fully characterized by the vector field $\boldsymbol{E}_g$, which implies that that cloud can be identified as the gravitational field of the particle. We will also show that the gravitational interaction between mass particles can be explained as the response of a particle to the disturbance of the symmetry of its "proper" gravitational field by the field that, in its direct vicinity, is created and maintained by other mass particles.

Keywords

Gravity, Gravitational Field, Gravitational Interaction, Informatons

1. Introduction

Daily contact with the things on hand confronts us with their substantiality. An object is not just form, it is also matter. It takes space, it eliminates emptiness. The amount of matter within the contours of a physical body is called its *mass.* The mass of an object manifests itself when it interacts with other objects. A fundamental form of interaction between objects is "*gravitation*". Material objects ("*masses*") attract each other and, if they are free, they move to each other.

In the framework of the classical theory of fields ("*Newtonian gravity*"), the gravitational interactions are described by introducing the field concept. Each material object manifests its substantiality by creating and maintaining a vector field, characterized by the vectoral quantity $\boldsymbol{E}_g$ that has a value at every point of space and time and is thus—relative to an inertial reference frame (IRF) ***O***—regarded as a function of space and time coordinates. And each object in that field experiences a tendency to accelerate. The field theory considers $\boldsymbol{E}_g$ as the mathematical entity that mediates in the gravitational interactions.

Although the classical theory of fields describes the gravitational phenomena in a correct and coherent manner, it doesn't create clarity about the physical nature of gravity: the gravitational field is considered as a purely mathematical construction.

In what follows we develop the idea that, if masses can influence each other "at a distance", they must in one way or another exchange data. We assume that each mass emits information regarding its magnitude and its position, and that it is able to "interpret" the information emitted by its neighbors. In this way we propose a physical foundation of Newtonian gravity by introducing *information* as the substance of a gravitational field.

We start from the idea that a material object at rest relative to an IRF ***O*** manifests itself in space by the emission—at a rate proportional to its rest mass—of mass and energy less granular entities that are rushing away with the speed of light and are carrying information regarding the position ("*g-information*") of their emitter. Because they transport nothing else than information, we call these entities "*informatons*". In that context, the gravitational field of a material object will be understood as an expanding cloud of informatons, that forms an indivisible whole with that object.

In the *postulate of the emission of informatons*, we define an informaton by its attributes and determine the rules that govern the emission by a point mass that is anchored in an IRF ***O***. A direct consequence of that postulate is that a mass particle at rest in ***O***, and by extension any material object at rest, is the source of an expanding cloud of informatons, that—at an arbitrary point *P*—is characterised by *the density of the flow of g-information* at that point. That vectoral quantity can be identified with $\boldsymbol{E}_g$, the vector field that—according to classical physics—mediates in the gravitational interactions, which implies that we can refer to the cloud of informatons as the *gravitational field* in ***O***.

Finally we explain the gravitational interaction between mass particles at rest relative to an IRF ***O*** (Newton's law of universal gravitation) as the response of an object to the disturbance of the symmetry of its "proper" gravitational field by the field that, in its direct vicinity, is created and maintained by other masses.

2. Preliminary Definitions

A material body occupies space, its surface encloses matter. The amount of matter within its contours is called its *mass*. According to the field theory, any material body is the source of a gravitational field that at a sufficiently large distance is independent of the form of the body. This "far field" can be calculated by reducing the body to a mathematical point in which all the mass is accumulated. Such a point is called a "*mass particle*" or a "*point mass*" and it will be graphically represented by a little sphere. If we can calculate the gravitational field generated by a point mass, integral calculus delivers the methods to calculate the gravitational field generated by any material body. This justifies the fact that we in the first instance focus on the emission of informatons by a mass particle.

The phenomena that are the subject of this article are situated in spacetime: they are located in "space" and dated in "time".

1) In the context of the theory of informatons *space* is conceived as a three-dimensional, homogeneous, isotropic, unlimited and empty continuum. This continuum is called the "Euclidean space" because what geometrically is possible in that space, is determined by the Euclidean geometry. By anchoring a standardized Cartesian coordinate system to a reference body, an observer can—relative to that reference body—localize each point by three coordinates x, y, z.

