MODÈLE D'ESPACE GRANULAIRE ANIMÉ (MEGA)

ANIMATED GRANULAR SPACE MODEL

AN INTERPRETATION OF THE LAWS OF GRAVITATION AND RADIATION

Abstract

Albert Einstein justified gravitation by the curvature of space-time. Based on a reflection on the nature and structure of space, an interpretation of this curvature is proposed here.

It would be caused by variations in the speed of light (which Albert Einstein himself had envisaged) caused by the existence of masses, and the distortion of its trajectory according to the density of the material objects present.

Based on this, the shape of orbital velocity curves in a galaxy would find an explanation. The hypothesis of *dark matter* would not be necessary.

A STRUCTURAL MODEL OF SPACE is thus presented: space is the substrate of everything that exists and happens in it, it has a granular structure, and each grain is the site of changes, in dimensions that are not those of extent. The temperature is that of space itself – the agitation of atoms and molecules being only a consequence.

The process of energy exchange (Planck's law) is specified through an analysis, on the basis of the granular structure of space, of the amplitude of electromagnetic waves: for very short wavelengths, the exchange would be lower than what Planck's law predicts. The energy of the photon would therefore no longer be proportional to the frequency for such wavelengths.

And cosmic rays, whose spectrum is reproduced by the law thus nuanced, would have an electromagnetic origin.

The MEGA Model would not contradict Relativity and Quantum Mechanics. It proposes a common basis.

Foreword

Physics is concerned with establishing the laws governing natural phenomena and, as centuries of scientific and technical progress have shown, we can do this better and better without knowing what they involve or what happens in them. And even without ever asking oneself these questions.

Scientists, and philosophers, however, are trying to answer it. But the prevailing theories, whose fecundity is nevertheless proven, are of no help to them – because this is not their object.

What is dealt with here is the NATURE OF THINGS. In other words, an *ontological hypothesis* will be proposed.

First of all: what SPACE is – its structure and the tendencies that govern it.

Then: what a MATERIAL OBJECT is.

Finally, the validity, or the plausibility, of what is said about SPACE and MATERIAL OBJECTS will be put to the test by establishing the fundamental laws that follow rationally from it: on these bases the law of GRAVITATION is found and justified, and the law of RADIATION is completed for very small wavelengths.

To approach this reading, it is necessary to take a step back from one's knowledge and ideas, and in particular to make a distinction, as far as possible, between observations (what one ascertains or measures) and interpretations (what one understands or reconstructs).

Never receive anything for true that I do not know it obviously be such. René Descartes

Not forgetting anything I know, forget that I know.

Failing to take such a step back, or a distance – an attitude inherent in the process of reflection – the reader will be put off, even shocked, and will risk rejecting what he is reading and not going to the end of his reading.

However, it is in no way a question of depreciating interpretations: what one will find here is indeed an interpretation of observations and, more generally, of sensible reality.

This interpretation is somewhat new compared to those underlying the prevailing theories, but there is nothing to suggest that it contradicts these theories.

The hypothesis developed on the structure of space would justify the curvature of space-time. It would also shed light on certain observations that are not accounted for by the laws of gravitation and radiation: gravitation in galaxies, and the spectrum of cosmic rays.

The presentation contains a few mathematical formulas – all of them are relatively simple. If the reader has difficulty, it will be to immerse himself in a world that does not quite resemble, at least at first glance, the idea he has of it – a world that would nevertheless be ours. An effort will be required of him there – reminders and repetitions will help him do so.

This presentation is designed to be widely accessible. So let the specialists be indulgent if we *break open doors*.

The assumptions of the proposed STRUCTURAL MODEL OF SPACE are obviously subject to discussion.

On the other hand, the calculations, and the conclusions drawn from them in terms of gravitation and radiation, are easily verifiable and reproducible.

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This work, motivated and driven by the thirst for **understanding** and *clarifying the meaning* (of *what is said* and *what is talked about*), is *fundamental research*: the consequences and the applications that could result from it are therefore not developed here.

Summary

Introduction

It is customary to distinguish, in the study of physics, and in theories which aim to establish laws governing phenomena,

- classical physics (world of solid, liquid and gaseous media),
- quantum physics (microscopic world of particles and fields),
- general relativity (macroscopic world of planets, black holes, and gravity).

Each has its own laws, and its areas of validity and application.

The object of physics is the establishment of the laws that govern the interactions between material objects.

The purpose of this work is the definition and description of a STRUCTURAL MODEL OF SPACE on the basis of which it becomes possible to **understand**, and **justify**, the laws governing two fundamental phenomena observed between two material objects distant from each other: their mutual attraction (gravitation), and the exchange of energy between them (radiation).

"*I have hitherto explained the phenomena of the heavens and those of the sea by the force of gravitation, but I have nowhere assigned the cause of this gravitation*" wrote Isaac Newton. And the **law of gravitation** that he established, even enriched by Albert Einstein, remains unexplained, and it does not account for orbital velocities in galaxies.

Unexplained?... Of course, Relativity connects gravitation with the curvature of space-time. But where does this curvature come from? And what does it consist of?...

Planck's **law of radiation** does not account for the spectrum of cosmic rays, and the origin of this radiation, considered not to be electromagnetic in nature, remains the subject of hypotheses.

What is proposed here is a description of space – its structure and tendencies – from which a STRUCTURAL MODEL OF SPACE derives in which the fundamental laws of physics would find a clearly intelligible explanation.

Sensitive reality, in all its aspects, exists and evolves in a **medium**, and it is in this medium that observable phenomena arise, the laws of which have been established by physical science.

This medium has the character of a **substrate** – a **cosmological** substrate. And this substrate is what is commonly called **space**.

This substrate is susceptible of description and, within the framework of the STRUCTURAL MODEL OF SPACE, it imposes constraints, resulting from the **tendencies** that govern it, on what happens in it. It is these constraints that are at the origin of the phenomena observed, and therefore of the laws of physics.

As it will be seen (§1.5), it is indeed space, or *space-time*, and not the ether.

This MODEL is based in particular on the permanent existence, in space, of **changes**.

The laws that result from it are those accepted and verified by physics under conditions where measurements are possible.

In the framework proposed by the MODEL, these laws would be valid at all scales.

1 – Structural model of space

What is proposed in this chapter is, of course, subject to discussion.

The reader is not required to accept it, except as **working hypotheses**.

It is therefore sufficient for him to make sure that these hypotheses are consistent and do not contradict the observations.

It is only the correspondence of the laws resulting from the MODEL with those established by physics (§2 & 3) that will make it possible to judge its validity, or at least its possible relevance.

1.1 – Space characters

The **medium** in which material objects evolve and interact is called *space*.

And one must be careful not to confuse **space** with **extent**, which is a magnitude.

Rather than a medium, to be more accurate, one should speak of **substrate**: space is the substrate of everything that exists and happens there.

Now, a substrate is something that can be described and characterized independently of what may be found or happen in it:

> This substrate has a granular structure: it is made up of **grains**, the number of which measures the **extent**.
> Each grain has properties and characteristics that define its **state**.
> As the state of each grain is subject to variation, and the number of grains increases*, the description of the substrate (space) is different at each moment of the passage of **time**.
> Each grain of space, at a given moment, is therefore described by its (fixed) position and its (variable) state,
> and space is described by the EXTENT, TIME, and STATE of its grains. It's *space-time*.

* This increase would be at the origin of the *expansion of the Universe*. The process by which this number increases will not be developed here.

This is the reason for the descriptive name of the Model: ANIMATED GRANULAR SPACE MODEL.

Such a granular structure is envisaged by Loop Quantum Gravity – but the rapprochement stops there.

1.1.1 – Extent

The structure of the substrate (space) is granular: it is made up of **grains** – indivisible elements **by nature**.

Extent is the measure of the number of grains: extent is a **discrete** quantity.

The arrangement of the space grains is **homogeneous** and **isotropic**.

> Only these aspects of the structure of space will be retained for the time being, and it is only in §3 about the exchange of energy that the arrangement of the grains will be questioned.

1.1.2 – State of the grains

Space and the grains of which it is made are by nature immobile.
But it is *animate* – each of its grains is animated*.

Space is animated in the sense that each of its grains is subject to an **internal change**. The properties and characteristics of this internal change define, at each moment, the state** of a grain of space.

But these internal changes **are not movements**: they take place in dimensions that are not those of extent (see §1.2.2).

* In a manner analogous to that in which a pixel, whose position does not change, is characterized at each moment by its color and intensity. And these properties are measured in dimensions that are not the two dimensions of the screen extent.

** The **state** of the grains can have several **properties**. Each property has three **characteristics** of **internal change**: amplitude, period, average.

1.1.3 – Time

Change is inconceivable without time, nor time without change.
Time proceeds from the internal change of the grains of space.

What is measured, in time, is **duration**, which is a quantity.

This quantity is **discrete**.

> Space is defined by **extent**, grain **state**, and **time** – the extent and the state of grains varying over time.

1.2 – The dimensions of the space

The **number of dimensions** is the number of independent variables whose value it is necessary to know in order to fully describe an object: in this case, space or one of its grains.

The three primary dimensions of space are: **extent**, **state**, **time**,
and you have to know
◦ three quantities to locate a grain of space,
◦ three quantities to describe each property of the state of a grain,
◦ one quantity to define a moment in the flow of time.

1.2.1 – Dimensions of the extent

The extent of space is finite and unbounded.

Finite: the number of grains of which space is made is not infinite.

Unbounded: space has no edge, it cannot be assigned a limit, an end.

Let's translate these characters into a <u>one-dimensional</u> extent:
The discrete extent of a segment is finite and this segment is bounded (it has two ends).
Folded in on itself in the form of a circle, it has the same finite extent, but no longer has a limit. It is a one-dimensional figure whose extent is finite and unbounded.

