

# Gravitation explains Superluminal Neutrinos

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## Abstract

This article explains mass and gravitation in a 4D space, with  $m = f(x,y,z,t)$ . This explanation is not a new theory per se but the result of the association of three basic observations concerning: 1/ The constitution of atoms, 2/ General Relativity, and 3/ The equivalence *Attractive force*  $\equiv$  *Pressure force* (in absolute value). This association shows that mass and gravitation are two identical phenomena, and that gravitation is not an attractive force but a pressure force exerted by the curvature of spacetime on objects that tends to bring them closer to each other. The superluminal neutrinos experiment conducted by the OPERA Collaboration is a direct consequence of these observations and has been predicted on May 3, 2008, by the author. This article also explains many other enigmas of physics such as the increase of the mass of relativistic particles, dilatation of time, attraction of the light by mass,  $E=mc^2$ .... Consequences in astrophysics are also very important.

## 1 Introduction

Mass and gravitation are explained by the association of the three following observations:

### 1 - Constitution of atoms

Examination of atoms highlights two kinds of volumes: 1/ Volumes with mass, such as the nucleus and electrons, and 2/ Massless volumes, such as the volume of orbitals. So, all volumes are not alike regarding mass, some have mass, others don't. Here we show that separating these two classes of volumes conducts to a new vision of the relationship between mass and volume.

### 2 - General Relativity (GR)

The origin of GR is the Fluid Mechanics: the fluid (spacetime) exerts a pressure on objects. More precisely, the trace of the Hooke Tensor describes an isostatic pressure. Since we are facing a pressure, it becomes possible to extract the mass component [M] from the pressure [M/LT<sup>2</sup>]

using simple mathematical operations.

### 3 - Attraction vs pressure force

During the last century, some physicists have suggested that gravitation would not be an attraction but a pressure force on objects. This suggestion failed because some explanations were missing: what is the origin of this pressure? what does "object" mean? why it is not possible to get the Newton Law from that suggestion? disagreement with 1919's Sir Eddington Experiment... This idea, full of good sense, has been taken again, but on new basis (volumes + GR). Result is a perfect explanation of mass and gravitation.

To summarize, these three evidences that everyone knows taken separately do not explain anything, but taken together (1 + 2 + 3), give the solution to mass and gravitation.

## 2 Origin of mass

All objects in the universe can be classified in two basic types of volumes:

**a/ Volumes with mass, or "Closed volumes"** (fig. 1a), such as elementary particles. Their internal spacetime "pushes" the surrounding spacetime to make room. Thus, "closed volumes" produce a convex curvature of spacetime. Since the latter has properties of elasticity (Einstein), it exerts a pressure on the surface of these volumes, as shown in GR and Fluid Mechanics (Hooke Tensor). As a result, a "mass effect" appears, i.e. an effect having all the characteristics of mass. The mass component  $[M]$  can be

extracted from the pressure  $[M/LT^2]$  by simple mathematical operations. This conducts to a 4D expression of the mass as  $M = f(x,y,z,t)$ .

**b/ Massless volumes, or "Open volumes"** (fig. 1b). It is a vacuum but sometimes found in various forms such as the volumes of orbitals of atoms. These volumes exist but they are "porous" regarding spacetime. More exactly, they are subject to variations of spacetime but they don't curve spacetime themselves. Therefore, open volumes are massless since *no curvature* means *no mass* (Einstein).