2) In the same context we define *time* as the monotonically increasing real quantity t that is generated by a standard clock[1]. In a Cartesian coordinate system a standard clock links to each event a "moment"—this is a specific value of t—and to each duration a "period" or "time interval"—this is a specific increase of t. The introduction of time makes it possible for the observer to express, in an objective manner, the chronological order of events in a Cartesian coordinate system.

A Cartesian coordinate system together with a standard clock is called a "*reference frame*". We represent a reference frame as $OXYZ(T)$, shortly as $\boldsymbol{O}$. A reference frame is called an "*inertial reference frame*" if light propagates rectilinear (in the sense of the Euclidean geometry) with constant speed everywhere in the empty space linked to that frame. This definition implies that the space linked to an inertial reference frame is a homogeneous, isotropic, unlimited and empty continuum in which the Euclidean geometry is valid.

3. The Concept of Gravitational Information

Newton's law of universal gravitation [1] [2] may be expressed as follows:

The force between any two particles having masses m_1 *and* m_2 *separated by a distance* r *is an attraction working along the line joining the particles and has a magnitude*

$$F = G \cdot \frac{m_1 \cdot m_2}{r^2}$$

[1]The operation of a standard clock is based on the counting of the successive cycles of a periodic process that is generated by a device inside the clock.

where G is a universal constant having the same value for all pairs of particles.

This law expresses the basic fact of gravitation, namely that two masses are interacting "at-a-distance": they exert forces on one another even though they are not in contact.

According to Newton's law $\boldsymbol{F}_B$, the force exerted by a particle *A*—with mass m_1—on a particle *B*—with mass *m*—is pointing to the position of *A* and has a magnitude:

$$F_B = \left(G \cdot \frac{m_1}{r^2}\right) \cdot m$$

The orientation of this force and the fact that it is directly proportional to the mass of *A* and inversely proportional to the square of the distance from *A* to *B*, implies that particle *B* must receive *information* about the presence in space of particle *A*: particle *A* must send information to *B* about its position and about its mass. This conclusion is independent of the position and the mass of *B*; so we can generalize it and posit that

A particle manifests itself in space by emitting information about its mass and about its position.

We consider that type of information as a substantial element of nature and call it "*gravitational information*" or "*g-information*". We assume that g-information is transported by mass and energy less granular entities that rush through space with the speed of light (*c*). These grains of g-information are called *informatons*.

4. The Postulate of the Emission of Informatons

A material object manifests its presence in space by continuously emitting informatons. The emission of informatons by a material object anchored in an IRF ***O***, is governed by the "*postulate of the emission of informatons*".

A. *The emission* of informatons by a particle at rest is governed by the following rules:

1) *The emission is uniform in all directions of space, and the informatons diverge with the speed of light (c* = 3 × 10⁸ m/s*) along radial trajectories relative to the position of the emitter.*

2) $\dot{N} = \frac{\mathrm{d}N}{\mathrm{d}t}$, *the rate at which a particle emits informatons*[2]*, is time independent and proportional to the rest mass* m_0 *of the emitter. So there is a constant K so that*:

$$\dot{N} = K \cdot m_0$$

3) *The constant K is equal to the ratio of the square of the speed of light* (*c*) *to the Planck constant* (*h*):

$$K = \frac{c^2}{h} = 1.36 \times 10^{50}\ \mathrm{kg}^{-1} \cdot \mathrm{s}^{-1}$$

[2]We neglect the possible stochastic nature of the emission, that is responsible for noise on the quantities that characterize the gravitational field. So, $\dot{N}$ is the average emission rate.

B. We call the essential attribute of an informaton its *g-index.* The g-index of an informaton refers to information about the position of its emitter and equals the *elementary quantity of g-information*. It is represented by a vectoral quantity $\boldsymbol{s}_g$:

1) $\boldsymbol{s}_g$ *points to the position of the emitter.*
2) *The elementary quantity of g-information is*:

$$s_g = \frac{1}{K \cdot \eta_0} = \frac{h}{\eta_0 \cdot c^2} = 6.18 \times 10^{-60} \text{ m}^3 \cdot \text{s}^{-1}$$

where $\eta_0 = \frac{1}{4 \cdot \pi \cdot G} = 1.19 \times 10^9 \text{ kg} \cdot \text{s}^2 \cdot \text{m}^{-3}$, *G* being the gravitational constant.

