CHAPTER 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 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 $\vec{E}_g$ that has a value at every point of space and time and is thus - relative to an inertial reference frame $\boldsymbol{O}$ - regarded as a function of space and time coordinates. And each object in that field experiences a tendency to accelerate. The field theory considers the gravitational field as the entity that *mediates* in the gravitational interactions.

Newtonian gravity is further developed and extended by Oliver Heaviside[1] and Oleg Jefimenko[2]. Their work results in the *theory of gravitoelectromagnetism* (*GEM*). In GEM the description of the gravitational field is starting from the idea that it must be isomorphic with the electromagnetic one. This implies that the gravitational field must be characterized by two vectoral quantities $\vec{E}_g$ - the *gravitational field* or the *g-field* - and $\vec{B}_g$ – the *gravitational induction* or the *g-induction* - that are analogue to respectively the electric field $\vec{E}$ and the magnetic induction $\vec{B}$. The gravitational induction $\vec{B}_g$ is representative for the kinematics of the gravitating objects, a phenomenon that was not taken into account in Newtonian gravity. The starting point of GEM also implies that the relations between $\vec{E}_g$ and $\vec{B}_g$ (the GEM equations or the *Maxwell-Heaviside equations*) must be analogue to Maxwell's laws. Neither these equations nor their solutions indicate an existence of causal links between $\vec{E}_g$ and $\vec{B}_g$. Therefore, in the framework of GEM it must be concluded that a gravitational field is a dual entity always having a "field-" and an "induction-" component simultaneously created by their common sources: time-variable masses and mass flows.

Although GEM 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 relative to its magnitude and its position, and that it is able to "interpret" the information emitted by its neighbours. In this way we propose a physical foundation of GEM by introducing *information* as the substance of a gravitational field[3],[4],[5],[6],[7].

We start from the idea 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 are carrying information regarding the position ("*g-information*") and regarding the velocity ("*β-information*") of their emitter. Because they transport nothing than information, we call these entities "*informatons*". The gravitational field of a material object will, in that context, 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 describe the rules that govern the emission by a point mass that is anchored in an inertial reference frame $\boldsymbol{O}$.

The first consequence of that postulate is that a point mass at rest in $\boldsymbol{O}$ - 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 $\vec{E}_g$, the gravitational field strength, and the cloud of informatons with the gravitational field in $\boldsymbol{O}$.

A second consequence is that the informatons emitted by a point mass that is moving relative to $\boldsymbol{O}$, constitute a gravitational field in $\boldsymbol{O}$ that is characterised by two vectoral quantities: $\vec{E}_g$, the density of the g-information flow and $\vec{B}_g$, *the density of the β-information cloud*. We will show that the relations between these two quantities (the laws of GEM) - the macroscopic expressions of the kinematics of the informatons - are the gravitational analogues of Maxwell's electromagnetic laws.

Next we explain the gravitational interaction between masses 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. And finally we examine the emission of energy by an accelerating mass.

The starting point of GEM and of the theory of informatons differs fundamentally from the starting point of GRT, because space and time don't play an active role neither in the description of gravity by GEM nor in the explanation of the gravitational phenomena and laws by the theory of informatons. In those contexts space and time are elements of the description of nature that do not participate in the physical processes. We still mention that GEM has been discussed within the framework of GRT by a number of authors[8],[9],[10]. They came to the conclusion that the gravitational analogues to Maxwell's equations (the GEM equations) are valid in the weak field approximation.

References

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