THE GRAVITATIONAL INTERACTION BETWEEN MOVING MASSES

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Abstract

In the paper GRAVITATION AND ELECTROMAGNETISM (viXra-classical physics:1001.0017), we explained the gravitational and the electromagnetic phenomena through the mediation of "informatons". We started from the hypothesis that any material object manifests itself in space by emitting informatons. These are dot-shaped entities that rush away with the speed of light carrying "information" about the position, the velocity and - if it is electrically charged - the electrical charge of the emitter. We showed that informatons constitute the gravitational and the electromagnetic fields which make the interactions possible.

In this paper we extend the theory to interactions between - electrically neutral - moving objects in relativistic situations.

Introduction

I. The postulate of the emission of informatons

With the aim to understand the gravitational phenomena we introduce a new quantity in the arsenal of physical concepts: *information.*

We suppose that information is transported by mass- and energy-less dot-shaped entities that rush with the speed of light (c) through space. We call these information carriers *informatons*.

Each material object continuously emits informatons. An informaton always carries *g-information*, which is at the root of gravitation.

The emission of informatons by a point mass (m) anchored in an inertial frame ***O***, is governed by the *postulate of the emission of informatons*.

A. *The emission* is governed by the following rules:

1. *The emission is uniform in all directions of space, and the informatons diverge at the speed of light ($c = 3.10^8$* m/s) *along radial trajectories relative to the location of the emitter.*

2. $\dot{N} = \dfrac{dN}{dt}$*, the rate at which a point-mass emits informatons, is time independent and proportional to its mass m. So, there is a constant K so that:*

$$\dot{N} = K.m$$

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

$$K = \frac{c^2}{h} = 1{,}36.10^{50}\,kg^{-1}.s^{-1}$$

B. We call the essential attribute of an informaton his *g-spin vector*. g-spin vectors are represented as $\vec{s}_g$ and defined by:

1. *The g-spin vectors are directed toward the position of the emitter.*

2. *All g-spin vectors have the same magnitude, namely:*

$$s_g = \frac{1}{K.\eta_0} = 6{,}18.10^{-60}\,m^3.s^{-1}$$

($\eta_0 = \dfrac{1}{4.\pi.G} = 1{,}19.10^{9}\,kg.s^2.m^{-3}$ with *G* the gravitational constant)

s_g, the magnitude of the g-spin-vector, is the *elementary g-information quantity.*

II. The gravitational field of a point mass at rest

In fig1 we consider an (electrically neutral) point mass that is anchored in the origin of an inertial frame. It continuously sends informatons in all directions of space.

The informatons that go through a fixed point *P* - defined by the position vector $\vec{r}$ - have two attributes: their velocity $\vec{c}$ and their g-spin vector $\vec{s}_g$:

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

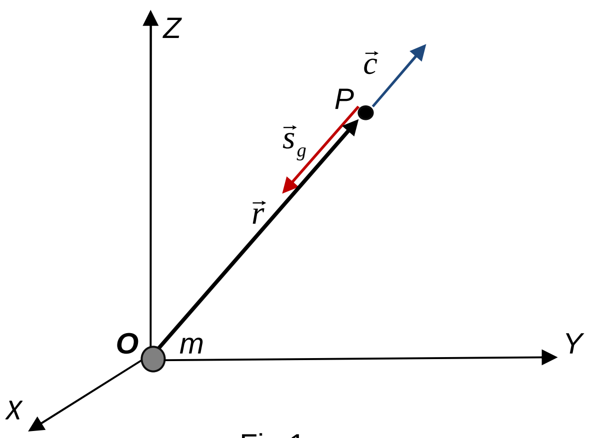

Fig 1

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:

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

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

The emission of informatons fills the space around *m* with a cloud of g-information. This cloud has the shape of a sphere whose surface goes away - at the speed of light - from the centre *O*, the position of the point mass.

- Within the cloud is a stationary state: each spatial region contains an unchanging number of informatons and thus a constant quantity of g-information. Moreover, the orientation of the g-spin vectors of the informatons passing through a fixed point is always the same.

- One can identify the cloud with a *continuum*: each spatial region contains a very large number of informatons: the g-information is like continuously spread over the extent of the region.

We call the cloud of g-information surrounding *m,* the *gravitational field* or the *g-field* of the point mass *m.*

Through any - even very small - surface in the gravitational field are rushing, without interruption, “countless” informatons: we can describe the motion of g-information through a surface as a continuous *stream* or *flow of g-information*.

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

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

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

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

This is the *density* of the flow of g-information in each point *P* at a distance *r* from *m* (fig 1). This quantity is, together with the orientation of the g-spin vectors of the informatons passing in the vicinity of *P,* characteristic for het gravitational field at that point.

Thus, the gravitational field of the point mass *m* is, in a point *P,* fully defined by the vectorial quantity $\vec{E}_g$:

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

We call this quantity the *gravitational field strength* or the *g-field strenght*. In any point of the gravitational field of the point mass *m*, the orientation of $\vec{E}_g$ corresponds with the orientation of the g-spin-vectors of the informatons who are passing by in the vicinity of that point. And the magnitude of $\vec{E}_g$ is the *density of the g-information flow* in that point. Let us note that $\vec{E}_g$ is opposite to the sense of movement of the informatons.

I. THE GRAVITATIONAL FIELD OF A MOVING POINT MASS

1.1. Rest mass and relativistic mass

In fig 2, we consider a point mass that moves along the *Z*-axis of an inertial reference frame ***O*** with constant velocity $\vec{v} = v.\vec{e}_z$. At the moment *t = 0*, it passes through the origin *O* and at the moment *t = t* through the point P_1.