Rule A.1 is the expression of the hypothesis that the space is a homogenous and isotropic continuum in which the gravitational phenomena are travelling with the speed of light. Rule A.2 posits that the rate at which a particle emits informatons is a measure for its rest mass and rule A.3 implies the fact that, when a particle absorbs (emits) a photon $h \cdot \nu$, its rest mass is increasing (decreasing) with an amount $\frac{h \cdot \nu}{c^2}$ while its emission rate is increasing (decreasing) with an amount ν.

Rule B.1 and rule B.2 respectively express the facts that the gravitational field of a particle always points to the position of the source of that field and that the gravitational force between any two particles depends on a universal constant *G*.

To summarize, each material object manifests itself in space by the emission of *informatons*, it is a source of informatons. Informatons are grains of *g-information* and, as such, the constituent elements of gravitational fields. In the context of the postulate informatons are completely defined by their g-index $\boldsymbol{s}_g$. We will represent an informaton as a quasi-infinitely small sphere, moving with velocity $\boldsymbol{c}$ and carrying a vector $\boldsymbol{s}_g$.

5. The Gravitational Field of a Particle at Rest

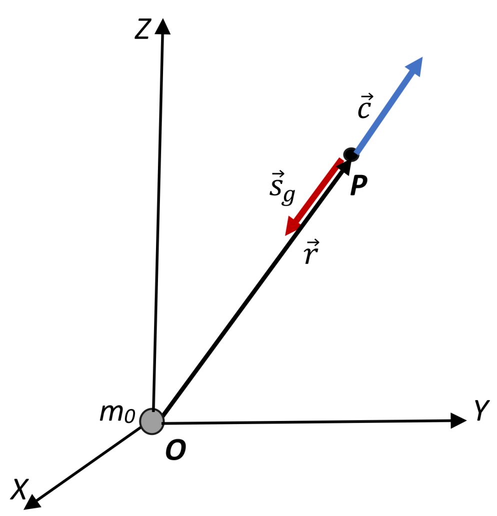

Figure 1. The emission of an informaton by a particle.

In **Figure 1** we consider a mass particle with rest mass m_0 that is anchored at the origin of an inertial reference frame ***O***. According to the postulate it continuously emits informatons in all directions of space.

The informatons that with velocity

$$\boldsymbol{c} = c \cdot \frac{\boldsymbol{r}}{r} = c \cdot \boldsymbol{e}_r$$

pass near a fixed point *P*, defined by the position vector $\boldsymbol{r}$, are characterised by their g-index $\boldsymbol{s}_g$:

$$\boldsymbol{s}_g = -\frac{1}{K \cdot \eta_0} \cdot \frac{\boldsymbol{r}}{r} = -\frac{1}{K \cdot \eta_0} \cdot \boldsymbol{e}_r$$

The rate at which the point mass emits g-information is the product of the rate at which it emits informatons with the elementary g-information quantity:

$$\dot{N} \cdot s_g = \frac{m_0}{\eta_0}$$

Of course, this is also the rate at which it sends g-information through any closed surface that surrounds m_0: it is the *intensity of the g-information-flow* through any closed surface that encloses m_0.

The emission of informatons fills the space around m_0 with an expanding cloud of g-information. This cloud has the shape of a sphere whose surface moves away from the center *O*—the position of the point mass—with the speed of light.

1) Within that cloud there is a *stationary state*. Because for each spatial region the inflow of g-information equals the outflow, each spatial region contains an unchanging number of informatons and thus a constant quantity of g-information. Moreover, the orientation of the g-indices of the informatons passing near a fixed point is always the same.

2) That cloud can be identified with a *continuum*. Each spatial region contains a very large number of informatons: the g-information is like continuously spread over the volume of the region.

The cloud of g-information surrounding O can be identified as the gravitational field or the g-field of the point mass m_0.

Without interruption "countless" informatons are rushing through any—even a very small—surface in the gravitational field: we can describe the motion of g-information through a surface as a *continuous flow* of g-information.

We know already that the intensity of the flow of g-information through a closed surface *that surrounds O is expressed as:*

$$\dot{N} \cdot s_g = \frac{m_0}{\eta_0}$$

If the closed surface is a sphere with radius *r*, the *intensity of the flow per unit area* is given by:

$$\frac{m_0}{4 \cdot \pi \cdot r^2 \cdot \eta_0}$$

This is the *density of the flow of g-information* at any point P at a distance r from m_0 (**Figure 1**).