Here, it is necessary to note an ambiguity in the notion of dimension: we represent this one-dimensional circle in a two-dimensional space. To remove this ambiguity, it would be necessary to distinguish between the *dimensions of representation* (here, two) and the *dimensions of measurement* (here, one), and it is the dimensions of measurement that are considered here: a single quantity is sufficient to measure the distance between two points on the circle (or would be sufficient to identify the position of a point on the circle, if an origin of the distances had been defined).

In <u>two dimensions</u>, it will be a portion of the plane which, folded in on itself, can constitute a spherical surface – a two-dimensional figure whose extent is finite and not bounded (but with three *dimensions of representation*).

In <u>three dimensions</u>, it will be a portion of volume which, folded in on itself, can constitute what is called a hypersphere – a three-dimensional figure whose extent is finite and not bounded (but with four *dimensions of representation* – note that it is very difficult for our mind to imagine this figure).

Such is the extent of space as we know, which is also the extent of physics and cosmology.

Extent has **three dimensions**.
And, in each of the three dimensions, the extent is measured by the number of grains.

It would make no sense to consider fractions of grain, since they are *indivisible by nature* (cf. §1.1.1).

The measurement of extent by the number of grains will be qualified as **absolute**, in the sense that it does not depend on an arbitrary reference (as opposed to the measurement in meters of the International System S.I.).

1.2.2 – Dimensions of the state of a grain

The properties of grain state are **dynamic**, in the sense that their characteristics define the modalities of internal change of each grain.

This change takes the form of a **beat** (in the sense that we speak of the heartbeat – one could also speak of a *pulsation*): it is characterized by its **amplitude**, **frequency** and **average** – **three dimensions** for each property of the state.

> Reminder: this beating is not a movement, because the dimensions of the state of the grains are not those of the extent (cf. §1.1.2).

The frequency of beats is defined as the number of beats per unit of time (ut). The **period** of beats is the inverse of frequency – it is the duration of a beat cycle.

> The period is a discrete magnitude. If the amplitude and the average have the same character, this could help explain the existence of energy quanta.
> Note that what is said here applies to the property whose temperature (see §3.1) measures a characteristic.

It is this beat – the periodic nature of the internal change of the grains of space – that is the basis of the time we know, and which is also that of physics: its period is an integer multiple of the absolute unit of time (ut).

The absolute measurement of time (as opposed to the measurement in seconds of the International System S.I.) is therefore made in relation to the absolute unit of time (ut), which would be equal to 1 in the absence of any mass – but would be affected by the presence of masses (see §1.3.2 & 2.3).

1.2.3 – Dimensions of the time

Time is a **one-dimensional** medium: a single quantity is enough to measure the time between two events – the primary events consisting of changes in the state of the grains of space.

If only one property of the state of space grains is considered, space would therefore have seven dimensions:

3 dimensions for extent + 3 for grain state + 1 for time = 7

1.3 – Space tendencies

Space is governed by two primary tendencies:
◦ The tendency to uniformity
◦ The tendency to rest

1.3.1 – The tendency to uniformity

A difference between the states of two neighbouring grains tends to diminish.

Let us call ***transfer*** the process of changing the states of the two grains involved, by which the differences between their states decrease.

If there is such a difference, then there is a transfer between the two grains: in the grain where a characteristic has the highest value, it decreases; and it increases in the one where it has the lowest value (Diagram 1).

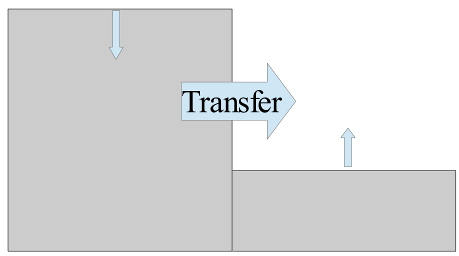


diagram 1

But this transfer is not instantaneous – it has a finite speed.

1.3.2 – The tendency to rest

The average transfer speed in whole space tends to decrease.

The transfer speed would therefore vary.

This in no way contradicts the Theory of Relativity, which says that the speed of light in vacuum has the same value in all inertial frames of reference – that it depends neither on the motion of the source nor on the motion of the observer.

Albert Einstein himself had envisaged this variable character:

“ *[…] according to the general theory of relativity, the law of the constancy of the velocity of light in vacuo, which constitutes one of the two fundamental assumptions in the special theory of relativity and to which we have already frequently referred, cannot claim any unlimited validity. A curvature of rays of light can only take place when the velocity of propagation of light varies with position. Now we might think that as a consequence of this, the special theory of relativity and with it the whole theory of relativity would be laid in the dust. But in reality this is not the case. We can only conclude that the special theory of relativity cannot claim an unlimited domain of validity; its results hold only so long as we are able to disregard the influences of gravitational fields on the phenomena (e.g. of light).*” Albert Einstein, Relativity 1916, at §22

Note in passing that we are not dealing here with material objects in **motion**, and even less with those in very fast motion: it is not in this aspect either that the MODEL contradicts the Theory of (special) Relativity.

Since the absolute metric of the extent is fixed*, **it would be the flow of time** (the relationship between time and extent) **that would be variable in order for the speed of transfer to vary**. It will be seen in §2 that it would depend on the presence of masses.

* Subject to the increase in the number of grains (expansion cf. §1.1).

1.3.2.1 – Transfer speed

If a change in the state of a grain takes a duration t to be translated, in the neighboring grains (i.e. at a distance of 1 unit extent), by a variation in the opposite direction, the transfer speed is 1/t.

> The transfer speed is therefore the inverse of the time (duration) that it takes for a variation in a property of a grain to be translated into a variation in the opposite direction in neighbouring grains.

Note that this definition of transfer speed does not prejudge the *importance* of variation in neighbouring grains, but only the *existence* of variation. The *importance* of the variation for temperatures will be examined in §3.

What is called *transfer* here corresponds to what is called, in the field of communication or computing, the *information shifting.*

1.3.2.2 – Unsurpassable transfer speed

Since extent and duration are discrete quantities, the transfer cannot take place over more than one unit of extent in one unit of time.

There is therefore an unsurpassable transfer speed, equal to one absolute unit of extent per absolute unit of duration.

The internal change in the grains is the benchmark against which the duration can be measured.

Whatever events may occur in space, the direction of the primary tendencies of space is invariable: the direction of the succession of instants in the flow of time is therefore invariable.

1.3.3 – Antagonistic character of the primary tendencies of space

It will be noted that, if the transfer speed were zero, the tendency to uniformity would not be **effective** (it would have no effect).

The tendency to uniformity would be all the less effective the lower the transfer speed.

In this sense, one can say that the primary trends of space are **antagonistic**.

Without this antagonism, matter might never have existed.

It will actually be seen that, in a material object, the speed of transfer is lower than around it (§2.5.2): the tendency to rest favors the formation of material objects. And the resulting lesser effectiveness of the tendency to uniformity favours the maintenance of the arrangement of the state of the grains (see §1.4.1).

The reasons why this formation would have been interrupted will not be discussed here.

1.4 – Matter and material objects

1.4.1 – What a material object is

An elementary material object is a portion of space in which the arrangement of the states of the grains is stable.

The state of the grains is variable by nature. It is indeed the arrangement of their states, and only this arrangement, that presents a character of stability in an elementary material object.

It should be noted that the MODEL does not refer to atoms or molecules. The consideration of this *state* of matter, intermediate between elementary particles (stable groupings of elementary material objects) and objects apprehended on a human scale, is not likely to affect what is proposed here.

And the question of the greater or lesser complexity of the groupings of elementary material objects that would be *particles* is not examined.

It is for these reasons that *strong interaction* and *weak interaction* are not addressed.

All that will be said here is that the formation of a stable arrangement requires energy.

1.4.2 – Movement of a physical object

The grains of space are immobile (cf. §1.1.2): only the state of the grains is therefore capable of accounting for a displacement.

When a material object moves, it is the characteristics of the state of the grains that pass from one grain to another*.

* Just as it is the properties of the pixels of a screen that change when a figure moves through it (cf. §1.1.2).

One thus understands, or senses, what would happen if a material object were to move at a speed approaching the speed of transfer: the arrangement that constitutes it would no longer be able to follow its movement, and the object would end up *unravelling**.

* As, on a screen, the figure would be in danger of becoming *blurred* if it were to move at a speed approaching that of the change in the properties of the pixels.

Thus, space is sensible reality – it is what every material object is made of.

The extent of space increases (expansion), but it does not move – and in relation to what could it move?...

Elementary material objects are a reality of order 2 – in the sense that their reality is due to the changes existing in the grains of space (which are the *reality of order 1). These changes, which are not movements, define the state of the grains.*

However, these objects are no less real than space – and, unlike space, some material objects are tangible*, which means that other material objects, living beings, are able to perceive them.*

Material objects can seem more concrete than space and its grains – the latter, which are not accessible to the senses, are nevertheless just as concrete.

1.5 – The STRUCTURAL MODEL OF SPACE in summary

- It is presented in the above a STRUCTURAL MODEL OF SPACE – or ANIMATED GRANULAR SPACE MODEL (MEGA).
- Space is the substrate of all sensible reality.
- So it's *something* – it's not *nothing*, it's not an abstraction. It can be described by its granular structure, and it has all the characters of a substance.
- Space is defined by the extent, the time, the state of its grains. It's *space-time*.
  Extent and time (duration) are discrete quantities.
- Two primary tendencies, to uniformity and to rest, govern space.
- The speed at which grain state is transferred from one grain to another (by virtue of the tendency to uniformity) tends to decrease (by virtue of the tendency to rest).
  That speed is therefore variable. And **it is a variation in the flow of time that is at the origin of the variation in the speed of transfer** – which is the speed of light.
- It can always be said that a material object (a portion of space in which the arrangement of the state of the grains is stable) is *in space*, but to speak correctly one would have to say that it is *space* – that it is *made of space*. This is why, in §1.1, space has been referred to as a substrate rather than a medium.
  Space and *Universe* are thus synonymous.
- This is a far cry from the ether, to which physical science attributed an existence until the beginning of the twentieth century.
  Or else we would have to consider that the ether merges with space.

