CHAPTER 3

THE GRAVITATIONAL FIELD OF AN OBJECT AT REST

In what follows we will show that the emission of informatons by an object at rest macroscopically manifests itself in the *gravitational field of that object*. The substance of that gravitational field is *g-information*. The gravitational field of an object at rest is completely characterized by a vectoral quantity $\vec{E}_g$, called the *g-field*. $\vec{E}_g$ has a value at every point of space and is thus - relative to an inertial reference frame O - regarded as a function of the space coordinates. At a certain point P, $\vec{E}_g$ is *the density of the g-information flow* passing near P. The relation between $\vec{E}_g$ and the rest mass of its source (i.e. the first equation of Maxwell-Heaviside) is the expression of the law of *conservation of g-information*.

3.1 THE GRAVITATIONAL FIELD OF A PARTICLE AT REST

In fig 1 we consider a particle or point mass with rest mass m_0 that is anchored at the origin of an inertial reference frame $\boldsymbol{O}$. According to the postulate it continuously emits informatons in all directions of space.

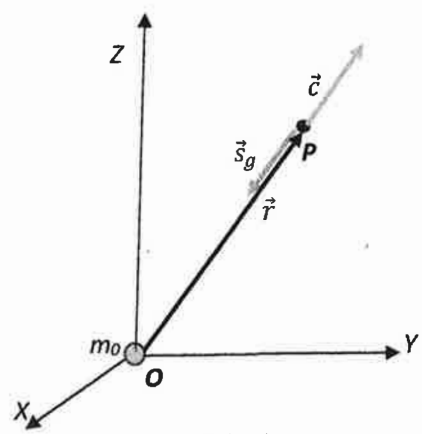

Fig 1

The informatons that with velocity

$$\vec{c} = c.\frac{\vec{r}}{r} = c.\vec{e}_r$$

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

$$\vec{s}_g = -\frac{1}{K.\eta_0}.\frac{\vec{r}}{r} = -\frac{1}{K.\eta_0}.\vec{e}_r$$

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:

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

Of course, this is also the rate at which it sends g-information through any closed surface that surrounds m_0.

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 with the speed of light from the centre O, the position of the point mass.

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 constitutes 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:*

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

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

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

This is the *density* of the flow of g-information at each point P at a distance r from m_0 (fig 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 defined by the vectoral quantity $\vec{E}_g$:

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

This quantity is the *gravitational field strength* or the *g-field strength* or the *g-field*. At any point of the gravitational field of the point mass m_0, the orientation of $\vec{E}_g$ corresponds to the orientation of the g-indices of the informatons which are passing near that point. And the magnitude of $\vec{E}_g$ is the *density of the g-information flow* at that point. Let us note that $\vec{E}_g$ is opposite to the sense of movement of the informatons.

Finally, let us consider a surface-element dS at P (fig 2,a). Its orientation and magnitude are completely determined by the surface-vector $\overrightarrow{dS}$ (fig 2,b). By $-d\Phi_G$, we represent the rate at which g-information flows through dS in the sense of the positive normal $\vec{e}_n$ and we call the scalar quantity $d\Phi_G$ the *elementary g-flux through dS*:

$$d\Phi_G = \vec{E}_g.\overrightarrow{dS} = E_g.dS.\cos\alpha$$

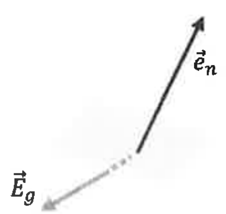

Fig 2,a

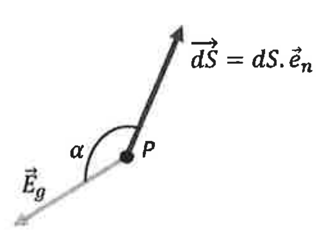

Fig 2,b

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

$$\Phi_G = \oiint \vec{E}_g \,.\, \overrightarrow{dS} = -\frac{m_0}{\eta_0}$$

This relation is the expression of the conservation of g-information in the case of a point mass at rest.

3.2 THE GRAVITATIONAL FIELD OF A SET OF PARTICLES AT REST

We consider a set of particles with rest masses $m_1,\ldots,m_i,\ldots m_n$ 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 $\vec{E}_{g1},\ldots,\vec{E}_{gi},\ldots,\vec{E}_{gn}$. $-d\Phi_g$, 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:

$$-d\Phi_G = \sum_{i=1}^{n} -(\vec{E}_{gi} \,.\, \overrightarrow{dS}) = -(\sum_{i=1}^{n} \vec{E}_{gi}).\overrightarrow{dS} = -\vec{E}_g.\overrightarrow{dS}$$

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

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

We conclude:

At a point of 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}:

$$-\oiint \vec{E}_g \,.\, \overrightarrow{dS} = \frac{m_{in}}{\eta_0}$$

This relation is the expression of the conservation of g-information in the case of a set of point masses at rest.

3.3 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 of 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:

$$\rho_G = \frac{dm}{dV}$$

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 $d\vec{E}_g$. $\vec{E}_g$, 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):

$$-\oiint_S \vec{E}_g . \overrightarrow{dS} = \frac{1}{\eta_0} . \iiint_V \rho_G . dV$$

That relation is equivalent with (theorem of Ostrogradsky[1]):

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

This is the expression of the conservation of g-information in the case of a mass continuum at rest.

Furthermore, one can show that[1],[2] $rot\vec{E}_g = 0$, what implies the existence of a gravitational potential function V_g for which:

$$\vec{E}_g = -gradV_g$$

3.4 CONCLUSION

The gravitational field of a particle at rest forms an indivisible whole with that particle. It is completely characterized by the physical quantity "gravitational field" or "g-field". This quantity is represented by the position dependent vector $\vec{E}_g$, the density of the flow of g-information at an arbitrary point P.

The substance of the gravitational field is "g-information" and its constituent element is the "informaton". This implies that the gravitational field is granular, that it continuously regenerates, that it shows fluctuations, that it expands with the speed of light, that gravitational phenomena propagate with that speed and that there is conservation of g-information at every point of the gravitational field.

References

1.**Angot, André**. *Compléments de Mathematiques*. Paris : Editions de la Revue d'Optique, 1957.

2.**Acke, Antoine.** *Gravitatie en elektromagnetisme*. Gent: Uitgeverij Nevelland, 2008