This quantity is, together with the orientation of the g-indices of the informatons that are passing near P, characteristic for the gravitational field at that point. Thus, at a point P, the gravitational field of the point mass m_0 is unambiguously defined by the vectoral quantity $\boldsymbol{E}_g$:

$$\boldsymbol{E}_g = \frac{\dot{N}}{4 \cdot \pi \cdot r^2} \cdot \boldsymbol{s}_g = -\frac{m_0}{4 \cdot \pi \cdot \eta_0 \cdot r^2} \cdot \boldsymbol{e}_r = -\frac{m_0}{4 \cdot \pi \cdot \eta_0 \cdot r^3} \cdot \boldsymbol{r}$$

This quantity is the *gravitational field strength* or the *g-field strength* or the *g-field* ($\text{m} \cdot \text{s}^{-2}$). At any point of the gravitational field of the point mass m_0, the orientation of $\boldsymbol{E}_g$ corresponds to the orientation of the g-indices of the informatons which are passing near that point. And the magnitude of $\boldsymbol{E}_g$ is the *density of the g-information flow* at that point (the rate per unit area at which g-information at P flows through an elementary surface perpendicular to the direction of $\boldsymbol{E}_g$). Let us note that, in the case under consideration, $\boldsymbol{E}_g$ is opposite to the direction of movement of the informatons.

Finally, let us consider a surface-element $\text{d}S$ at P (**Figure 2(a)**). Its orientation and magnitude are completely determined by the surface-vector $\text{d}\boldsymbol{S}$ (**Figure 2(b)**).

By $-\text{d}\Phi_G$, we represent the rate at which g-information flows through $\text{d}S$ in the sense of the positive normal $\boldsymbol{e}_n$ and we call the scalar quantity $\text{d}\Phi_G$ defined as

$$\text{d}\Phi_G = \boldsymbol{E}_g \cdot \text{d}\boldsymbol{S} = E_g \cdot \text{d}S \cdot \cos\alpha$$

the *elementary g-flux through* $\text{d}S$. ($\text{m}^3 \cdot \text{s}^{-2}$).

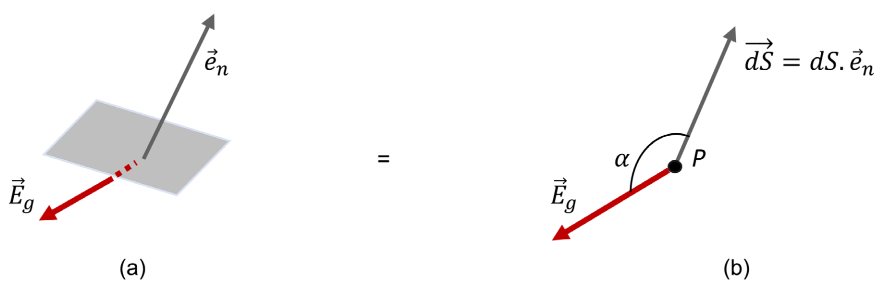

Figure 2. The elementary g-flux through a surface-element.

For an arbitrary closed surface S that surrounds m_0, the outward flux (which we obtain by integrating the elementary contributions $\text{d}\Phi_g$ over S) must be equal to the rate at which the mass emits g-information. Thus:

$$\Phi_G = \oiint \boldsymbol{E}_g \cdot \text{d}\boldsymbol{S} = -\frac{m_0}{\eta_0}$$

This is Gauss's law [1] [2] in the case of a mass particle at rest. *Gausse's law is the expression of the conservation of g-information.*

6. The Gravitational Field of a Set of Particles at Rest

We consider a set of particles with rest masses $m_1, \cdots, m_i, \cdots, m_n$ that are anchored in an inertial reference frame $\boldsymbol{O}$. At an arbitrary point P, the flows of g-information who are emitted by the distinct masses are defined by the gravitational fields $\boldsymbol{E}_{g1}, \cdots, \boldsymbol{E}_{gi}, \cdots, \boldsymbol{E}_{gn}$. $-\mathrm{d}\Phi_g$, the rate at which g-information flows through a surface-element dS at P in the sense of the positive normal, is the sum of the contributions of the distinct masses:

$$-\mathrm{d}\Phi_G = \sum_{i=1}^{n} -\left(\boldsymbol{E}_{gi} \cdot \mathrm{d}\boldsymbol{S}\right) = -\left(\sum_{i=1}^{n} \boldsymbol{E}_{gi}\right) \cdot \mathrm{d}\boldsymbol{S} = -\boldsymbol{E}_g \cdot \mathrm{d}\boldsymbol{S}$$