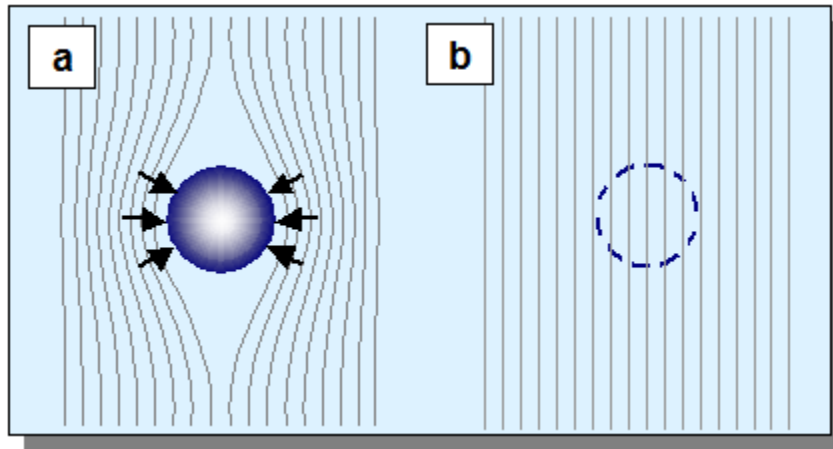


Figure 1: Pedagogical representation of closed and open volumes in 1D

## 3 Relation $M = f(\text{closed volume})$

The *mass effect* and *closed volumes* are connected by a 4D relation  $M=f(x,y,z,t)$  described in Supplementary Information C:

$$M = \frac{c^2}{G_0} \epsilon_v \frac{V}{S} \delta \quad (1)$$

with:

$M$  = Mass effect (kg),  
 $V$  = Volume of the closed volume ( $m^3$ ),  
 $S$  = Surface of the closed volume ( $m^2$ ),  
 $c$  = Speed of light (m/s),  
 $\epsilon_v$  = Coefficient of elasticity of spacetime,  
 $G_0$  = Universal constant of gravitation,  
 $\delta$  = Density of spacetime (vs. flat spacetime).

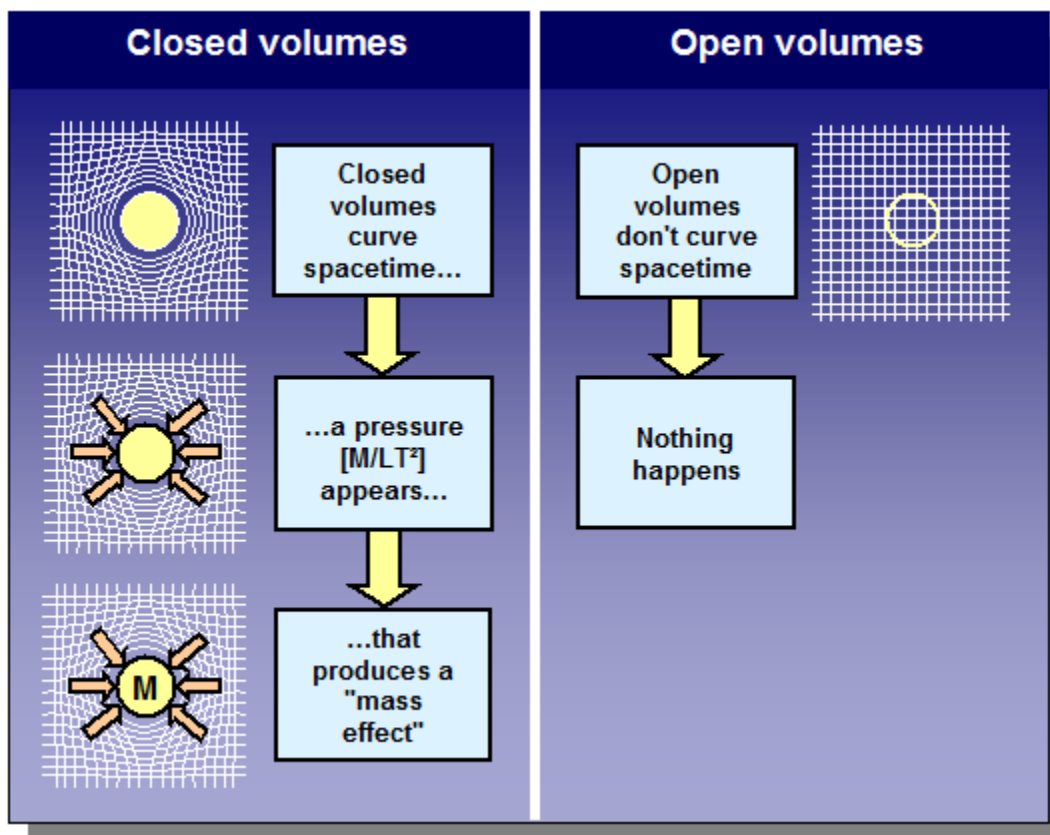


Figure 2: Closed and open volumes in 2D

## 4 Apparent volumes

Objects we use daily are apparent volumes:

$$\text{Apparent Volumes} = \sum \text{Closed Volumes} + \sum \text{Open Volumes}$$

Apparent volumes, mainly atoms, are a combination of:

**Closed volumes** such as elementary particles. These volumes deform spacetime and, therefore, have a mass, more precisely a "mass effect".