◦ Space is what everything is made of: material objects as well as the interactions between them, and vacuum.
◦ Vacuum is the *state* of space when no stable arrangement of the state of grains exists in it – or a portion of space where there are no material objects. It is made up of animate grains and is not uniform.

All the grains of space are similar, they differ only in their state. There are no material grains*, nor* vacuous grains*.*

It is on the basis of this STRUCTURAL MODEL OF SPACE that it is possible to examine the two fundamental laws that are

. that of **gravitation** (§2),
. that of the **exchange of energy**, or of **radiation** (§3).

They respond to the spatial trends defined in §1.3:
. the tendency to rest for the law of gravitation,
. the tendency to uniformity for the law of radiation.

The STRUCTURAL MODEL OF SPACE *deals with reality at its finest scale, which is that of simple objects – the grains of space.*
It aims to identify what is simple in the mechanisms at work within the phenomena observed.
And to identify what is simple is not to simplify – to simplify would be to ignore complexity.
The MODEL *is therefore not a* simplification of reality*: we will see that the laws identified at the scale of simple objects are those that govern observable phenomena involving objects of extreme complexity.*

2 – Gravitation

Gravitation is the mutual attraction between objects provided with mass.

Space and the grains of which it is made are objects. But they are not material objects.

A material object, as defined in §1.4.1, has a character of its own: it has **mass**.
This character manifests itself in two ways:

- By **inertia**: a material object, alone and immobile in space (obviously an ideal situation), would remain where it is. It *resists* displacement: for it to move, it is necessary that a **force** be applied to it. This is due to the fact that the state of the grains is not absolutely **fluid** (the transfer is not instantaneous, cf. §1.3.1). The force to be applied would be proportional to the number of grains of space occupied by the object. Hence the first notion of mass: the **inertial mass**, which would therefore be proportional to the number of grains of space occupied by the object.
- By **weighing**: an object weighs more and more as the number of grains it occupies is larger. Hence a second notion of mass: the **gravitational mass** – also proportional to the number of grains of space occupied by the object. It is this second notion that will be retained here.

2.1 – Mass

The **absolute mass** of a material object is defined as the ratio between the number of grains in the portion of space it occupies (its volume) and the number of grains in the entire space.

Such a definition seems to take no account of the density of the material object. Density will be dealt with in §2.6.

As we will see, the fact that, for the same mass, a denser object is perceived as smaller, is analyzed as the result of a distortion of the transfer trajectories that is all the more pronounced the greater the density.

The absolute mass of space would therefore be zero if there were no material object in it, and it would be equal to **1** if a material object occupied it entirely.

2.2 – Mass and transfer speed

In the absence of any material object, the speed of transfer (cf. §1.3.2.1) would be the unsurpassable speed, equal to **1**.

In the presence of a material object, and therefore of a mass, the speed of transfer at a *point** in space is all the smaller
. that the mass is greater,
. that the point is closer to the material object.
And these effects are composed in the presence of several material objects.

The statement of the tendency to rest (§1.3.2) is completed here.

* Strictly speaking, one should not talk about points: it is the speed of transfer from one grain to the neighboring grain.

The range of gravitation would theoretically have no limit.

The speed of transfer would also vary according to the temperature: it would be all the smaller the lower the temperature (§3.1).

2.3 – Variations in transfer speed

What appeared in §1.3.2 is thus reaffirmed here: the speed of transfer is not the same at all times or in all places in space.

Now, the speed of transfer is that of all the transfers of characteristics of the state of the grains, and in particular that of light (cf. §1.5).

But the variations in the speed of transfer are considerably less than the precision with which the speed of light can be measured: the calculations presented in §2.5 establish that, in the vicinity of the Earth, they are of the order of 10^{-95}, whereas the accuracy of measurements of the speed of light today is of the order of 10^{-9}.

If the material objects are very small (quantum scale), on the other hand, the calculations presented in §2.5 suggest that the variations in the transfer speed are no longer negligible (see Graph 2 in §2.5.4).

In order for the transfer speed to vary, the absolute metric of the extent being fixed, it must be the metric of time that varies: the value of the absolute unit of time (ut) is affected by the presence of masses (cf. §1.3.2).

Note that the independence of the speed of light in a vacuum with respect to the speed of the source as well as the inertial frame of reference of the observer stems from the nature of space described by the MODEL, and is therefore not questioned.

2.4 – Minimum size of a material object

The distance between two objects, whatever their masses, cannot be zero: it is necessarily at least 1 (the extent of a grain of space, in absolute units).

Furthermore, a material object cannot be of extent 1 – how could it then, indeed, be a portion of space in which the arrangement of the state of the grains is stable? (cf. §1.4.1)

There is, therefore, for material objects, a minimum mass, and a minimum extent.

The smallest material object corresponds to the minimum number of grains of space that allow a stable arrangement of their states – it is the smallest massive particle that can exist.

2.5 – The Law of Gravitation

On these bases, it is now possible to establish the law that governs the interaction between the masses.

Let us consider two spherical objects, characterized by their radii (from which their masses are deduced, cf. §2.1).

And let us note

r	the minimum radius of a material object
R1 and R2	the radii of the objects
M1 and M2	their masses
d	the distance between their centers
x	the distance between the center of object 1 and a point (a grain) between the two objects on the line defined by their centers
v(x)	the transfer speed at that *point*
w(d)	the average transfer speed from x = r to x = d - r

2.5.1 – The primary Law of Gravitation

The function $v(x)$ results, in a simple way, from the complete statement of the tendency to rest (§1.3.2 & 2.2):

- Effect of object 1 – $v1(x)$ would be the speed of transfer everywhere in space in the presence of only object 1.

$$v1(x)=1-\frac{M1}{x^2}$$ it is an increasing monotonic function of x

This formula expresses the **primary law of gravitation**.

- Effect of object 2 – $v2(x)$ would be the speed of transfer anywhere in space in the presence of only object 2.

$$v2(x)=1-\frac{M2}{(d-x)^2}$$ it is a decreasing monotonic function of x

In the compound effect, the deviation from the unsurpassable speed is the sum of the deviations due to each of the two objects, assigned a factor $(M1\times M2)/(M1+M2)$:

$$v(x)=1-\left[\frac{M1}{x^2}+\frac{M2}{(d-x)^2}\right]\times\frac{M1\times M2}{M1+M2}$$

Where do these functions come from?... These are the ones that, within the framework of the hypotheses of the STRUCTURAL MODEL OF SPACE, *make it possible to understand and interpret the observations on the fall of bodies and the orbits of the stars – and the law of gravitation.*
And the law of gravitation, like all the laws of physics, consists in a mathematical shaping of observations.

The hypotheses of the MODEL *allow us to conclude that an attraction between two material objects decreases as the extent between them increases (see §2.5.3). In order for this attraction to correspond to the law of gravitation in space described by the* MODEL, *the* primary law *stated above is necessary – Newton's law, valid for low speeds of displacement, being then, in a way, a* secondary law.

It should be noted that what is at stake in these functions is the speed of transfer of the state of the grains (whatever the property concerned) and not the intensity of the transfer. It will be different for radiation (§3): it will then be the transfer itself and its intensity that will be at stake.

Note that $v(x)$ *is the transfer speed at any* point *(cf. §2.2) on the line connecting the centers of the two objects, between the* smaller material object *(cf. §2.4) in the center of object 1 and the* smaller material object *in the center of object 2.*

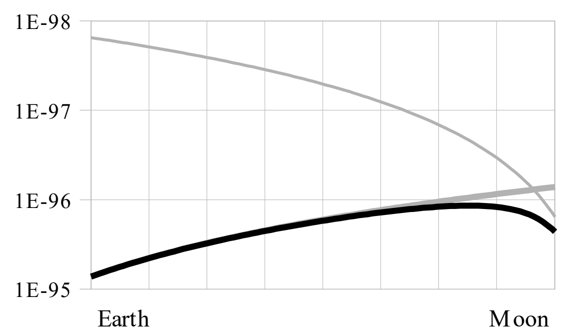
2.5.2 – Variations in transfer speed

Graph 1 shows on this basis, between the surface of the Earth and that of the Moon, the variation of the difference between the transfer speed and the unsurpassable speed equal to 1.

On the y-axis (inverted logarithmic scale): 1 - v

On the x-axis: the distance between the surface of the Earth (object 1, left) and that of the Moon (object 2, right).

In thick grey line: $v1(x)$ the effect of the Earth
In thin grey line: $v2(x)$ the effect of the Moon
In black line: $v(x)$ the compound effect



graph 1

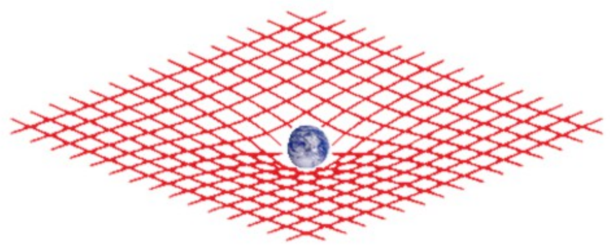
The graph for the Sun and the Earth is not presented because it would be difficult to read, the curve v1 of the Sun's effect being almost confused with the curve v of the compound effects.

And the representation of curves down to the objects would also make the graph unreadable by considerably increasing the variations of v.

As can be seen in this graph, the transfer speed between the two objects has a maximum.
The existence of this maximum results from the **composition of two monotonous primary laws**, those which apply to each of the two objects.