So, the *effective density of the flow of g-information at P* (the effective g-field) is completely defined by:

$$\boldsymbol{E}_g = \sum_{i=1}^{n} \boldsymbol{E}_{gi}$$

We conclude:

At a point in space, the g-field of a set of point masses at rest is completely defined by the vectoral sum of the g-fields caused by the distinct masses.

Let us remark that the orientation of the effective g-field has no longer a relation with the direction in which the passing informatons are moving.

One easily shows that the outward g-flux through a closed surface in the g-field of a set of anchored point masses only depends on the surrounded masses m_{in}:

$$-\oiint \boldsymbol{E}_g \cdot \mathrm{d}\boldsymbol{S} = \frac{m_{in}}{\eta_0}$$

This is Gauss's law [1] [2] in the case of a set of mass particles at rest. *It is the expression of the conservation of g-information.*

7. The Gravitational Field of a Mass Continuum at Rest

We call an object in which the matter in a time independent manner is spread over the occupied volume, a *mass continuum*. At each point Q in such a continuum, the accumulation of mass is defined by the (*mass*) *density* ρ_G. To define this scalar quantity one considers the mass dm of a volume element dV that contains Q. The accumulation of mass in the vicinity of Q is defined by:

$$\rho_G = \frac{\mathrm{d}m}{\mathrm{d}V}$$

A mass continuum—anchored in an inertial reference frame—is equivalent to a set of infinitely many infinitesimal small mass elements dm. The contribution of each of them to the field strength at an arbitrary point P is $\mathrm{d}\boldsymbol{E}_g$. $\boldsymbol{E}_g$, the effective g-field at P, is the result of the integration over the volume of the continuum of all these contributions.

It is evident that the outward g-flux through a closed surface S only depends on the mass enclosed by that surface (the enclosed volume is V):

$$-\oiint_S \boldsymbol{E}_g \cdot \mathrm{d}\boldsymbol{S} = \frac{1}{\eta_0} \cdot \iiint_V \rho_G \cdot \mathrm{d}V$$

This is Gauss's law [1] [2] in the case of a mass continuum. *It is the expression of the conservation of g-information.*

That relation is equivalent with (theorem of Ostrogradsky [3]):

$$div\,\boldsymbol{E}_g = -\frac{\rho_G}{\eta_0}$$

Furthermore, one can show that in any matter free point [3] $rot\,\boldsymbol{E}_g = 0$, what implies the existence of a gravitational potential function V_g for which:

$$\boldsymbol{E}_g = -grad\,V_g$$

8. The Gravitational Field of Objects at Rest

A mass particle at rest, a set of mass particles at rest and a mass continuum at rest are the sources of gravitational fields that are completely characterized by the time independent vectoral quantity $\boldsymbol{E}_g$. The magnitude of this quantity is the rate per unit area at which g-information at an arbitrary point flows through an elementary surface perpendicular to the direction of $\boldsymbol{E}_g$.

The constituent element of these fields is the "informaton" and their substance is "g-information".

This implies that gravitational fields are granular, that they continuously regenerate, that they show fluctuations, that they expand with the speed of light, that gravitational phenomena propagate with that speed and that there is conservation of g-information.

9. The Gravitational Interaction between Mass Particles at Rest

We consider a set of mass particles anchored in an IRF ***O***. They create and maintain a gravitational field that at each point of the space linked to ***O*** is completely determined by the vector $\boldsymbol{E}_g$. Each particle is "immersed" in a cloud of g-information. At every point, except at its own position, each particle contributes to the construction of that cloud.

