The Spacetime Model ®

Part 2/5

Constitution of Matter

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In 2006, this theory was addressed to more than 7000 physicists worldwide by e-mail. Several paper copies were sent in October 2006 to the most important Academics of Science and Committees of Foundations for Research.

This theory was also published on November, 30, 2006, on 28 different web sites. It is also referenced on many sites such as Google, Google Books, Yahoo, DMOZ... Since 2006, more than 300,000 Internet Users (about 230,000 Physicists) have read it.

Important note

This paper attempts to explain some enigmas of modern physics. In this regard, some parts are speculations, but Science can only advance through speculative theories.

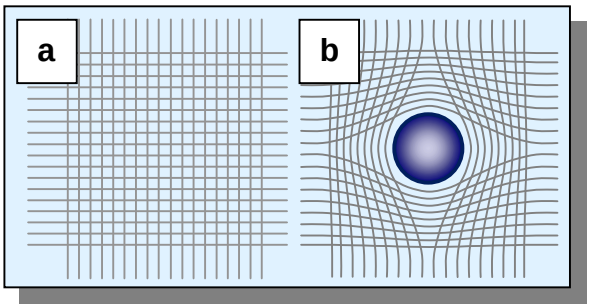
To date, the Spacetime Model, is nothing but a theory. Despite the fact that this theory is logical, coherent, and makes sense, the reader must be careful, bearing in mind that the Spacetime Model has not yet validated by experimentation.

Before reading…

To fully understand this part, the reader must be familiar with the deductions and results developed in Part 1. These results are summarized below:

The curvature of spacetime

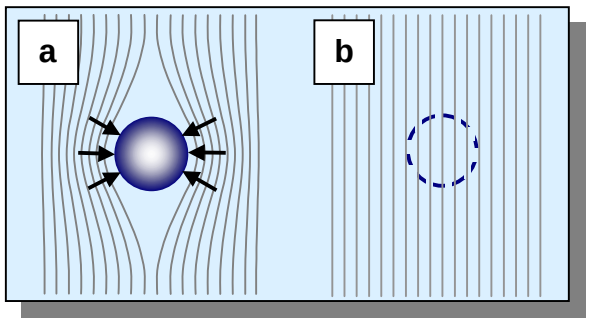
Lets consider a flat spacetime (a). It could be logical to consider that it is the volume, not the mass, that curves spacetime (b).



Einstein Field Equations and experimentations show that it is the mass, not the volume, that deforms spacetime… The solution to this enigma is given below.

Closed and open volumes

All volumes have not the same behaviour regarding spacetime. In reality, we have three classes of volumes:



a/ Volumes with mass, or "Closed volumes" 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 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).

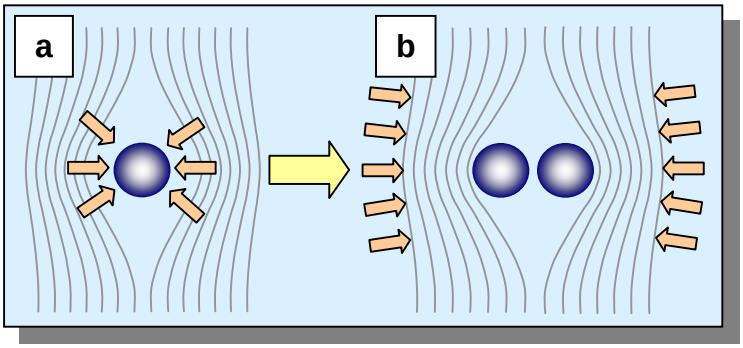
b/ Massless volumes, or "Open volumes". It is a vacuum but sometimes found in various forms such as the volumes of orbitals of atoms. These volumes exist but they are "porous" regarding spacetime. More exactly, they are subject to variations of spacetime but they don't curve spacetime themselves. Therefore,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

c/ Apparent volumes are combinations of closed and open volumes. In atoms for example, the nucleus is a closed volume which has mass, whereas orbitals are massless open volumes. 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.