**Open volumes** such as volumes of orbitals or space between atoms. These volumes are transparent regarding spacetime and doesn't have mass.

The proportion of closed/open volumes, i.e. volumes with/without mass, varies from one atom to another, from one molecule to another, from one object to another... This is why we feel that mass and volume are two different quantities. This is an illusion. It is the proportion of closed/open volumes that varies from one object to another, which gives us this feeling.

To summarize, we must always have in mind that, strictly speaking, the word "Volume" without any precision doesn't mean anything, at least to understand the curvature of spacetime, mass, and gravitation. It is important to clarify our definition of volume. Are we talking about:

- Closed Volumes?**
- Open Volumes?**
- ...or Apparent Volumes?**

Since these volumes have different behaviors regarding mass, we must differentiate them.

## 5 Gravitation

If we replace the closed volume of figure 1a by two or more closed volumes (fig. 3b), an external pressure made by spacetime on the two objects appears. The result is that of an attraction.

Finally, mass and gravitation are nothing but the consequence of the pressure of spacetime on closed volumes. As shown in fig. 3, in both cases

we are faced with the same phenomenon. So:

**Gravitation is not an attractive force between masses, but a pressure force exerted by the convex curvature of spacetime on closed volumes that tends to bring them closer to each other.**

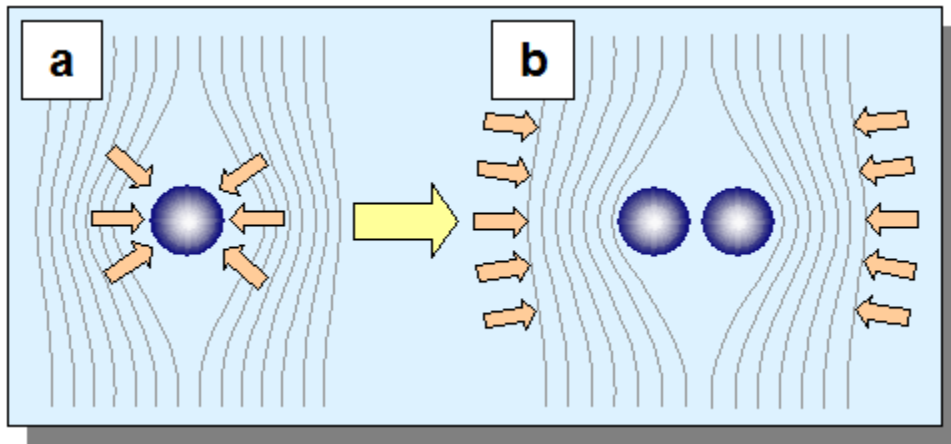


Figure 3: Mass and gravitation are two identical phenomena

## 6 Curvature of spacetime, mass and gravitation

Figure 4 (next page) explains in four steps how closed volumes can produce a curvature of spacetime that leads to mass and gravitation.

*Note: It is not the mass that produces the curvature of spacetime but the reverse. As explained in Supplementary Information E, this assertion is in line with GR.*