> *We posit that $\dot{N}$ - the rate at which a point mass emits informatons in the space connected to **O** - is determined by its rest mass m_0 and independent of its motion:*
>
> $$\dot{N} = \frac{dN}{dt} = K.m_0$$

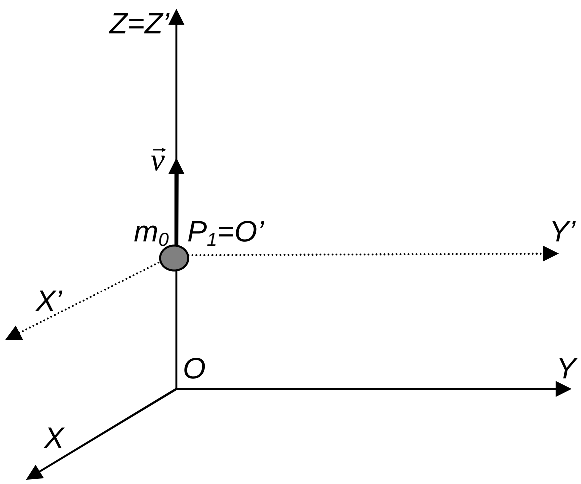

Fig 2

That implies that - if the time is read on a standard clock anchored in ***O*** - the number of informatons that is emitted in the space connected to ***O*** during the interval *dt* by a, whether or not moving, point mass is:

$$dN = K.m_0.dt$$

We can the space-time also connect to an inertial reference frame ***O'*** (fig 4) which origin is anchored to the point mass and that is running away relative to ***O*** with the velocity $\vec{v} = v.\vec{e}_z$. We assume that *t = t' = 0* when the mass passes in ***O*** (*t* is the time read on a standard clock in ***O*** and t' the time read on a standard clock in ***O'***). We determine the time that expires while the moving point mass emits *dN* informatons.

1. An observer in ***O*** uses therefore a standard clock that is linked to that reference frame. The emission of *dN* informatons takes *dt* seconds. The relationship between *dN* and *dt* is:

$$dN = K.m_0.dt$$

2. To determine the duration of the same phenomenon, an observer in ***O'*** uses a standard

clock that is linked to the frame ***O'***. According to that clock - that moves relative to ***O*** - the emission of *dN* informatons takes *dt'* seconds. We call ***O'*** the "eigen inertial frame" of the moving mass en *dt'* the "eigen duration" of the phenomenon.

(*x, y, z; t*) - the coordinates of an event connected to ***O*** - and (*x', y', z'; t'*) - the coordinates of the same event connected to ***O'*** - are related by the Lorentz-transformation:

$x' = x$	$x = x'$
$y' = y$	$y = y'$
$z' = \dfrac{z - vt}{\sqrt{1-\beta^2}}$	$z = \dfrac{z' + vt'}{\sqrt{1-\beta^2}}$
$t' = \dfrac{t - \frac{v}{c^2}z}{\sqrt{1-\beta^2}}$	$t = \dfrac{t' + \frac{v}{c^2}z'}{\sqrt{1-\beta^2}}$

The relationship between *dt* and *dt'* is:

$$dt = \frac{dt'}{\sqrt{1-\beta^2}} \quad \text{with} \quad \beta = \frac{v}{c}$$

So:

$$dN = K.m_0.dt = K.m_0.\frac{dt'}{\sqrt{1-\beta^2}} = K.\frac{m_0}{\sqrt{1-\beta^2}}.dt' = \frac{\dot{N}}{\sqrt{1-\beta^2}}.dt'$$

and:

$$\frac{dN}{dt'} = \frac{\dot{N}}{\sqrt{1-\beta^2}} = K.\frac{m_0}{\sqrt{1-\beta^2}} = K.m \quad \text{with} \quad m = \frac{m_0}{\sqrt{1-\beta^2}}$$, de "relativistic mass"

Conclusion: *The rate at which a point mass, moving with constant velocity relative to an inertial reference frame* ***O****, emits informatons in the space linked to* ***O*** *is determined by its relativistic mass if the time is read on a standard clock that is anchored to the mass.*

1.2. The field strength caused by a uniform rectilinear moving point mass

In fig 3,a, we consider again a point mass with rest mass m_0 that moves along the *Z*-axis of an inertial reference frame ***O*** with constant velocity $\vec{v} = v.\vec{e}_z$. At the moment *t = 0*, it passes through the origin *O* and at the moment *t = t* through the point P_1. It is evident that:

$$OP_1 = z_{P_1} = v.t$$

m_0 continuously emits informatons that, with the speed of light, rush away with respect to the point where the mass is at the moment of emission. We wish to determine the density of the flow of g-information - this is the field strength $\vec{E}_g$ - in a fixed point *P*. The position of *P* relative to the reference frame ***O*** is determined by the time independent Cartesian coordinates (*x, y, z)*, or by the time dependent position vector $\vec{r} = \overrightarrow{P_1P}$. ϑ is the angle between $\vec{r}$ and the *Z*-axis.