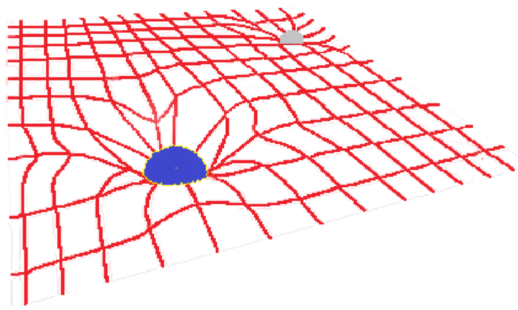
The presence of a material object diminishes what might be called the *fluidity* of the state of the grains of space (cf. §2).

Diagrams 2 and 3 illustrate with *layers* the *deformation of the geometry of space-time* according to the theory of Relativity. Graph 1 can be compared with Diagram 3: the curvature of the *layer*, between the *blue* object (the Earth) and the *grey* object (the Moon), has a shape similar to that of the curve in graph 1.



One object

diagram 2



Two objects

diagram 3

The presence of masses, because of the variation in the transfer speed that it induces, is therefore at the origin of a deformation, or a curvature, of space. It is important to emphasize that this is not a distortion of the extent, but of the space.

> The ordinate, in diagrams 2 and 3, would thus be related to the difference between 1 and the transfer speed, which can be reduced to time, as we have seen in §1.3.2.

2.5.3 – Average transfer speed between two objects

$w(d)$, the average transfer speed from $x = r$ to $x = d - r$, is

$$w(d)=1-\left[\frac{1}{r}-\frac{1}{d-r}\right]\times\frac{M1\times M2}{d-2r} ,$$

the distance d between the centers of the two objects not being be less than $2r$ (nor, of course, $R1+R2$).

The average speed of transfer between the centers of the two objects therefore increases as the distance between them increases.

By virtue of the tendency to rest (cf. §1.3.2), the two objects therefore tend to move closer together in order to minimize the speed of transfer in the portion of space concerned by the phenomenon.

From this gravitation would proceed.

2.5.4 – The force exerted on the two objects

The force F acting on each of the two objects is proportional to the derivative of $w(d)$ with respect to the distance d separating their centers.

$$F=\frac{C}{r}\frac{M1\times M2}{(d-r)^2}$$, C being a constant

This force can be analysed as the effect of variations, as a function of the distance between two objects, in the average value of the transfer speed in the interval between them (cf. Graph 1). But it is indeed a force exerted on each of the two objects.

The two graphs below represent respectively

Graph 2:

the average speed of transfer w, and F/C, for small distances between the two objects (these are the distances between their centers, and the objects are therefore necessarily very small),

Graph 3:

F/C for objects that are much larger than the smallest material object.

On the x-axis:

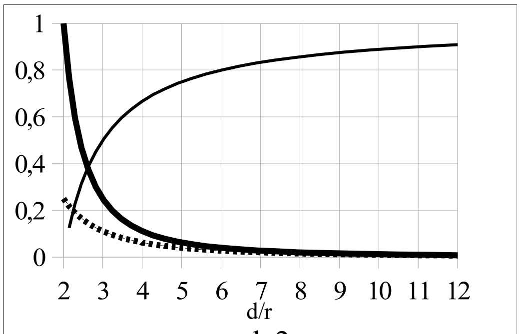
the ratio d/r between the distance d and the radius r of the smallest material object.

On the y-axis:

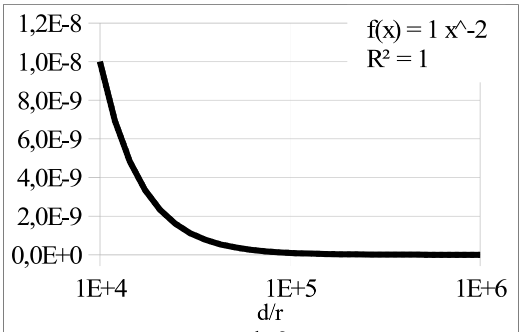
in thick line: F/C

in thick dotted lines: F/C according to Newton's law

in fine lines: w , the average transfer speed



graph 2



graph 3

For very small material objects and short distances, the force of attraction would be greater than that predicted by the law of gravitation.

For sufficiently large distances from r , the force responds to the function

$$F=\frac{C}{r}\frac{M1\times M2}{d^2}$$, C being a constant

to be compared with Newton's law:

$$F=G\frac{M1\times M2}{d^2}$$

The value of the constant G would therefore be C/r – r being the minimum radius of a material object.

It will have been noted that:

- The calculations were made by considering only one dimension of the extent (the line defined by the centers of the two objects),
- The variations of $v(x)$ on either side of the two objects have not been taken into account : they are indeed negligible.

These functions do not therefore claim to be a faithful and complete reflection of reality.
However, they would allow us to conclude

- that, on the basis of the proposed STRUCTURAL MODEL OF SPACE, we find the law of gravitation for a high ratio between the distance between the centers of the two objects (d) and the minimum radius of a material object (r),
- that gravitation would deviate from the law for very small masses and distances.

The law of gravitation thus becomes clearly intelligible in its field of validity.
And it would be *corrected* for very small material objects and very small distances.

Reminder: we are not dealing here with material objects on the move, and even less with those moving very quickly (cf. §1.3.2).

*Perhaps one will have noticed the **simplicity** of the functions identified. It reflects that of reality at the scale at which it is considered here (cf. §1.5).*

> *And it is the proposed **reversal of perspective** that allows us to perceive this simplicity.*
>
> *This reversal consisted,*
>
> *instead of trying to go back, from the observation of complex objects and phenomena, to more and more elementary and varied particles,*
>
> *to look for what would be simple, to formulate a hypothesis about the primary changes, objects, and mechanisms – the simplest things there is – and to verify that we reconstitute, on these bases, the fundamental phenomena observed on a scale where the objects are complex.*

Extent and time being discrete quantities, the reference to an absolute metric thus makes it possible to identify this simplicity, in a manner analogous to the transition, for the calculation of the orbits of the planets, from a system centered on the Earth to a heliocentric system.

2.6 – Density

As mentioned in §2.1, the density of material objects has not been taken into account so far.

Given its mass, a material object, whatever its density, is made up of the same volume of space, it has been said. What must be specified now is that it **appears** to occupy all the less of it as its density is greater.

2.6.1 – The trajectory of the transfer

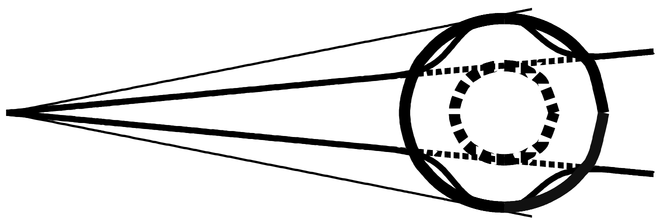
If a material object appears to occupy, for the same mass, a different volume depending on whether it is more or less dense, it would be because the trajectory of the transfer (and therefore, in particular, that of light) depends on the density of the objects.

> The trajectory of the transfer from object 1 to object 2 is such that, for an observer located on the surface of object 2, the angle from which object 1 is viewed corresponds to its apparent size.

Graph 4 illustrates schematically the trajectory of the transfer (the surface of object 2 is on the left of the diagram).

in thin lines: what the trajectory of the transfer would be without distortion – object 1 is represented in thick solid lines

in bold lines: the trajectory of the transfer, and the angle from which object 1 is seen – object 1 is then represented in thick dotted lines



graph 4

There is therefore a second kind of deformation of space here. The first (cf. §2.5.2) had to do with the speed of transfer, this one has to do with the trajectory of the transfer.

Note that the ***apparent*** character of the radii of objects does not have the same meaning as that of the equality everywhere of the speed of light in vacuum: the latter is only due to the limit of the precision of the measurements (cf. §2.1.3).

Note also that this is not an *optical illusion*, but the reality of the world in which we live, which would be that of the space described by the MODEL, and its laws.

> What is called the *curvature of space-time* would be due both to the variations in the speed of transfer in the presence of material objects and to this deformation, depending on the density of the objects, of the trajectory of the transfer.

2.6.2 – Calculation model

To take into account densities, the integral calculation presented in §2.5 becomes excessively complicated. A **calculation model** is therefore used.

This calculation model is built on a spreadsheet. It is therefore easily **reproducible**, as are the previous calculations, by anyone who knows how to handle a spreadsheet.

Since the transfer speed $v(x)$ is very close to the unsurpassable speed (equal to 1), the calculation is made on its difference with the unsurpassable speed.

The calculation over two neighbouring distances makes it possible to estimate the force of attraction, which is proportional to the derivative of w (the average transfer speed between the two objects) with respect to the distance d (cf. §2.5.4).

For each distance, an **orbital velocity V** is thus obtained.

It is an approximate calculation, approximations resulting from the number of lines in the model, the method of calculating the derivative, and the hypothesis of circular orbits.

2.6.3 – Orbital velocities

In order to be able to compare the results with the observations, the reference adopted is that of **orbital velocities**.

Indeed, a force cannot be *seen* – what can be observed and measured are its effects, the consequences of its action, for example a speed or an acceleration.

If an object is orbiting another, its velocity V is a function of the force pulling them toward each other, the mass of the central object, and, of course, the distance between them – this is the orbital velocity. It is such that the force of attraction is equal to the *centrifugal force*.