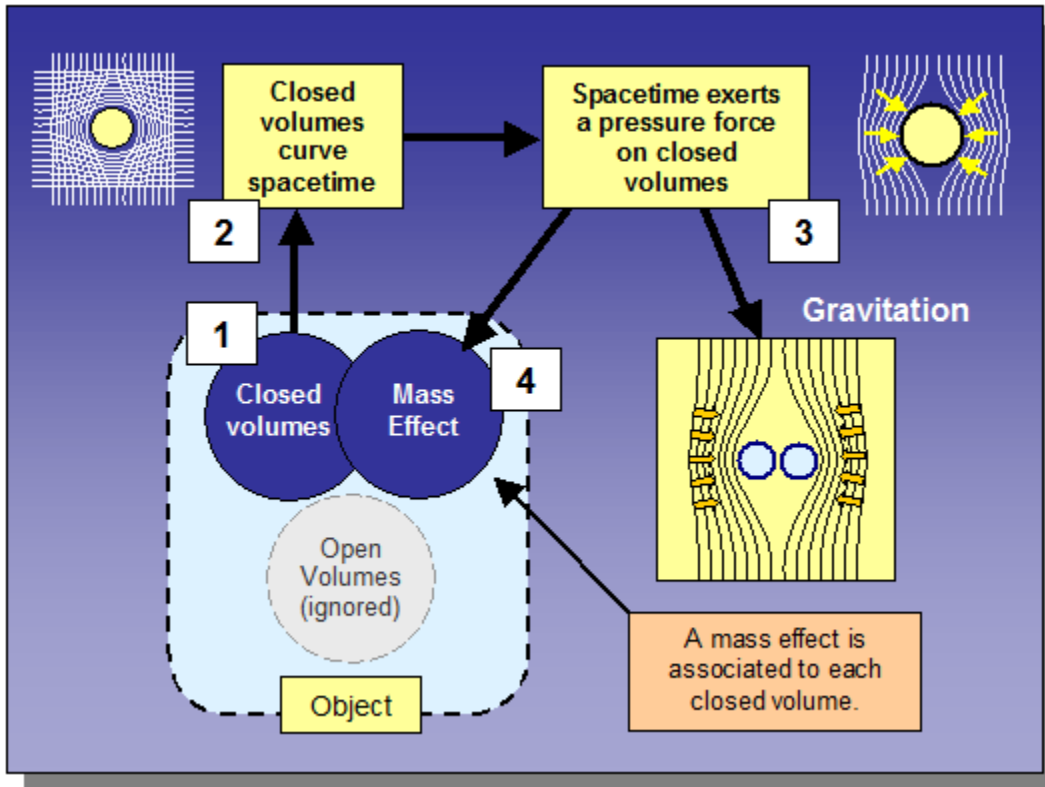


Figure 4: Explanation in 4 steps of the curvature of spacetime, mass, and gravitation.

## 7 Earth-Moon curvature of spacetime

Let's consider the spacetime curvature of the Earth on points L and R (fig. 5, next page):

**Point L** (Left side): The curvature of spacetime of the Moon is added to that of the Earth.

**Point R** (Right side): The curvature of spacetime of the Moon is subtracted from that of the Earth because the two curvatures are in opposition.

So,

$$\mathbf{L \text{ curvature} > R \text{ curvature}}$$

Since the *curvature of spacetime*  $\rightarrow$  *pressure*,

the pressure of spacetime on the left side of the Earth (black arrows on fig. 6, next page) is greater than that on its right side (red arrows). In reality, fig. 5 and 6 are two different representations (curvature of spacetime vs pressure) of the same phenomenon.

This imbalance of pressures will generate forces that move the Earth toward the Moon and conversely. This is "Gravitation". It also explains tides. Seas movements don't come from the attraction of the seas by the Moon, a phenomenon that no one can explain (gravitation), but from the difference of pressures of spacetime on both sides of the Earth, as shown in fig. 6.

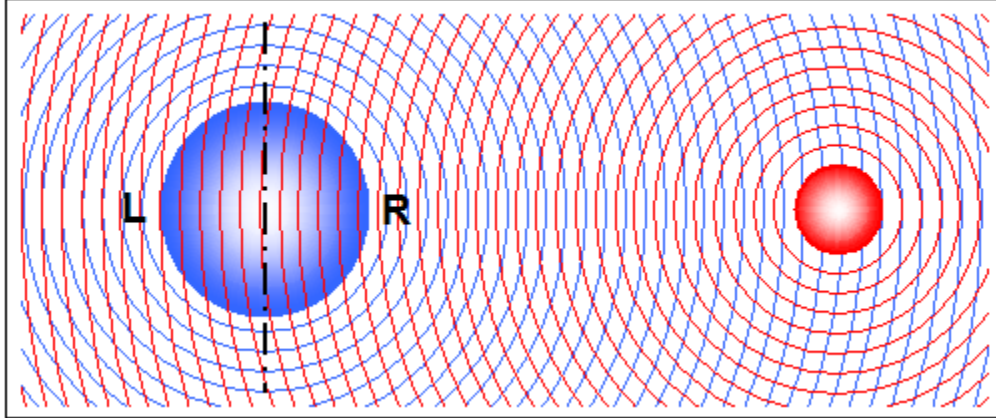


Figure 5: Pedagogical representation of the curvature of the Earth and the Moon in 2D