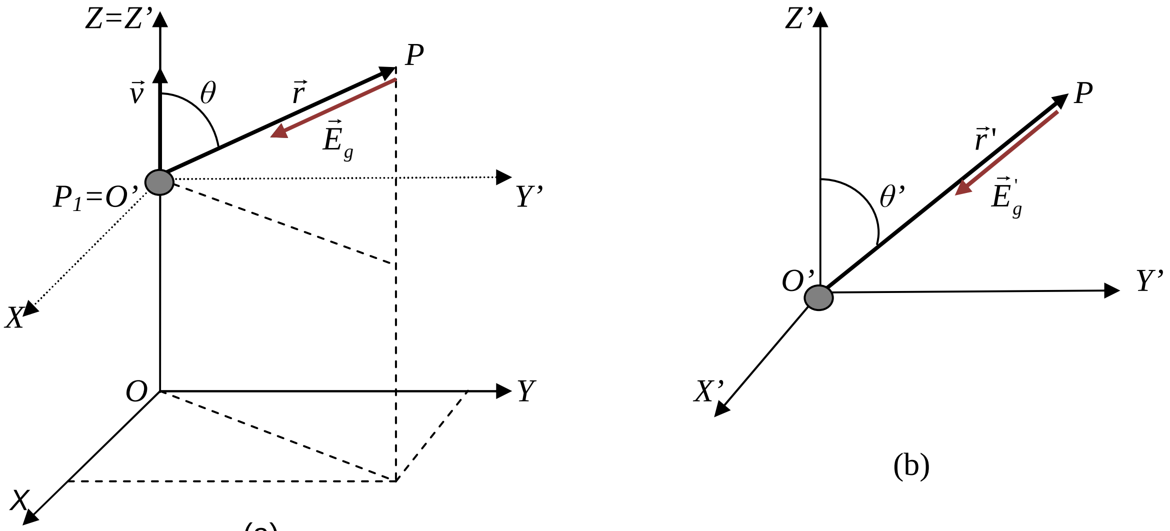

Fig. 3

We start with the description of the flow of g-information relative to the inertial reference frame ***O'*** that is anchored at the point mass and that at the moment *t = t' = 0* coincides with ***O*** (fig 3,b).

When we read the time on a standard clock connected to ***O'***, the emission of *dN* informatons takes a time interval *dt'.* In the space linked to that frame, the spin vector of each informaton points to the origin *O'* and its magnitude is the the elementary g-information quantity s_g. Indeed in ***O'*** the point mass is at rest, so the spin vectors of the informatons are determined by rule B of the postulate of the emission of informatons:

$$\vec{s}_g = -s_g.\frac{\vec{r}\,'}{r'} = -\frac{1}{K.\eta_0}.\frac{\vec{r}\,'}{r'}$$

So, the density of the flow of g-information relative to ***O'*** is at the moment *t* in the point *P*:

$$\vec{E}_g^{\,'} = -\frac{\frac{dN}{dt'}.s_g}{4\pi r'^3}.\vec{r}\,'$$

The position of *P* relative to ***O'*** is determined by the time dependent Cartesian coordinates (*x', y',z'*) or by the position vector $\vec{r}\,'$.

The components of $\vec{E}_g^{\,'}$ in *O'X'Y'Z'*, namely:

$$E'_{gx'} = -\frac{\frac{dN}{dt'}.s_g}{4\pi r'^3}.x' \qquad E'_{gy'} = -\frac{\frac{dN}{dt'}.s_g}{4\pi r'^3}.y' \qquad E'_{gz'} = -\frac{\frac{dN}{dt'}.s_g}{4\pi r'^3}.z'$$

determine in *P* the densities of the flows of g-information respectively through a surface element *dy'.dx'* perpendicular to the *X'*-axis, through a surface element *dz'.dx'* perpendicular to the *Y'*-axis and through a surface element *dx'.dy'* perpendicular to the *Z'*-axis.

The amounts of g-information, that the point mass during the time interval *dt'* sends through those different surface elements in *P*, is.

$$E'_{gx'}.dy'.dz'.dt' = -\frac{\frac{dN}{dt'}.s_g.x'}{4\pi r'^3}.dy'.dz'.dt'$$
$$E'_{gy'}.dz'.dx'.dt' = -\frac{\frac{dN}{dt'}.s_g.y'}{4\pi r'^3}.dz'.dx'.dt'$$
$$E'_{gz'}.dx'.dy'.dt' = -\frac{\frac{dN}{dt'}.s_g.z'}{4\pi r'^3}.dx'.dy'.dt'$$

The Cartesian coordinaties of *P* in the frames ***O*** and ***O'*** are connected by:

$x' = x$ $\qquad$ $y' = y$ $\qquad$ $z' = \frac{z - v.t}{\sqrt{1-\beta^2}} = \frac{z - z_{P_1}}{\sqrt{1-\beta^2}}$

And the line elements by:

$dx' = dx$ $\qquad$ $dy' = dy$ $\qquad$ $dz' = \frac{dz}{\sqrt{1-\beta^2}}$

Further: $dt' = dt.\sqrt{1-\beta^2}$; $\qquad \frac{dN}{dt'} = \frac{\frac{dN}{dt}}{\sqrt{1-\beta^2}} = \frac{\dot{N}}{\sqrt{1-\beta^2}}$ $\qquad$ and[1]: $r' = r.\frac{\sqrt{1-\beta^2.\sin^2\theta}}{\sqrt{1-\beta^2}}$

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[1] In ***O*** is: $r = \sqrt{x^2 + y^2 + (z - z_{P_1})^2}$, $\sin\theta = \frac{\sqrt{x^2+y^2}}{r}$ and $\cos\theta = \frac{z - z_{P_1}}{r}$.

And in ***O'***: $r' = \sqrt{x'^2 + y'^2 + z'^2}$ and $\sin\theta' = \frac{\sqrt{x'^2+y'^2}}{r'}$.

We express *r'* in function of *x*, *y* en *z*:

$$r' = \sqrt{x^2 + y^2 + \frac{(z - z_{P1})^2}{(1-\beta^2)}} = \sqrt{r^2.\sin^2\theta + \frac{(z-z_{P1})^2}{1-\beta^2}} = \frac{\sqrt{r^2.\sin^2\theta.(1-\beta^2) + r^2.\cos^2\theta}}{\sqrt{1-\beta^2}} = r\frac{\sqrt{1-\beta^2.\sin^2\theta}}{\sqrt{1-\beta^2}}$$

So relative to ***O***, the amounts of g-information that the moving mass during the time interval *dt* sends - in the positive direction - through the surface elements *dy.dz*, *dz.dx* and *dx.dy* in *P* are:

$$-\frac{\dot{N}.s_g}{4\pi r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.x.dy.dz.dt$$

$$-\frac{\dot{N}.s_g}{4\pi r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.y.dz.dx.dt$$

$$-\frac{\dot{N}.s_g}{4\pi r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.(z-z_{P_1}).dx.dy.dt$$