Let us consider the particle with rest mass m_0 anchored at *P*. If the other particles were not there, then m_0 would be at the center of a perfectly spherical cloud of g-information. In reality this is not the case: the emission of g-information by the other particles is responsible for the disturbance of that "*characteristic symmetry*" of the proper g-field of m_0. Because $\boldsymbol{E}_g$ at *P* represents the intensity of the flow of g-information send to *P* by the other particles, the extent of disturbance of the characteristic symmetry in the immediate vicinity of m_0 is determined by $\boldsymbol{E}_g$ at *P*.

If it was free to move, particle m_0 could restore the characteristic symmetry of the g-information cloud in its immediate vicinity by accelerating with an amount $\boldsymbol{a} = \boldsymbol{E}_g$. Indeed, accelerating this way has the effect that the extern field disappears in the origin of the reference frame anchored to m_0. If it accelerates with an amount $\boldsymbol{a} = \boldsymbol{E}_g$, m_0 would become "blind" for the g-information send to its immediate vicinity by the other particles, it would "see" only its proper spherical g-information cloud.

So, from the point of view of a particle at rest at a point *P* in a gravitational field $\boldsymbol{E}_g$, the characteristic symmetry of the g-information cloud in its immediate vicinity is conserved if it accelerates with an amount $\boldsymbol{a} = \boldsymbol{E}_g$. A particle that is anchored in a gravitational field cannot accelerate. In that case it *tends* to move.

This insight is expressed in the following postulate:

A particle anchored at a point in a gravitational field is subjected to a tendency to move in the direction defined by $\boldsymbol{E}_g$*, the g-field at that point. Once the anchorage is broken, the mass acquires a vectoral acceleration* $\vec{a}$ *that equals* $\boldsymbol{E}_g$*.*

10. The Gravitational Force—The Force Concept

A particle m_0, anchored at a point *P* in a gravitational field, experiences an action because of that field, an action that is compensated by the anchorage.

1) That action is proportional to the extent to which the characteristic symmetry of the proper gravitational field of m_0 in the immediate vicinity of *P* is disturbed by the extern g-field, thus to the value of $\boldsymbol{E}_g$ at *P*.

2) It depends also on the magnitude of m_0. Indeed, the g-information cloud created and maintained by m_0 is more compact as m_0 is greater. That implies that the disturbing effect on the spherical symmetry around m_0 by the extern g-field $\boldsymbol{E}_g$ is smaller when m_0 is greater. Thus, to impose the acceleration $\boldsymbol{a} = \boldsymbol{E}_g$, the action of the gravitational field on m_0 must be greater as m_0 is greater.

We can conclude that the action that tends to accelerate a particle in a gravitational field must be proportional to $\boldsymbol{E}_g$—the g-field to which the particle is exposed—and to m_0—the rest mass of the particle. We represent that action by $\boldsymbol{F}_G$ and we call this vectoral quantity "*the force developed by the g-field on the particle*" or the *gravitational force* on m_0. We define it by the relation:

$$\boldsymbol{F}_G = m_0 \cdot \boldsymbol{E}_g$$

A particle anchored at a point *P* cannot accelerate, which implies that the effect of the anchorage must compensate the gravitational force. It cannot be otherwise than that the anchorage exerts an action on that particle that is exactly equal and opposite to the gravitational force. That action is called a *reaction force*.

Between the gravitational force on a particle with rest mass m_0 and the local field strength exists the following relationship:

$$\boldsymbol{E}_g = \frac{\boldsymbol{F}_G}{m_0}$$

So, the acceleration imposed to the mass by the gravitational force is:

$$\boldsymbol{a} = \frac{\boldsymbol{F}_G}{m_0}$$

Considering that the gravitational force is nothing but a special force, we can conclude that this relation can be generalized.

The relation between a force $\boldsymbol{F}$ *and the acceleration* $\boldsymbol{a}$ *that it imposes to a free particle with rest mass* m_0 *is:*

$$\boldsymbol{F} = m_0 \cdot \boldsymbol{a}$$

11. Newton's Law of Universal Gravitation

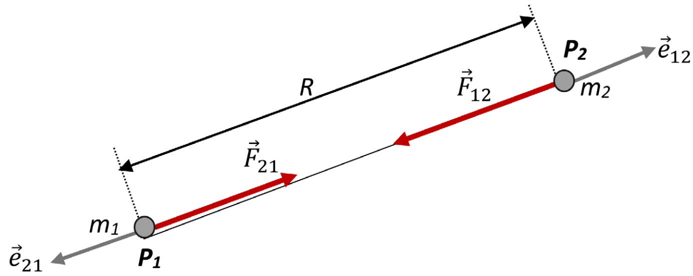

Figure 3. The gravitational interaction between two particles at rest.