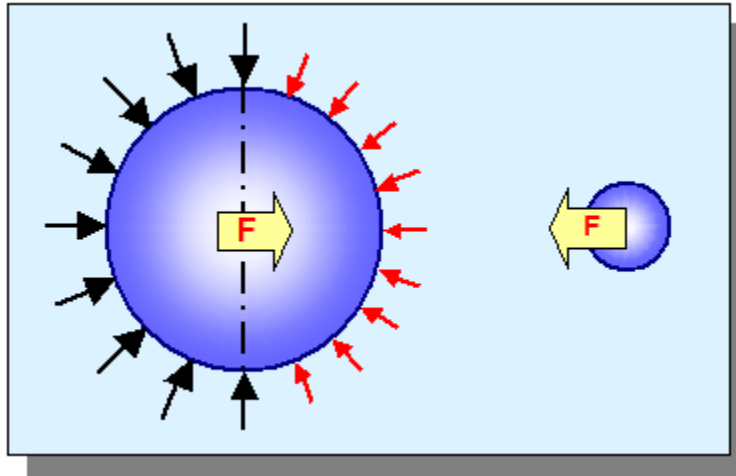


Figure 6: This figure is identical to fig. 5 since *curvature of spacetime*  $\rightarrow$  *pressure*

## 8 Particles in a crystal

Why does the mass of a particle crossing a crystal increase? Here we explain this anomaly which is exactly the opposite of that of superluminal neutrinos (see section 9).

The lattice of a crystal is an array of tunnels. The particle moves inside one of these tunnels. Closed volumes of each atom of the crystal (nucleus and electrons) curve the spacetime located inside the tunnel, on the path of the particle. As

explained in the precedent sections and as shown in equ. (1), if the density of spacetime increases, the mass effect of the particle increases too.

*Note: The increase of mass has been predicted by the author early in 2005 [3]. In 2006, the author became aware of the anomaly of particles crossing a crystal. Under these circumstances, this prediction is not validated since it is later than the experiment.*

## 9 Superluminal neutrinos

Fig. 7 shows that the curvature of spacetime is null in the green area between the Earth and the Moon. This "zero gravity zone", more exactly this "flat spacetime zone", is well-known.

The path of neutrinos from the CERN to Gran Sasso [1] divides the Earth into two unequal parts similar to the Earth and the Moon. An area of *low curvature of spacetime* (in yellow)

low) exists because the spacetime curvature of the Alps partially annihilates that of the Earth.

The decrease of the density of spacetime in the yellow area leads necessarily to a decrease of the "mass effect" of neutrinos (equ. 1, paragraph 3). Since the energy of neutrinos is constant [2], a decrease of their "mass effect" conducts automatically to an increase of their speed.