Finally, taking into account that $\dot{N}.s_g = \frac{m_0}{\eta_0}$, we find the densities in *P* of the flows of g-information in the direction of the *X*-, the *Y*- and the *Z*-axis. This are the components of the field strength in *P* caused by the moving point mass m_0:

$$E_{gx} = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.x$$

$$E_{gy} = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.y$$

$$E_{gz} = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.(z-z_{P_1})$$

The field strength caused by the moving point mass in the fixed point *P* is:

$$\boxed{\vec{E}_g = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.\vec{r} = -\frac{m_0}{4\pi\eta_0 r^2}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.\vec{e}_r}$$

We conclude: *A point mass describing a uniform rectilinear movement - relative to an inertial reference frame **O** - creates a time dependent g-field in the space linked to that frame.* $\vec{E}_g$*, the g-field strength in an arbitrary point P, points at any time to the position of the mass at that moment and its magnitude is:*

$$E_g = \frac{m_0}{4\pi\eta_0 r^2}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}$$

If the speed of the mass is much smaller than the speed of light, this expression reduces itself to this valid in the case of a mass at rest. This result could also been obtained if one assumes that the displacement of the point mass during the time interval that the informatons need to move from the emitter to *P* can be neglected compared to the distance they travel during that period.

The orientation of the field strength implies that the spin vectors of the informatons that at a certain moment pass through P, point to the position of the emitting mass at that moment.

The points where E_g - at the moment *t* - has a certain magnitude satisfy the relation:

$$r^2 = \frac{m_0}{4\pi\eta_0 E_g} \cdot \frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}$$

If the mass is at rest, this equation defines a sphere: the gravitational field of a point mass at rest shows spherical symmetry relative to the position of the mass.

If the mass moves with constant velocity, this equation defines a surface of revolution with the *Z*-axis (this is the path of the mass) as symmetry-axis. The faster the mass moves, the more the surface differs from a sphere. The dimension in the direction of the movement is reduced by a factor ($1 - \beta^2$), and that perpendicular on the movement is increased by a factor $\frac{1}{\sqrt{1-\beta^2}}$.

1.3. The emission of informatons by a point mass that describes a uniform rectilinear motion

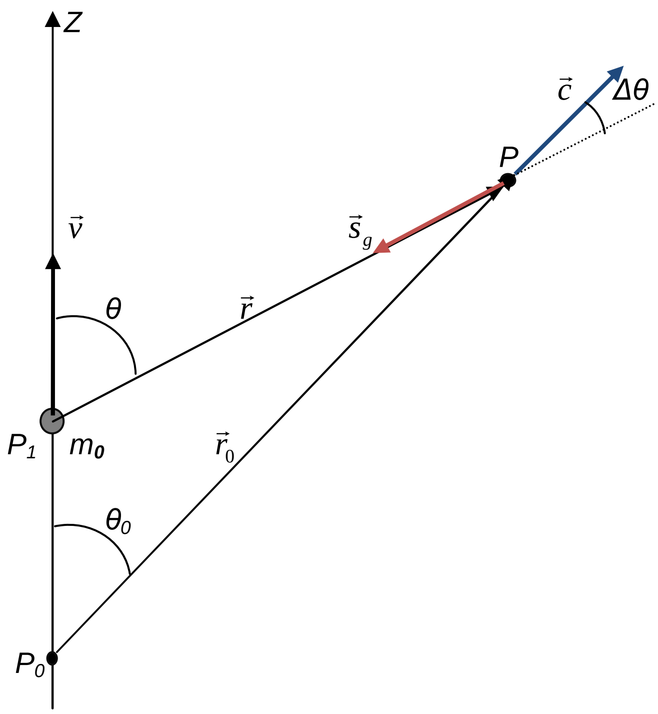

Fig 4

In fig 4 we consider a point mass m_0 that moves with a constant velocity $\vec{v}$ along the *Z*-axis of an inertial frame. Its instantaneous position (at the arbitrary moment *t*) is P_1.

The position of *P*, an arbitrary fixed point in space, is defined by the vector $\vec{r} = \overrightarrow{P_1P}$. The position vector $\vec{r}$ - just like the distance *r* and the angle *θ* - is time dependent because the position of P_1 is constantly changing.

The informatons that - with the speed of light - pass at the moment *t* through *P*, are emitted when m_0 was at P_0. Bridging the distance $P_0P = r_0$ took the time interval Δt:

$$\Delta t = \frac{r_0}{c}$$

During their rush from P_0 to *P*, the mass moved over the distance from P_0 to P_1:

$$P_0P_1 = v.\Delta t$$

- The velocity of the informatons $\vec{c}$ is oriented along the path they follow, thus along the radius P_0P.

- Their g-spin vector $\vec{s}_g$ points to P_1, the position of m_0 at the moment *t*. This is an implication of rule B.1 of the postulate of the emission of informatons.

The lines who carry $\vec{s}_g$ and $\vec{c}$ form an angle $\Delta\theta$. We call this angle, *that is characteristic for the speed of the point mass*, the *characteristic angle*.

The quantity $s_\beta = s_g.\sin(\Delta\theta)$ is called the *characteristic g-information* or the *β-information* of an information.

We posit *that informatons emitted by a moving point mass transport information about the velocity of the mass.* This information is represented by the *gravitational characteristic vector* or *β-vector* $\vec{s}_\beta$ *which is defined by:*

$$\boxed{\vec{s}_\beta = \frac{\vec{c} \times \vec{s}_g}{c}}$$

- The β-vector is perpendicular to the plane formed by the path of the informaton and the straight line that carries the g-spin vector, thus perpendicular to the plane formed by the point *P* and the path of the mass.

- Its orientation relative tot that plane is defined by the “rule of the corkscrew”: in the case of fig 6, the β-vectors have the orientation of the positive *X*-axis.

- Its magnitude is: $s_\beta = s_g.\sin(\Delta\theta)$, the β-information of the information.

We apply the sine rule to the triangle P_0P_1P:

$$\frac{\sin(\Delta\theta)}{v.\Delta t} = \frac{\sin\theta}{c.\Delta t}$$

It follows:

$$s_\beta = s_g.\frac{v}{c}.\sin\theta = s_g.\beta.\sin\theta = s_g.\beta_\perp$$

$\beta_\perp$ is the component of the dimensionless velocity $\vec{\beta} = \frac{\vec{v}}{c}$ perpendicular to $\vec{s}_g$.