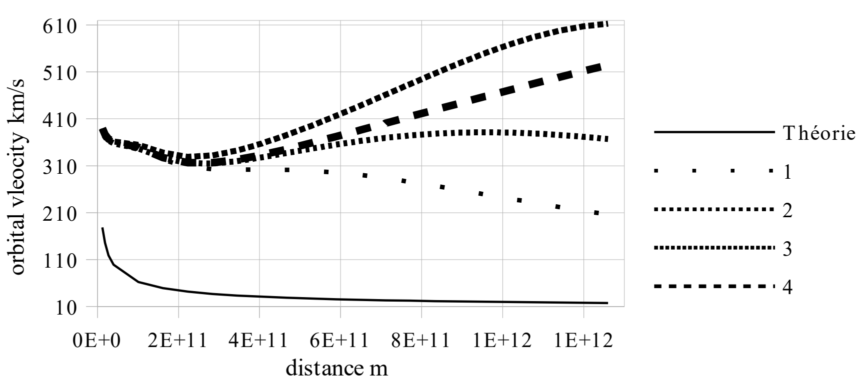
The calculation makes it possible to verify that, for the celestial bodies of the solar system, the difference between the calculated and observed orbital velocities does not exceed 1%.

2.6.4 – Galaxy centered on a very high density star

Graph 5 shows, for the Sun and the Earth, what the Earth's orbital velocity curves could be if the Sun's density were extremely high.

They are established for the Earth and the Sun isolated in space, that is, in the absence of any other material object.

They correspond to a deformation profile of the transfer trajectory similar to that presented in Graph 4 in §2.6.1.



graph 5

This graph shows four orbital velocity curves, depending on the density of the Sun and the parameters of the trajectory deformation profile.

1 : density of the Sun multiplied by 10^{13}

2 and 3: density of the Sun multiplied by 10^{15}

4: density of the Sun multiplied by 10^{24}

Note that, however great the density of the material object, the deformation, as illustrated in Graph 4, has a maximum – the *hole* would indeed have a *bottom*... (It is the hypothesis of the existence of *wormholes* that is alluded to here).

Note also that we are only talking about an *object of very high density*: the particular characteristics that a *black hole* could present are therefore not considered.

Let us recall that these calculations correspond to the existence of two isolated objects (ideal situation).

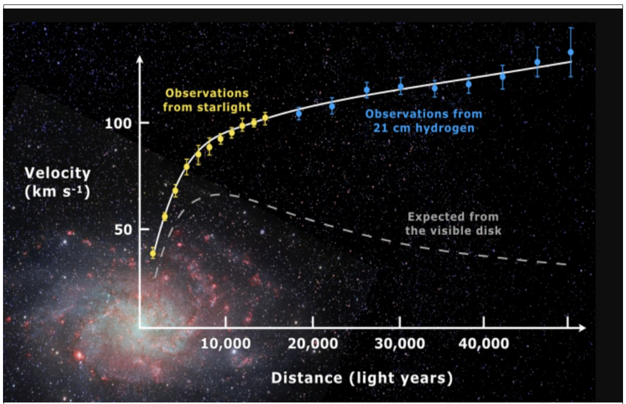
It therefore does not take into account all the other objects that can surround, as in a galaxy, the central object and affect, by their presence, the forces to which the orbiting object is subjected, and therefore the shape of the curves.

On the contrary, in Diagrams 4 and 5 which show observations, the existence of such objects affects the shape of the curves.

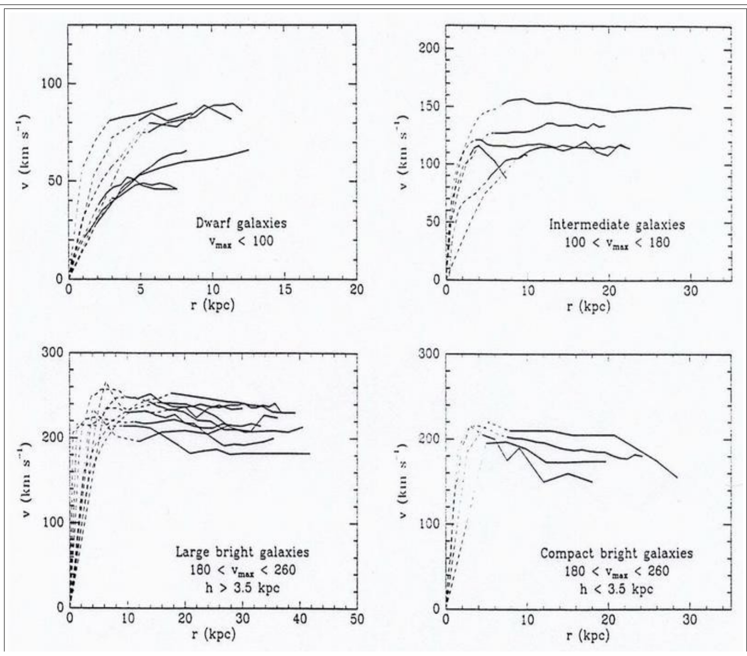
Note that in Diagrams 4 and 5, the radius of the central object is very small – in Graph 5, it is larger by a factor of the order of the cube root of density.

The shape of orbital velocity curves derives from both the law of gravitation and the law governing the trajectory of transfer.

The hypothesis of the existence of *dark matter* (supposed to account for the difference between the observed curve and the theoretical curve, and an apparent excess of mass) would then not be necessary.



Source : ref [3]
diagram 4



Rotation curves
Source : OBSPM
diagram 5

2.7 – The curvature of space

How does the presence of mass cause a curvature of space? And what does this curvature consist of?

The presence of a material object would affect
. the transfer speed, by its mass,
. the trajectory of the transference, by its density.

✧ The variable nature of the transfer speed would to be at the origin of gravitation.

✧ The deformation and lengthening of the transfer trajectory would be at the origin of an increase in orbital velocities around a very high density celestial body.

✧ The curvature of space, under these conditions, would result from the combined effects of the variation in the transfer speed and the distortion of its trajectory.

And gravitation would indeed be a force.

The high density of the central object is at the origin of an increase in the length of the transfer path compared to the theoretical conditions. The force of attraction is diminished, but to a lesser extent. And this results in a higher rotational speed.

The greater the density, the smaller the force. And its variation (as a function of distance) is very small compared to that of the theoretical force.

> Somewhat paradoxically, the high density of the central object would therefore be at the origin of a reduction in gravitation exerted on orbiting objects. But a proportionally greater increase in the length of the trajectory would cause an increase in orbital velocities.

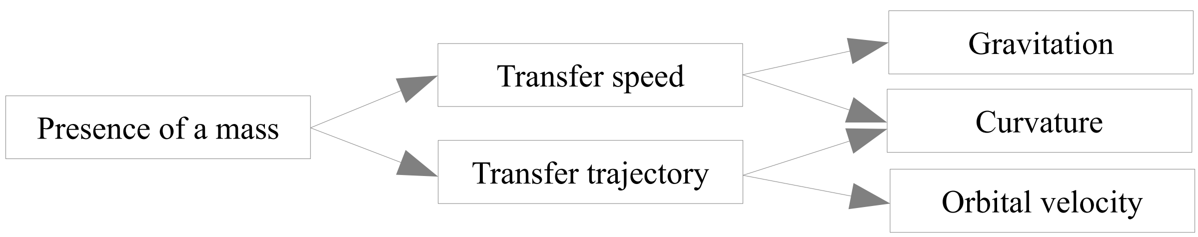
And it would not be by virtue of gravitation that light rays are deflected in the vicinity of a material object (*gravitational lensing effect*). But by the effect of the curvature of space, which is due to both the mass and density of the object.

- Mass is at the origin of gravitation by the effect of the variation in transfer speed.
- The curvature of space results from both this variation and the deformation of the trajectory of the transfer by the effect of the density of the object.

This is illustrated in the diagram below.

It would be true that one of the origins of curvature is also at the origin of gravitation. But it would be wrong to attribute the deflection of light to gravitation.

There would be no need to speak of anything like a *feedback between space-time and matter*, since the ultimate nature of matter would be space itself.



2.8 – Conclusions on gravitation

The phenomenon of gravitation has its origin in one of the two primary tendencies of space, the substrate of all sensible reality: the tendency to rest (cf. §1.3.2).

In this phenomenon, equal forces of opposite directions are exerted on two material objects.

These forces can be analysed as the effect of variations in the transfer speed as a function of the distance between the objects (cf. §2.5.4).

They are therefore the result of the characteristics of space as described in the STRUCTURAL MODEL OF SPACE.

The three primary dimensions of space are: time, extent, and the state of the grains (cf. §1.1), and this is why the term *space* (in the sense of the MODEL) says the same thing as the term *space-time*.

The proposed STRUCTURAL MODEL OF SPACE makes it possible to justify how the force between two material objects varies as the distance between them varies.

- The law of gravity is valid for masses of a much higher order of magnitude than that of the smallest material object that can exist.
- For objects whose mass is of an order of magnitude comparable to that of such objects (quantum scale), the law of gravitation would no longer be applicable.

The value in S.I. units of the gravitational constant G depends on the extent of space, and therefore varies over time.

But gravitation has no effect on expansion.

If, for the same mass, an object appears smaller when it is denser, this would be due to the trajectory of the transfer, which would be all the more distorted the denser the object.

The shape of orbital velocity curves around an object of very high density would thus be explained without the hypothesis of the existence of *dark matter* being necessary (cf. §2.6).

The presence of masses is at the origin of a curvature of space under the double effect of mass (variation in the speed of transfer) and the density of objects (distortion of the trajectory of the transfer).

It should no be said that gravitation originates from the curvature of space – nor that the curvature of space originates from gravitation.

The speed of transfer within material objects is lower than it is in a vacuum: the tendency to uniformity is therefore less effective there than in a vacuum (cf. §1.3.3).

If the unsurpassable speed (cf. §1.3.2.2) is not only imposed on the transfer of the state of the grains of space, then the ***velocity of gravity*** could be this unsurpassable speed, and there is nothing to suggest that it is variable, unlike the speed of transfer.