In **Figure 3** we consider two particles with (rest) masses m_1 and m_2 anchored at the points P_1 and P_2 in an inertial reference frame.

1) m_1 creates and maintains a gravitational field that at P_2 is defined by the g-field:

$$\boldsymbol{E}_{g2} = -\frac{m_1}{4 \cdot \pi \cdot \eta_0 \cdot R^2} \cdot \boldsymbol{e}_{12}$$

If m_2 was free, according to the postulate of the gravitational interaction it would accelerate with an amount $\boldsymbol{a}$:

$$\boldsymbol{a} = \boldsymbol{E}_{g2}$$

So the gravitational field of m_1 exerts a "gravitational force" on m_2:

$$\boldsymbol{F}_{12} = m_2 \cdot \boldsymbol{a} = m_2 \cdot \boldsymbol{E}_{g2} = -\frac{m_1 \cdot m_2}{4 \cdot \pi \cdot \eta_0 \cdot R^2} \cdot \boldsymbol{e}_{12}$$

In a similar manner we find $\boldsymbol{F}_{21}$:

$$\boldsymbol{F}_{21} = -\frac{m_1 \cdot m_2}{4 \cdot \pi \cdot \eta_0 \cdot R^2} \cdot \boldsymbol{e}_{21} = -\boldsymbol{F}_{12}$$

This is the mathematical expression of "Newton's law of universal gravitation" [1] [2]:

The force between any two particles having masses m_1 *and* m_2 *separated by a distance R is an attraction acting along the line joining the particles and has the magnitude*

$$F = G \cdot \frac{m_1 \cdot m_2}{R^2} = \frac{1}{4\pi\eta_0} \cdot \frac{m_1 \cdot m_2}{R^2}$$

$G = \frac{1}{4\pi\eta_0}$ is a universal constant having the same value for all pairs of particles.

12. Conclusions

The phenomenon described by Newton's law of universal gravitation can perfectly be explained by the hypothesis that *g-information, i.e. information carried by informatons*, is the substance of the medium that the interaction between mass particles separated in space makes possible. On the macroscopic level, that medium, the "gravitational field", manifests itself as the vector field $\boldsymbol{E}_g$ that—according to classical physics—mediates the gravitational interactions.

Each mass particle is the source of a gravitational field: it creates and maintains a cloud of g-information that, when the particle is at rest, at an arbitrary point *P* is completely defined by the vector field $\boldsymbol{E}_g$. E_g, the magnitude at *P*, is the density of the flow of g-information at that point (the rate per unit area at which g-information at *P* flows through an elementary surface perpendicular to the direction of $\boldsymbol{E}_g$.)

A mass particle with rest mass m_0 in a gravitational field $\boldsymbol{E}_g$ generated by other particles is subjected to a tendency to accelerate with an amount $\boldsymbol{a} = \boldsymbol{E}_g$. The gravitational field exerts a force $\boldsymbol{F}$ on it: $\boldsymbol{F} = m_0 \cdot \boldsymbol{a}$.

13. Epilogue

What precedes this can be expanded to the interaction between moving particles [4] [5]. In the follow-up article "*The gravitational interaction between moving mass particles explained by the theory of informatons*" we deduce from the postulate of the emission of informatons that the gravitational field of a moving mass particle is a dual entity always having a field- and an induction-component simultaneously created by their common sources: time-variable masses and mass flows and that the gravitational interaction is the effect of the fact that an object in a gravitational field tends to become "blind" for that field by accelerating according to a Lorentz-like law.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Resnick, D. and Halliday, R. (1970) Fundamentals of Physics. John Wiley & Sons.

[2] Ohanian, H.C. (1985) Physics. W. W. Norton & Company, Inc.

[3] Angot, A. (1957) Compléments de Mathematiques. Editions de la Revue d'Optique.

[4] Acke, A. (1990) Beginselen van de informatonentheorie. Uitgeverij Nevelland.

[5] Acke, A. (2008) Gravitatie en elektromagnetisme. Uitgeverij Nevelland.