Taking into account the orientation of the different vectors, the β-vector of an information emitted by a point mass with constant velocity can also be expressed as:

$$\vec{s}_\beta = \frac{\vec{v}\times\vec{s}_g}{c}$$

1.4. The gravitational induction of a point mass describing a uniform rectilinear motion

We consider again the situation of fig 4. All informatons in *dV* - the volume element in *P* - carry both g-information and β-information. The β-information is related to the velocity of the emitting mass and represented by the characteristic vectors $\vec{s}_\beta$:

$$\vec{s}_\beta = \frac{\vec{c}\times\vec{s}_g}{c} = \frac{\vec{v}\times\vec{s}_g}{c}$$

If *n* is the density of the cloud of informatons at *P* (number of informatons per unit volume) at the moment *t*, the amount of β-information in *dV* is determined by the magnitude of the vector:

$$n.\vec{s}_\beta.dV = n.\frac{\vec{c}\times\vec{s}_g}{c}.dV = n.\frac{\vec{v}\times\vec{s}_g}{c}.dV$$

And the density of the β-information (characteristic information per unit volume) in *P* is determined by:

$$n.\vec{s}_\beta = n.\frac{\vec{c}\times\vec{s}_g}{c} = n.\frac{\vec{v}\times\vec{s}_g}{c}$$

We call this (time dependent) vectorial quantity - that will be represented by $\vec{B}_g$ - the *gravitational induction* or the *g-induction* in *P:*

- Its magnitude B_g determines the density of the β-information in *P.*

- Its orientation determines the orientation of the β-vectors $\vec{s}_\beta$ at that point.

So, the g-induction caused in *P* by the moving mass m_0 (fig 4) is:

$$\vec{B}_g = n.\frac{\vec{v}\times\vec{s}_g}{c} = \frac{\vec{v}}{c}\times(n.\vec{s}_g)$$

N - the density of the flow of informatons in *P* (the rate per unit area at which the informatons cross an elementary surface perpendicular to the direction of movement) - and *n* - the density of the cloud of informatons in *P* (number of informatons per unit volume) - are connected by the relation:

$$n = \frac{N}{c}$$

With:

$$\vec{E}_g = N.\vec{s}_g$$

we can express the gravitational induction in *P* as:

$$\vec{B}_g = \frac{\vec{v}}{c^2}\times(N.\vec{s}_g) = \frac{\vec{v}\times\vec{E}_g}{c^2}$$

Taking into account (3.2):

$$\vec{E}_g = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.\vec{r}$$

We find:

$$\vec{B}_g = -\frac{m_0}{4\pi\eta_0 c^2.r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.(\vec{v}\times\vec{r})$$

We define the constant $\nu_0 = 9{,}34.10^{-27}\ m.kg^{-1}$ as:

$$\nu_0 = \frac{1}{c^2.\eta_0}$$

And finally obtain:

$$\boxed{\vec{B}_g = \frac{\nu_0.m_0}{4\pi r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.(\vec{r}\times\vec{v})}$$

$\vec{B}_g$ in *P* is perpendicular to the plane formed by *P* and the path of the point mass; its orientation is defined by the rule of the corkscrew; and its magnitude is:

$$B_g = \frac{\nu_0.m_0}{4\pi r^2}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.v.\sin\theta$$

If the speed of the mass is much smaller than the speed of light, this expression reduces itself to:

$$\vec{B}_g = \frac{\nu_0.m}{4\pi r^3}.(\vec{r}\times\vec{v})$$

This result could also been obtained if one assumes that the displacement of the point mass during the time interval that the informatons need to move from the emitter to *P* can be neglected compared to the distance they travel during that period.

1.5. The gravitational field of a point mass describing a uniform rectilinear motion

A point mass m_0, moving with constant velocity $\vec{v} = v.\vec{e}_z$ along the *Z*-axis of an inertial frame, creates and maintains a cloud of informatons that are carrying both g- and β-information. That cloud can be identified with a time dependent continuum. That continuum is called the *gravitational field of* the point mass. It is characterized by two time dependent vectorial quantities: the gravitational field strength (short: *g-field*) $\vec{E}_g$ and the gravitational induction (short*: g-induction*) $\vec{B}_g$.

- With *N* the density of the flow of informatons in *P* (the rate per unit area at which the informatons cross an elementary surface perpendicular to the direction of movement), the g-field at that point is:

$$\vec{E}_g = N.\vec{s}_g = -\frac{m_0}{4\pi\eta_0 r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.\vec{r}$$

- With *n,* the density of the cloud of informatons in *P* (number of informatons per unit volume), the g-induction at that point is:

$$\vec{B}_g = n.\vec{s}_\beta = \frac{\nu_0.m_0}{4\pi r^3}.\frac{1-\beta^2}{(1-\beta^2.\sin^2\theta)^{\frac{3}{2}}}.(\vec{r}\times\vec{v})$$

One verifies that:

1. $div\vec{E}_g = 0$
2. $div\vec{B}_g = 0$
3. $rot\vec{E}_g = -\frac{\partial\vec{B}_g}{\partial t}$
4. $rot\vec{B}_g = \frac{1}{c^2}.\frac{\partial\vec{E}_g}{\partial t}$

And that, if *v* << *c,* the expressions for the g-field and the g-induction reduce to:

$$\vec{E}_g = -\frac{m_0}{4\pi\eta_0 r^3}.\vec{r} \qquad \text{and} \qquad \vec{B}_g = \frac{\nu_0.m_0}{4\pi r^3}.(\vec{r}\times\vec{v})$$

1.6. The gravitational field of a set of point masses describing uniform rectilinear motions

We consider a set of point masses $m_1,\ldots,m_i,\ldots m_n$ which move with constant velocities $\vec{v}_1,\ldots,\vec{v}_i,\ldots,\vec{v}_n$ in an inertial frame. This set creates and maintains a gravitational field that in each point of space is characterised by the vector pair ($\vec{E}_g$, $\vec{B}_g$) .