And it would therefore be greater than the speed of light in a vacuum, which is lower than the unsurpassable speed (the difference being much less than the precision of the measurements of which we are capable).

One can therefore speak of a *gravitational wave*, with the particularity that it does not have the character of a beat: it has a *front* (a variation of the transfer speed) propagating at the unsurpassable speed and whose *height* decreases with distance from the source.

The wave will, of course, be a beat if there is a periodic phenomenon at the source.

3 – Energy exchange

The form of energy dealt with here is **thermal energy**.
The exchange occurs between two objects of different temperatures.
And the exchange takes place by radiation.

3.1 – Temperature

Temperature is associated with one of the properties of grain state. This is the only property that will be examined here.

And there is nothing to suggest that the state of the grains has any other properties.

It is a **dynamic** property, in the sense that it does not describe a situation at a given moment, but the conditions for the change of a situation (cf. §1.1.2).

This change has the character of a beat, and the property is defined by an amplitude, a period and an average (cf. §1.2.2).

> Temperature is the measure of the amplitude of the beat.
>
> And it is again recalled that this beating is not a movement, because the dimensions of the state of the grains are not those of the extent (cf. §1.1.2).

- The **period** is expressed in units of time. It is the inverse of the **frequency**, and it is equal to the **wavelength** if the transfer speed is equal to 1.
- Note that the role played by the **average** (which, as a measure of charge, would be at the origin of the electrostatic force) will not be examined here.

The thermal energy of an object (space grain or material object) is proportional to its temperature and volume (number of grains).

> The temperatures observed would therefore be those of space, the agitation of atoms and molecules being only the consequence.

3.2 – Planck's Law

The **law of radiation** (known as electromagnetic) was established by Max Planck in 1900.

The difficulties of his establishment (to which Gustav Kirchhoff, Joseph Stefan, John Rayleigh, Ludwig Boltzmann, Wilhelm Wien, James Jeans contributed) were at the origin of the discovery of energy quanta, and of quantum mechanics.

According to this law, the flow of energy is expressed by a function (of the temperature T and the period p) of the form:

$$E = \frac{\alpha}{p^5}\frac{1}{e^{\frac{\beta}{pT}}-1}$$

It is the measurement of the energy transmitted per unit of time, per unit of area, and per unit of wavelength (or period).

The coefficients α and β are constants depending on the environment in which the transfer takes place:

$\alpha = 2hc^2n^5$ and $\beta = hcn/k$ with
- h: Planck constant
- k: Boltzmann constant
- c: speed of light in vacuum
- n: refractive index of the environment

Planck's law is valid for the emission of energy by an ideal body, called a *black body*, which absorbs all the energy it receives (i.e. it does not reflect or transmit any energy).

3.3 – Energy exchange mechanism

3.3.1 – The primary Laws

Sensible reality is more complex than a human mind can conceive.

However, on an elementary scale, it would be very simple in its principles.

If reality is so complex, it is because it is extraordinarily compounded, even on the smallest scale that we are able to observe.

But it is only considered and examined here on the scale on which it is not compounded – that of the grain of space.

Note that ***simple*** means both *uncomplicated*, *not complex*, and *not compounded* – the two meanings meet here clearly.

Leonhard Euler (1707-1783) said that *nothing happens in the universe without a minimum or a maximum appearing*. One can think he was right, and perhaps that is why there is *something*, and not *nothing*.

But the most elementary laws, the **primary laws**, are **monotonous** – and there is good reason to believe that they are **simple**.

Maxima and minima only appear because of the composition of these laws.

This is the case with gravitation, as we have seen in §2.5.2.

And Planck's law is analyzed as the product of a *theoretical* flux by a probability.

3.3.2 – The propagation of changes

> Note that one should speak, to be more precise, of the propagation of grain states, i.e. the modalities of changes.

The structure of the extent has been described in §1.1.1, without any mention of its organization at the grain level – its intimate structure.

Now, the number of grains with which each space grain is directly surrounded, which will be denoted g_0, and which is necessarily the same at all points in space (homogeneity), intervenes in the way in which the internal change of the grains propagates.

Let us therefore start from a situation (quite ideal, as was that of two material objects isolated in space in §2.5) in which the internal change is uniform throughout space, and try to imagine what would happen if a modification in the magnitude of the change occurred in a grain (source).

Let's say that this modification is an increase in amplitude:

- after a unit of time (if the period is equal to 1), the amplitude decreases in this grain and increases in the g_0 grains that surround it, forming a **wave** in the shape of a quasi-sphere,
- after an additional unit of time, the amplitude decreases further in this grain and in the g_0 grains that surround it, and increases in a new wave,
- and so on...

A series of waves is thus formed, the amplitude of which decreases, due to the increase in their surface, with the distance from the source grain.

What has been described here corresponds to what would happen on the surface of a pond where a stone has been thrown. With a difference in the number of dimensions: in two dimensions, therefore, for the surface of the water, the height of the waves being measured in the third dimension of the extent. These would be *mechanical waves*.

Things don't happen quite the same way

- **in a vacuum**, that is to say, in a portion of space where there are no material objects,
- with waves whose amplitude is measured **in a dimension other than those of the extent** (cf. §1.1.2 & 1.2.2) – *electromagnetic waves*.

Under the conditions of space as described in §1:

- ◦ Waves have a **constant amplitude** – that is, there is no decrease of amplitudes with distance from the source.
- ◦ It is as a function of the **period** that a reduction in amplitudes occurs. And to each period correponds a **wavelength** (cf. §3.1): it is therefore, there also, a question of a distance.
- ◦ Waves are **real**, but they only become effective (cf. §1.3.3) when and where they encounter an obstacle (a change likely to *disturb* the wave).
  They become **effective** (and not *material*, of course) – that is, they have an effect, and are therefore observable.
  In a vacuum, therefore, one does not observe a wave: one observes only its effects – just as it has been said that one does not observe a force, but its effects (cf. §2.6.3).
- ◦ These are indeed **waves**, consisting of a propagation (cf. §1.3.1 *transfer*), in all directions around the source, of the internal change of the grains – that is to say, of the characteristics of their state.
  But, at any point in the wave, its encounter with an obstacle can produce an effect, which physics would interpret as the existence of a ***particle***.

  *Under these conditions, on the **infra-material scale** considered here, the measure does not only have an influence on the object measured: the object measured exists only because of the measurement.*

This is why one speaks of **wave-particle duality**.

And it is thus that two *particles* with the same characteristics can appear at the same instant in two different places, without there being any reason to question the existence of time (cf. §1.1.3), or the finite character of the transfer speed (cf. §1.3.2.2).

This is also how it is possible to measure

- . either the speed of the wave, its position being definable only in the dimension of its propagation,
- . or the position of the *particle*, but not its speed – since the effect (to which the reality of the *particle* is reduced) exists only at the instant of the measurement.

If the wave encounters a material object of lower temperature than that of the source, the temperature (cf. §3.1) of that object increases, that of the source decreases, and the amplitude of the wave decreases accordingly. And the phenomenon is likely to continue, so that the amplitude of the wave tends to cancel each other out, thus responding to the **tendency of space to uniformity** (cf. §1.3.1).

Since the purpose of the MODEL is limited to the simplest forms of reality, the problems encountered by physics experiments will not be dealt with here: there are in fact complex changes, or waves, or elementary material objects whose density is very high – hence a distortion of the trajectories of the transfer of the state of space grains (cf. §2.6.1).

3.3.3 – The amplitude of the waves

According to Planck's law, the energy flow E is analyzed as the product

- . of a *theoretical* flux, which would be the maximum energy emitted and which is denoted F_X
- . and a probability (according to the Bose-Einstein distribution) of the occurrence of this emission, which is denoted Φ.

$$E = F_X \cdot \Phi$$

The law of probability is related to the discrete nature of the energy states of the source of radiation, and therefore to quantum mechanics – it is not within the scope of this presentation to discuss it.

It is the *theoretical* flux F_X that is dealt with here, and it depends on the amplitude of the waves – more precisely: on the variation of this amplitude.

It is therefore a question of examining how this amplitude evolves as a function of the wavelength λ.

In Planck's formula, it decreases as λ^{-4} (or p^{-4}).

The consideration of a granular structure of space leads to *nuance* this law – while specifying that it will not be called into question under conditions where it is experimentally verifiable.

According to the MODEL presented in §1, space has a granular structure, and it is homogeneous and isotropic.

At any point in the extent, a grain is therefore surrounded by the same number of grains, g_0 (cf. §3.3.2).

And, at a distance d of a grain, there is a number $g(d)$ of grains.

If the transfer speed is equal to 1, the wavelength λ and the period p of the wave are equal. And the wavelength is an integer multiple of the absolute unit of extent.

It is the function $g(d)$ that is at issue in this attempt at analysis, and therefore, in a way, **the *geometry* of space** (note that, here, we are talking about something quite different from the curvature of space).

To examine the variation in amplitude, let us take the hypothetical case, chosen to allow a simple calculation, of a regular hexahedral structure (i.e. in a centered cube) of space.

In this configuration, $g_0 = 8$ – there are 8 grains around each grain, and at a distance d from one grain, there are: $g(d) = (g_0^{1/3}+d-1)^3$ grains.

In the extent between each grain and those located at this distance d, the number of grains is:

$$\Sigma g = (g_0^{1/3}-1)^3 d + 3(g_0^{1/3}-1)^2 d(d+1)/2 + 3(g_0^{1/3}-1)d(d+1)(2d+1)/6 + d^2(d+1)^2/4$$

The amplitude $A(p)$ of a wave is such that

$$A(p)\cdot\Sigma g + A_S = A°,$$

A_S being the function of the period p according to which the temperature of the source decreases.

$$A(p) = (A° - A_S) / \Sigma g$$

And the *theoretical* flow F_X is: $$F_X = \frac{\partial A}{\partial p}\cdot\frac{g}{4\pi\cdot p^2}$$

The *nuance* mentioned above comes from the fact that the function Σg, which is indeed in p^4 (or is extremely close to it) for long periods, is not so for the shortest periods.