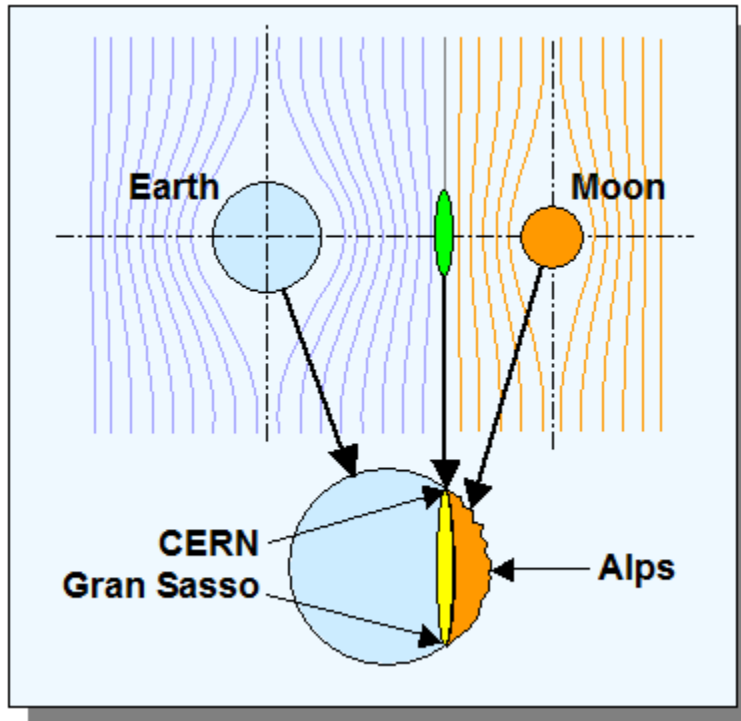


Figure 7: Comprehensive explanation of the superluminal neutrinos anomaly

## 10 Predictions

The author has already made two predictions:

**a/ Particles crossing a crystal.** However, this prediction is not validated for the reasons explained in section 8,

**b/ Superluminal neutrinos.** On an official

paper dated May 5, 2005 [3], the author [6] explains the mechanism of the curvature of spacetime and its relation with mass and gravitation. On May 3, 2008, on other official papers [5] but also in his websites [4] confirmed by a Bailiff, he predicted the variation of the mass of particles, including muons neutrinos.

So, **this prediction is validated.**

Many other easy-to-verify predictions can be conducted to validate this explanation of mass and gravitation. For example, since the mass is function of the density of spacetime, a measurement of the mass of a particle during 7 days must highlight 7 sinusoidal variations due to the Moon influence on the curvature of spacetime each revolution of the Earth. Theoretically, any modification of the density of spacetime must

lead to a modification of the mass of the particle measured.

**Note:** *Physicists interested in setting up experiments on other predictions of the author may contact him at [6]. If these experimentations are successful, physicists and/or laboratories that have conducted these experiments will be associated to the theory to get possible prizes or awards.*

## 11 Objections

The main objections to this explanation of mass and gravitation are:

**1. Misunderstanding.** It is important to understand well the difference between:

- *Mass,*
- *Mass effect,*
- *Volumes,*
- *Closed volumes,*
- *Open volumes,*
- *Apparent volumes.*

For example, saying "the light is curved by volumes" is wrong, whereas "the light is curved by closed volumes" is perfectly correct.

**2. Simplicity.** Some physicists consider that this explanation of mass and gravitation is too simple to be credible. This objection is irrelevant because the simplicity (or complexity) of a theory is not a criteria of validation.

**3. Spacetime.** At last, the behaviour of spacetime is often questionable. Please read books or web articles about Relativity.

## 12 Supplementary Information (mathematics)

Supplementary information are available from internet [8]:

A - New calculation of the Newton Law,  
B - New calculation of the Schwarzschild Metric,

C - Expression of the Mass Effect  $m=f(x,y,z,t)$ ,  
D - Increase of the mass of relativistic particles,  
E - Revisiting Einstein Field Equations (EFE),  
F - Von Laue Diagrams and black holes,  
G - New explanation of the equivalence principle.

## 13 Download

Use [7] to download this article (9 pages).

Use [8] to download Supplementary Information (24 pages).

Use [9] to download the full article, i.e. this article + mathematics section (33 pages).

## 14 References

- [1] ArXiv 1109.4897, OPERA Collaboration
- [2] ArXiv 1110.3763, ICARUS Collaboration
- [3] Copyright: INPI references: 238268, 238633, 244221, 248427, 258796, 261255, 268327, 297706, 297751, 297811, 297928, 298079, 298080, 329638, 332647, 335152, 335153, 339797.
- [4] Author's Website: In 2011, the 2007 original website has been replaced by [www.superluminal-neutrinos.com](http://www.superluminal-neutrinos.com)
- [5] Prediction: Theory of Everything, ISBN 978 2953 1234-0-1, version 2,53, prediction on page 209, printed on April, 11, 2008, published on May, 3, 2008.
- [6] Author's email: [diaverre@sfr.fr](mailto:diaverre@sfr.fr)
- [7] [http://www.jacky-jerome.com/latex/neutrinos\\_lite.pdf](http://www.jacky-jerome.com/latex/neutrinos_lite.pdf)
- [8] <http://www.jacky-jerome.com/latex/mathematics.pdf>
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