- Each mass m_i emits continuously g-information and contributes with an amount $\vec{E}_{gi}$ to the g-field at an arbitrary point *P*. As in I.3 we conclude that the effective g-field $\vec{E}_g$ in *P* is defined as:

$$\boxed{\vec{E}_g = \sum \vec{E}_{gi}}$$

- If it is moving, each mass m_i emits also β-information, thereby contributing to the g-induction in *P* with an amount $\vec{B}_{gi}$. It is evident that the β-information in the volume element *dV* in *P* at each moment *t* is expressed by:

$$\sum(\vec{B}_{gi}.dV) = (\sum \vec{B}_{gi}).dV$$

Thus, the effective g-induction $\vec{B}_g$ in *P* is:

$$\boxed{\vec{B}_g = \sum \vec{B}_{gi}}$$

The relations mentioned in the previous section remain valid for the effective g-field and induction.

1.7. The gravitational field of a stationary mass flow

The term "stationary mass flow" indicates the movement of a homogeneous and incompressible fluid that in an invariable way flows through a region of space.

The intensity of the flow in an arbitrary point *P* is characterised by the flow density $\vec{J}_G$. The magnitude of this vectorial quantity equals the rate per unit area at which the mass flows through a surface element that is perpendicular to the flow at *P*. The orientation of $\vec{J}_G$ corresponds to the direction of that flow. If $\vec{v}$ is the velocity of the mass element $\rho_G.dV$ that at the moment *t* flows through *P*, then:

$$\vec{J}_G = \rho_G.\vec{v}$$

The rate at which mass flows through a surface element $\overrightarrow{dS}$ in *P* in the sense of the positive normal, is given by:

$$di_G = \vec{J}_G.\overrightarrow{dS}$$

And the rate at which the flow transports - in the positive sense (defined by the orientation of the surface vectors $\overrightarrow{dS}$) - mass through an arbitrary surface *ΔS*, is:

$$i_G = \iint_{\Delta S} \vec{J}_G.\overrightarrow{dS}$$

We call i_G the *intensity of the mass flow through ΔS.*

Since a stationary mass flow is the macroscopic manifestation of moving mass elements $\rho_G.dV$, it creates and maintains a gravitational field. And since the velocity $\vec{v}$ of the mass element in each point is time independent, *the gravitational field of a stationary mass flow will be time independent*.

It is evident that the rules of 1.4 also apply for this time independent g-field:

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

- $rot\vec{E}_g = 0$ what implies: $\vec{E}_g = -gradV_g$

One can prove that the rules for the time independent g-induction are:

- $div\vec{B}_g = 0$ what implies $\vec{B}_g = rot\vec{A}_g$

- $rot\vec{B}_g = -\nu_0.\vec{J}_G$

1.8. The laws of the gravitational field

We have shown that moving (inclusive rotating) masses create and maintain a gravitational field, that in each point of space is characterised by two time dependent vectors: the (effective) g-field $\vec{E}_g$ and the (effective) g-induction $\vec{B}_g$.

The informatons that - at the moment *t* - pass in the direct vicinity of *P* with velocity $\vec{c}$ contribute with an amount ($N.\vec{s}_g$) to the instantaneous value of the g-field and with an amount ($n.\vec{s}_\beta$) to the instantaneous value of the g-induction in that point.

- $\vec{s}_g$ and $\vec{s}_\beta$ respectively are their g-spin vectors and their β-vectors. They are linked by the relationship:

$$\vec{s}_\beta = \frac{\vec{c} \times \vec{s}_g}{c}$$

- N is the instantaneous value of the density of the flow of informatons with velocity $\vec{c}$ at *P* and *n* is the instantaneous value of the density of the cloud of those informatons in that point. *N* and *n* are linked by the relationschip:

$$n = \frac{N}{c}$$

One can prove that in a **matter free** point of a gravitational field $\vec{E}_g$ en $\vec{B}_g$ obey the following laws:

1. $div\vec{E}_g = 0$

2. $div\vec{B}_g = 0$

3. $rot\vec{E}_g = -\frac{\partial \vec{B}_g}{\partial t}$

4. $rot\vec{B}_g = \frac{1}{c^2}.\frac{\partial \vec{E}_g}{\partial t}$

The first law expresses the *conservation of g-information*, the second the fact that the β-vector of an informaton is always perpendicular to its g-spin vector and to its velocity. Laws 3 and 4 express that a local fluctuation of $\vec{B}_g$ ($\vec{E}_g$) is always related to a spatial change of $\vec{E}_g$ ($\vec{B}_g$).

A mass element at a point *P* in a mass continuum is always an emittor of g-information, and - - if it moves - also a source of β-information. The instantaneous value of ρ_G at *P* contributes with an amount $-\frac{\rho_G}{\eta_0}$ to the instantaneous value of $div\vec{E}_g$ at that point. And the contribution of the instantaneous value of $\vec{J}_G$ to $rot\vec{B}_g$ is $-\nu_0.\vec{J}_G$. In an **arbitrary point** of a gravitational field the previous laws become:

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

2. $div\vec{B}_g = 0$

3. $rot\vec{E}_g = -\frac{\partial \vec{B}_g}{\partial t}$

4. $rot\vec{B}_g = \frac{1}{c^2}.\frac{\partial \vec{E}_g}{\partial t} - \nu_0.\vec{J}_G$

These are the *gravitational analogues of Maxwell laws.*

II. THE GRAVITATIONAL INTERACTION BETWEEN MOVING POINT MASSES

We consider a number of point masses moving relative to an inertial reference frame ***O***. They create and maintain a gravitational field that in each point of the space linked to ***O*** is defined by the vectors $\vec{E}_g$ and $\vec{B}_g$.
Each mass is "immersed" in a cloud of informatons carrying both g- and β-information. In each point, except its own position, each mass contributes to the construction of that cloud.