> A value of g_0 other than 8 would complicate the calculation, but would not affect the principle, and would not be such as to formally affect the results.

The examination of the amplitude of the waves gives rise to the calculation of an **index**:

Index I = slope of the $\log(F_X)$ curve as a function of $\log(\lambda)$

According to Planck's law, this index is equal to -4 regardless of the wavelength.

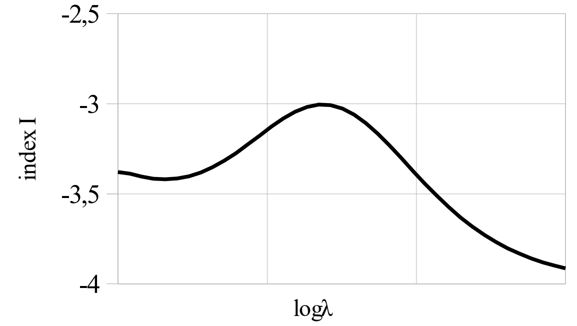
Two calculation assumptions are presented below.

1° In a first calculation, the temperature of the source does not depend on the period of the wave:

$$A_S = 0.$$

Index I would vary as a function of λ along a curve similar to that shown in Graph 6, in which the value of index I tends to -4 for longer wavelengths.

The fluctuation of index I is due to the evolution of g(d): the rate of increase of Σg increases with the period, to stabilize (as a function p^4) with long periods, for which Planck's law is verified.



graph 6

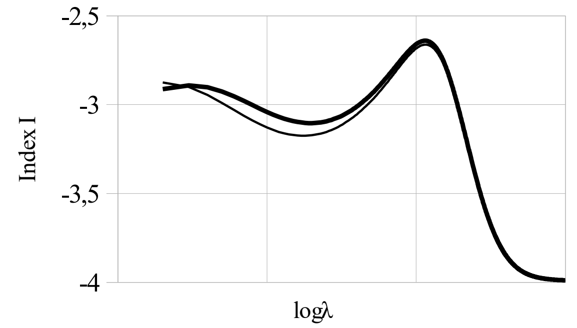
2° If, now, the temperature of the source decreases according to a function $A_S(p)$ of the form

$$A_S(p) = \frac{1}{1+a\cdot\exp(-b.p^i-j)} ,$$

curve I(λ) could look like that in Graph 7.

According to this $A_S(p)$ function, the temperature drop is small for very small wavelengths, then larger, then lower and lower for long wavelengths.

The shape of the curve is due both to the function g(d) and to the way in which the temperature of the source varies with wavelength.

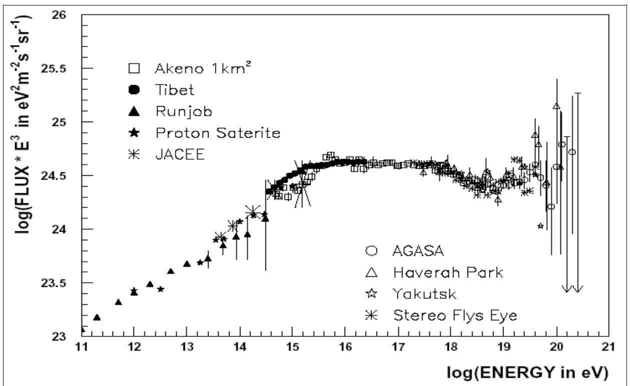


graph 7

In thick lines: $g_0 = 8$

In fine lines: $g_0 = 4$ (approximate calculation: 4 replaced 8 in the functions g(d) and Σg)

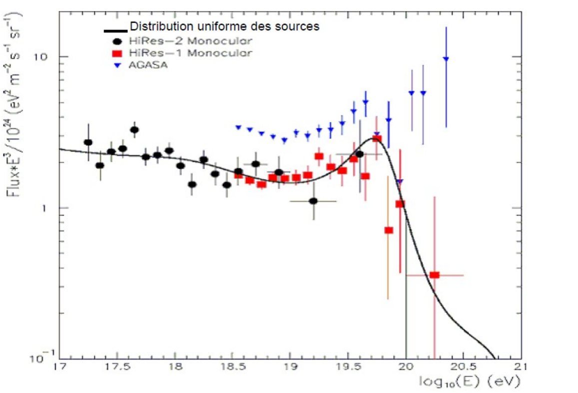
Graph 7 can be compared with Diagram 7.



CR Energy Spectrum : flux*E^3

Source : ref. [5]

diagram 6



Spectrum*E^3 of RCUEs (black line: prediction with the GZK cut)

Source : ref. [6]

diagram 7

In Graphs 6 and 7, the values of the x-coordinates are not specified.

To do so, it would be necessary to be sure of an interpretation of the Planck length: is it an order of magnitude of the absolute unit of extent, or of the size of the smallest material object (cf. §2.4)? And how big is the smallest material object in absolute units?... This is beyond the scope of this note.

The values of the x-coordinates also depend on the parameters of the calculation, in particular those of the function $A_5(p)$, and more particularly on the exponent i of p.

According to the ANIMATED GRANULAR SPACE MODEL, there is a distance such that a lower distance is not conceivable – this is the absolute unit of extent. And there is a minimum wavelength corresponding to it, the elementary wavelength.

The x-coordinates of the two graphs 6 and 7 have in common that their minimum is the elementary wavelength.

The analysis of the law of radiation on the basis of the amplitude of the waves could therefore justify, for the shortest wavelengths, a spectrum of electromagnetic radiation of the form shown in Graph 7.

And cosmic rays (see Diagrams 6, 7 and 8) could well come from electromagnetic radiation of wavelengths short enough for the *theoretical* energy flux F_x to deviate from Planck's law.

If this is so, in Diagram 8 of the spectrum of cosmic rays (next page), it would be because there is nothing more to observe that nothing is observed for the greater energies...

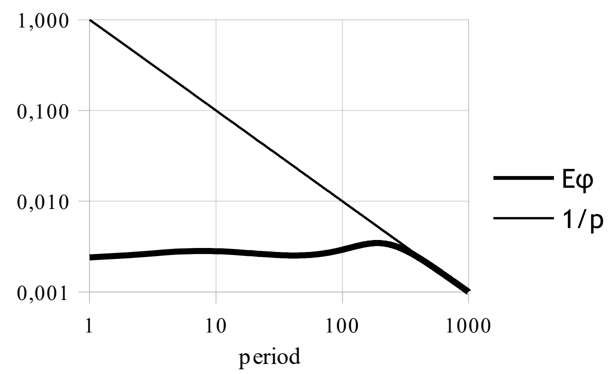
By fitting the curve in Graph 7 to the observations, an attempt could be made to assess:

- the elementary wavelength – and, consequently, the conversion of absolute units of time and extent into S.I. units,
- the parameters a, b, i, j of the function $A_5(p)$,
- the value of g_0 – and the function $g(d)$,
- the diameter of the observable space in absolute units.

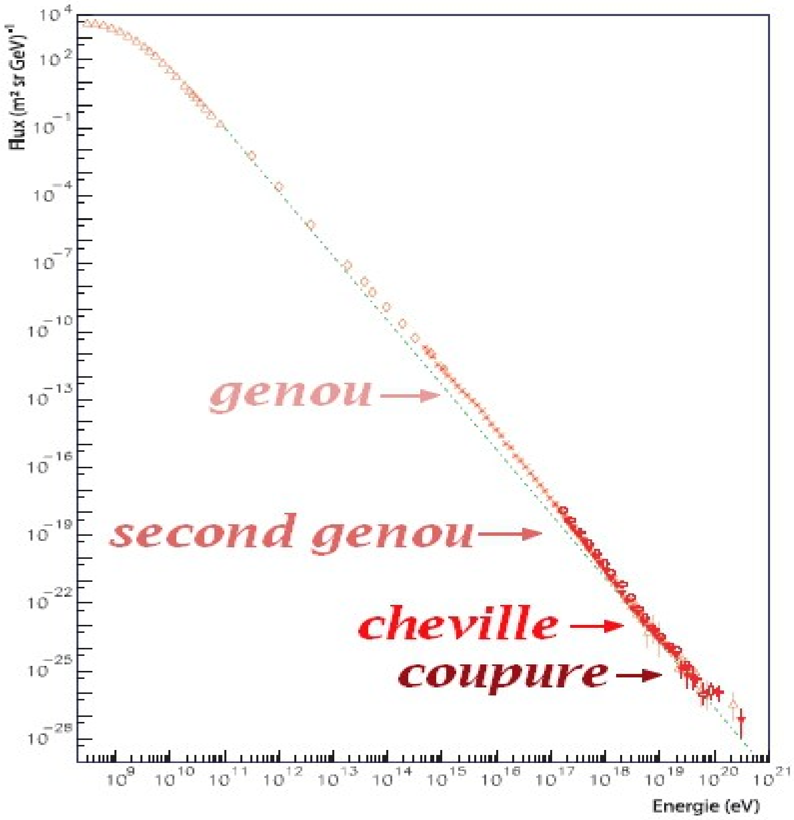
As one will have noticed in passing, the **energy of the photon** would no longer be proportional to the frequency for very short wavelengths.

Under the conditions of the **2°** calculation presented above, the energy of the photon $E\varphi$ could be represented, as a function of the period, according to Graph 8 in which the scales are in absolute units.

Note that the x-coordinate scale is arbitrary: it corresponds, once again, to the parameters of the $A_5(p)$ function adopted in the calculation.



graph 8



Energy spectrum of cosmic ray flux
Source : ref. [4]
diagram 8

3.4 – Conclusions on Radiant Energy Exchange

The exchange of energy by radiation has its origin in one of the two primary tendencies of space: the tendency to uniformity (cf. §1.3.1).