Let us consider the mass *m* that, at the moment *t*, goes through the point *P* with velocity $\vec{v}$.

- If the other masses were not there, the g-field in the vicinity of *m* (the "eigen" g-field of *m*) should be symmetric relative to the carrier of the vector $\vec{v}$. Indeed, the g-spin vectors of the informatons emitted by *m* during the interval (*t* - *Δt*, *t* + *Δt*) are all directed to that line. In reality that symmetry is disturbed by the g-information that the other masses send to *P*. $\vec{E}_g$, the instantaneous value of the g-field in *P,* defines the extent to which this occurs.

- If the other masses were not there, the β-field in the vicinity of *m* (the "eigen" β-field of *m*) should "rotate" around the carrier of the vector $\vec{v}$. The vectors of the vector field defined by the vector product of $\vec{v}$ with de g-induction that characterizes the "eigen" β-field of *m,* should - as $\vec{E}_g$ - be symmetric relative to the carrier of the vector $\vec{v}$. In reality this symmetry is disturbed by the β-information send to *P* by the other masses. The vector product $(\vec{v}\times\vec{B}_g)$ of the instantaneous values of the velocity of *m* and the g-induction at *P*, defines the extent to which this occurs.

If it was free to move, the point mass *m* could restore the specific symmetry in its direct vicinity by accelerating with an amount $\vec{a}'=\vec{E}_g+(\vec{v}\times\vec{B}_g)$ relative to its "eigen" inertial frame*.
In that manner it should become "blind" for the disturbance of symmetry of het gravitational field in its direct vicinity.

These insights form the basis of the following postulate.

2.1. The postulate of the gravitational action

A point mass m, moving in a gravitational field ($\vec{E}_g,\vec{B}_g$) with velocity $\vec{v}$, tends to become blind for the influence of that field on the symmetry of its eigen field. If it is free to move, it will accelerate relative to its "eigen" inertial reference frame with an amount $\vec{a}'$:

$$\vec{a}'=\vec{E}_g+(\vec{v}\times\vec{B}_g)$$

* The "eigen" inertial frame of the point mass *m* is the reference frame that at the moment *t* moves relative to ***O*** with the same velocity as *m*.

2.2. The gravitational force

The action of the gravitational field ($\vec{E}_g, \vec{B}_g$) on a moving point mass *m* (velocity $\vec{v}$) is called the *gravitational force* $\vec{F}_G$ on *m.* We define• $\vec{F}_G$ as:

$$\boxed{\vec{F}_G = m_0.\left[\vec{E}_g + (\vec{v} \times \vec{B}_g)\right]}$$

m_0 is the rest mass of the point mass: it is the mass that determines its rate of the emission of informatons within any reference frame.

The acceleration $\vec{a}'$ of the point mass relative to the eigen reference frame ***O'*** can be decomposed in a tangential ($\vec{a}_T^{'}$) and a normal component ($\vec{a}_N^{'}$).

$$\vec{a}_T^{'} = a_T^{'}.\vec{e}_T \qquad \text{en} \qquad \vec{a}_N^{'} = a_N^{'}.\vec{e}_N$$

$\vec{e}_T$ and $\vec{e}_N$ are the unit vectors, respectively along the tangent and along the normal to the path of the point mass in ***O'*** (and in ***O***).

We express $a_T^{'}$ en $a_N^{'}$ in function of the characteristics of the motion in the reference system ***O***:

$$a_T^{'} = \frac{1}{(1-\beta^2)^{\frac{3}{2}}}.\frac{dv}{dt} \qquad \text{and} \qquad a_N^{'} = \frac{v^2}{R.\sqrt{1-\beta^2}}$$

(If *R* is the curvature of the path in ***O***, the curvature in ***O'*** is $R\sqrt{1-\beta^2}$.)

The gravitational force is:

$$\vec{F}_G = m_0.\vec{a}' = m_0.(a_T^{'}.\vec{e}_T + a_N^{'}.\vec{e}_N) = m_0.\left[\frac{1}{(1-\beta^2)^{\frac{3}{2}}}.\frac{dv}{dt}.\vec{e}_T + \frac{1}{(1-\beta^2)^{\frac{1}{2}}}.\frac{v^2}{R}.\vec{e}_N\right] = \frac{d}{dt}\left[\frac{m_0}{\sqrt{1-\beta^2}}.\vec{v}\right]$$

Finally, with:

$$\frac{m_0}{\sqrt{1-\beta^2}}.\vec{v} = \vec{p}$$

We obtain:

$$\boxed{\vec{F}_G = \frac{d\vec{p}}{dt}}$$

• GRAVITATION AND ELECTROMAGNETISM (viXra 1001.0012) - §4.2

$\vec{p}$ is the linear momentum of the point mass relative to the inertial reference frame ***O***. It is the product of its relativistic mass $m = \dfrac{m_0}{\sqrt{1-\dfrac{v^2}{c^2}}}$ with its velocity $\vec{v}$ in ***O***.

The linear momentum of a moving point mass is a measure for its inertia, for its ability to persist in its dynamic state.

2.3. The equivalence mass-energy

The instantaneous value of the linear momentum $\vec{p} = m.\vec{v}$ of the point mass m_0, that freely moves relative to the inertial reference frame ***O***, and the instantaneous value of the force $\vec{F}$ that acts on it, are related by:

$$\vec{F} = \frac{d\vec{p}}{dt}$$

The elementary vectorial displacement $d\vec{r}$ of m_0 during the elementary time interval *dt* is:

$$d\vec{r} = \vec{v}.dt$$

And the elementary work done by $\vec{F}$ during *dt* is:

$$dW = \vec{F}.\overrightarrow{dr} = \vec{F}.\vec{v}.dt = \vec{v}.d\vec{p}$$

With $\vec{p} = m.\vec{v} = \dfrac{m_0}{\sqrt{1-(\frac{v}{c})^2}}.\vec{v}$, this becomes:

$$dW = \frac{m_0.v.dv}{\left[1-(\frac{v}{c})^2\right]^{\frac{3}{2}}} = d\left[\frac{m_0}{\sqrt{1-(\frac{v}{c})^2}}.c^2\right] = d(m.c^2)$$

The work done on the moving point mass equals, by definition, the increase of the energy of the mass. So, $d(m.c^2)$ is the increase of the energy of the mass and $m.c^2$ is the energy represented by the mass.