By analysing the energy exchange on the basis of the amplitude of the waves, in the framework of the MODEL, we find Planck's law for sufficiently high wavelengths – the exchange would have deviations from this law for very short wavelengths, such as those of cosmic rays (cf. §3.3.3).
The origin of cosmic rays could well, then, be electromagnetic radiation.

The photon's energy would *stabilize* for the shortest wavelengths.

At the quantum scale, the absolute transfer speed deviates from **1** (cf. §2.3). The period is therefore no longer equal to the wavelength. Deviations of another kind from Planck's law of radiation could result.

In complex reality, the one that can be the subject of observation, what is called *wave-particle duality* has a double meaning: waves *perceived* as *particles*, or elementary material objects, with a period of their own, *interpreted* as waves.

4 – General conclusion

The STRUCTURAL MODEL OF SPACE presented here is based on assumptions, some of which are relatively new:

Space is a **substance**. It has a granular structure. It is the **substrate** of every sensible reality.

It is described by the **extent**, the **time**, and the **state** of its grains. *Space*, understood in this way, and *space-time* say the same thing.

cf. §1.1

Space has a **granular structure**: there are **grains of space**.

Extent and **time** (duration) are both **discrete** quantities.

cf. §1.1.1 & 1.1.3

The grains of space are ***animated***: their **state** (the modalities of their **internal change**, which is not a movement) is variable in extent and time.

cf. §1.1.2 & 1.2.2

Space is governed by two **primary tendencies** concerning the state of the grains:

- The **tendency to uniformity**: a difference between the states of two neighboring grains tends to decrease (**transfer**).
- The **tendency to rest**: the average **transfer speed** in whole space tends to decrease.

These tendencies are at the origin of the phenomena of radiation and gravitation, respectively.

cf. §1.3 & 2.5.3 & 3.3.2

The MODEL establishes the existence of an **unsurpassable** speed – of transfer, as well as of displacement.

The **speed of transfer** – and, consequently, that of light in vacuum – is not the same at all times or in all places in space.

But its variations, where it is measurable, are considerably less than the precision of the measurements of the speed of light.

cf. §1.3.2.2 & 1.4.2

The ***fields*** proceed from the variable nature of the transfer speed and that of the state of the space grains.

An elementary **material object** is a portion of space in which the arrangement of the states of grains is stable. The displacement of an object is that of this arrangement of states.

A material object is therefore *made* of space.

cf. §1.4

The **mass** of a material object is proportional to the ratio between the number of grains in the portion of space it occupies – its volume – and the number of grains in the entire space.

cf. §2.1

There would indeed be an *absolute space*, which would not be accessible to our perceptions or our measurements.

The relationship $E=mc^2$ could be interpreted as a relationship between the mass energy of the object and the speed of transfer.

It is accepted in *classical physics* that every change has a cause and that this cause is a change.

This is not the case with fundamental phenomena – such as gravitation or energy exchange – which are governed by **laws** that respond to **tendencies** of space.

It is in this sense that these laws are ***fundamental***.

cf. §2.5.3 & 3.3.2

And one understands that an effect responding to substrate tendencies, and not to a locally identifiable cause, may not have an unambiguous determination.

This MODEL makes it possible to replicate, under conditions where their verification by measurements is possible, the laws of **gravitation** and **radiation**.

The hypotheses set out above are thus subject to verification and validation.

cf. §2.8 & 3.4

What is called the *Big Bang* (rather, what would be the beginning of the *Big Bang*) would be the first grain (cf. §1.1).

Not the *appearance* of the first grain, since time does not exist without it (cf. §1.1.3) – there is no *before*, therefore there can be no *appearance*. It would not be an event – let alone an explosion.

After this first grain, due to the appearance of new grains, there would be a *dilation* of space – at first very rapid, but constantly slowed down.

The first grain has *always* existed, since time does not exist without it. It has *always* existed, in eternity, which is the absence of time.

It *contains* all the energy of space, that is, of the Universe (cf. §1.5).

We can't say anything about it, except in relation to the space we observe. We can't say anything about it, except that it exists.

And it could be considered that it exists *everywhere*, insofar as it has *shared* all its properties with the grains that have appeared in the course of time – to the point that it is no longer distinguishable from them.

The examination of gravitation and radiation leads to conclusions that are also relatively new.

Gravitation

Gravitation proceeds from a variation in the speed of transfer in the presence of masses (the internal change of the grains of space is slowed down).

cf. §1.3.2 & 2.5.2

The fact that, for the same mass, a **denser** material object appears smaller can be analyzed as a distortion of the trajectory of the transfer.

cf. §2.6

The **curvature of space** is due to variations in the speed of transfer and the distortion of its trajectory.

cf. §2.7

The shape of **orbital velocity** curves in a galaxy centered on an object of very high density can be explained by the laws thus derived, without the need to resort to the hypothesis of ***dark matter***.

cf. §2.6.4

The phenomena of **expansion** and gravitation are independent of each other. At most, it can be said that, in order to evaluate the rate of expansion from observations, it is necessary to take into account the existence of matter (and celestial bodies) and the effects of gravitation.

cf. §1.1

Radiation

The **temperature** of a material object is that of space. The agitation of atoms and molecules is only the consequence of this.

cf. §3.1

The analysis of the energy exchange by radiation on the basis of the **amplitude of the waves** shows that it deviates from Planck's law for very short wavelengths.

For such wavelengths, the **energy of the photon** is no longer proportional to the frequency.

And the shape of the **cosmic ray** spectrum is explained by these differences.

cf. §3.3.3

One will have noticed differences in approach between the analysis of gravitation and that of radiation:

- For gravitation, what is at stake is the speed of transfer, whereas in radiation it is the transfer itself.
- The analysis of gravitation sheds light on the meaning of gravitation, and that of the curvature of space – the analysis of radiation on the basis of wave amplitude justifies a deviation from Planck's law for very short wavelengths.

*

What has been dealt with in these pages finds a place *upstream* of physics and its theories – *upstream* of what is complex: *behind* the complex, there is always something simple.

There is nothing to suggest that the ***reversal of perspective*** (cf. §2.5.4) calls into question the theories in force.

In particular, although the MODEL attributes to space *a real existence independent of matter*, this seven-dimensional space endowed with an absolute metric is animated, and the transfers take place according to curvilinear trajectories and at variable speeds, so that the characteristics of *space-time* of the theory of relativity are found there.

This *reversal* makes possible, on the other hand, an interpretation of reality that is likely to complete these theories and, perhaps, to unify them.

It is the interpretation of proven laws that this *reversal* calls into question. And it leads to the clarification of their areas of validity.

It is not surprising that the fundamental laws of physics flow rationally from the STRUCTURAL MODEL OF SPACE, if it is true that material objects are *made* of space: we are in fact – whether we reduce ourselves to it or not – material objects, and the nature of space is therefore not foreign to us.

Let us recall that the MODEL considers reality at its finest scale, which is that of simple objects – the grains of space.

The laws proposed there account for the phenomena of gravitation and radiation observed, and they would be valid at all scales.

However, the MODEL only evokes phenomena related to the complexity of material objects, even those as small as *elementary particles*.

At the infra-material scale considered, the simplicity of phenomena is real and reflects that of objects.
At the *elementary* level, the complexity of phenomena goes hand in hand with that of material objects.
At a human scale, there is a relative simplicity, apparent and linked to an effect of numbers.

> The STRUCTURAL MODEL OF SPACE therefore does not claim to be a faithful and complete description of sensible reality – at most one can wonder if it would not be *something like that*.

The laws of gravitation and radiation are constitutive, under conditions where they are experimentally verifiable, of *knowledge*. To have an *universal* character, and therefore not to be only *true and justified beliefs* under such conditions, they lack to have been experimentally verified *under all conditions*.
The requirement *under all conditions* is impossible to satisfy. However, current means do not allow them to be verified under certain conditions.
The establishment of universal laws verified in extreme conditions such as very small masses, very high densities, very high temperatures, very short wavelengths – and thus the verification of what is proposed here – will only be possible (**observations relative to orbital velocities in galaxies, and to cosmic rays, not being sufficient**) by examining their indirect consequences.

Some suggestions to extend this work – obviously incomplete

1► What form would the law of gravitation take for **very small material objects of very high density**? (cf. §2.8)

2► It has been said that the animation of the grains of space consists of a **beat**, in a dimension other than those of the extent (cf. §1.2.2). Several dimensions may need to be considered for the amplitude of the beat.

3► It has been said that the speed of transfer depends on the presence of material objects (cf. §2). But it would also depend on the **temperature**, and it would be all the smaller the lower the temperature (cf. §2.2),
Does it also depend on

- of the **charge** of objects (cf. §3.1)? – the analysis of the electrostatic force could be carried out in a homologous manner to that of gravitation.
- of the **period**, the transfer speed being then all the smaller the longer the period?

If the objects are very small, then the variations in the transfer speed would be all the less negligible (cf. §2.3).
And it may well be that the mathematical formulas are no longer so simple...

4► It has been said that

- *the temperatures observed are those of space, the agitation of atoms and molecules being only the consequence* (cf. §3.1).
- *the average transfer rate in whole space tends to decrease* (cf. §1.3.2).

Doesn't that give us something to think about **entropy**?...

Indeed, thermal energy, of an *electromagnetic* nature, is always associated with what could be called a *transfer energy* (or ***energy of space***), which could be considered of a *mechanical* nature, although it is present in vacuum. This *energy of space* is due to the speed of transfer, which decreases in the presence of material objects, and would increase with temperature (cf. §2.2). Like the supposed ***dark energy***, it *counteracts* the tendency to rest, and therefore gravitation.

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