We conclude: *A point mass with relativistic mass m is equivalent to an amount of energy of* $m.c^2$.

2.3. The interaction between two uniform linear moving point masses

The point masses m_1 and m_2 (fig 7) are anchored in the inertial frame ***O'*** that is moving relative to the inertial frame ***O*** with constant velocity $\vec{v} = v.\vec{e}_z$. The distance between the masses is *R*.

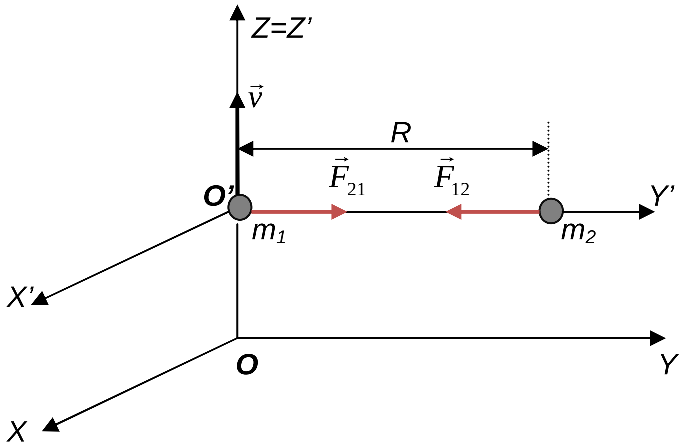

Fig 7

In ***O'*** the masses don't move. They are immersed in each other's g-information cloud and they attract - according Newton's law of gravitation - one another with an equal force:

$$F' = F_{12}^{'} = F_{21}^{'} = m_2.E_{g2}^{'} = m_1.E_{g1}^{'} = \frac{1}{4.\pi.\eta_0}.\frac{m_1.m_2}{R^2}$$

In the frame ***O*** both masses are moving in the direction of the *Z*-axis with the speed *v*. The gravitational field of a moving mass is characterized by the vector pair ($\vec{E}_g, \vec{B}_g$) and, according to 4. 3 the mutual attraction is:

$$F = F_{12} = F_{21} = m_2.(E_{g2} - v.B_{g2}) = m_1.(E_{g1} - v.B_{g1})$$

From 3.5 follows:

$$E_{g1} = \frac{m_2}{4\pi\eta_0 R^2}.\frac{1}{\sqrt{1-\beta^2}} \quad \text{and} \quad E_{g2} = \frac{m_1}{4\pi\eta_0 R^2}.\frac{1}{\sqrt{1-\beta^2}}$$

and:

$$B_{g1} = \frac{m_2}{4\pi\eta_0 R^2}.\frac{1}{\sqrt{1-\beta^2}}.\frac{v}{c^2} \quad \text{and} \quad B_{g2} = \frac{m_1}{4\pi\eta_0 R^2}.\frac{1}{\sqrt{1-\beta^2}}.\frac{v}{c^2}$$

Substitution gives:

$$F_{12} = F_{21} = \frac{1}{4\pi\eta_0}.\frac{m_1 m_2}{R^2}.\sqrt{1-\beta^2}$$

We can conclude that the component of the gravitational force due to the g-induction is β^2 times smaller than that due to the g-field.

This implies that, for speeds much smaller than the speed of light, the effects of het β-information are masked.

The β-information emitted by the rotating sun is neglected by the classical theory of gravitation: it is responsible for deviations of the real planetary orbits with respect to these predicted by that theory.

Epilogue

1. The theory of informatons is also able to explain the phenomena and the laws of electromagnetism. It is sufficient to add the following rule at the postulate of the emission of informatons:

Informatons emitted by an electrically charged point mass (a "point charge" q) at rest in an inertial reference frame, carry an attribute referring to the charge of the emitter, namely the e-spin vector. e-spin vectors are represented as $\vec{s}_e$ and defined by:

1. *The e-spin vectors are radial relative to the position of the emitter. They are centrifugal when the emitter carries a positive charge (q = +Q) and centripetal when the charge of the emitter is negative (q = -Q).*
2. *s_e, the magnitude of an e-spin vector depends on Q/m, the charge per unit of mass of the emitter. It is defined by:*

$$s_e = \frac{1}{K.\varepsilon_0}.\frac{Q}{m} = 8{,}32.10^{-40}.\frac{Q}{m} N.m^2.s.C^{-1}$$

($\varepsilon_0 = 8{,}85.10^{-12} F/m$ is the permittivity constant).

Consequently (cfr III) , the informatons emitted by a moving point charge *q* have in the fixed point *P* - defined by the time dependant position vector $\vec{r}$ (cfr fig 6) - two attributes that are in relation with the fact that *q* is a moving point charge: their e-spin vector $\vec{s}_e$ and their b-vector $\vec{s}_b$:

$$\vec{s}_e = \frac{q}{m}.\frac{1}{K.\varepsilon_0}.\vec{e}_r = \frac{q}{m}.\frac{1}{K.\varepsilon_0}.\frac{\vec{r}}{r} \qquad \text{and} \qquad \vec{s}_b = \frac{\vec{c}\times\vec{s}_e}{c} = \frac{\vec{v}\times\vec{s}_e}{c}$$

Macroscopically, these attributes manifest themselves as, respectively the *electric field strength* (the *e-field*) $\vec{E}$ and the *magnetic induction* (the *b-induction*) $\vec{B}$ in *P*.

2. Certain properties of a photon can be explained by the assumption that this "particle" is nothing else but an informaton transporting an energy package.

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