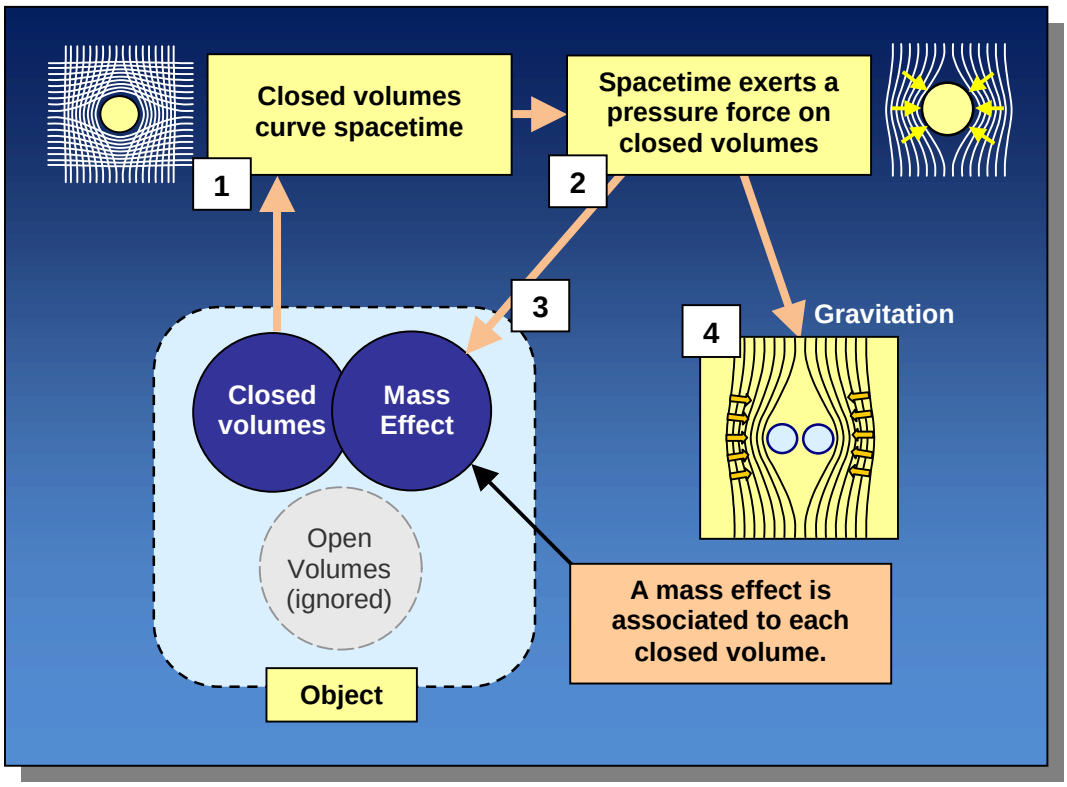
Mass and Gravitation

Two closed volumes inserted into spacetime curve it. Since spacetime is elastic, its curvature produces pressures on these two volumes. So:

Gravitation is not an attractive force between masses but a pressure force exerted by spacetime on closed volumes that tends to bring them closer to each other



As shown in this figure, mass and gravity are the same phenomenon



Note: Part 1 also shows that the Higgs Field is nothing but Spacetime.

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1 Wave-Particle Duality

Matter presents the particularity of having a wave and particle behavior. This phenomenon is known as "wave-particle duality", or "complementarity". However, this enigma, which has been challenged by so many physicists, has still not been solved.

This chapter solves the mystery of wave-particle duality.

1.1 Current definition of the duality

It is generally accepted that wave-particle duality is two different visions of a single object (fig. 1-1). Usually, physicists take a cylinder to explain duality. We observe either a rectangle or a circle depending on where we stand.

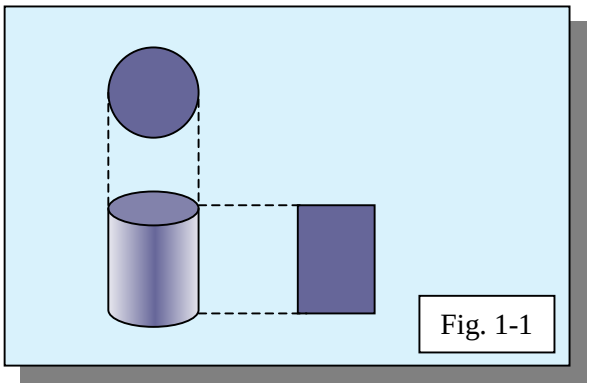


Fig. 1-1

This metaphor is very interesting but it doesn't explain anything. It does not explain what really occurs at the particle level.

As physicist, it is necessary to leave this philosophical aspect to the philosophers and to try to solve this enigma in a scientific way, with a logical and rational explanation.

1.2 Wave-particle duality

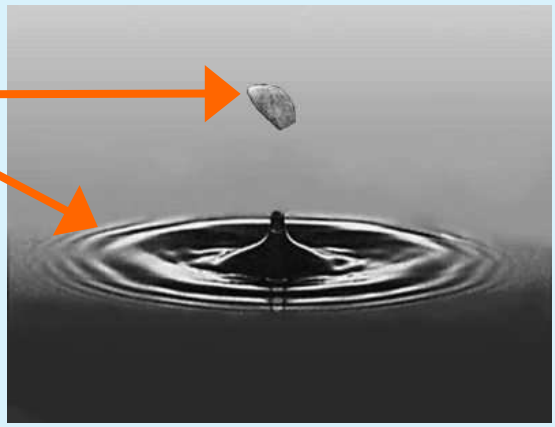
To explain relativity, Einstein used metaphors such as a train (lengths dilatation) or a lift (equivalence principle). Here we use the same method to explain the duality.

As shown in Fig. 1-2, example 1 doesn't explain the wave-particle duality. In example 2, the corpuscle is a drop of water, which is of identical matter than the wave.

The same object (water) has either a particle behaviour (drop) or a wave behaviour. We are exactly in a wave-particle duality situation. This photograph proves that the wave-particle duality also exists on Earth.

Example 1
A stone
and a water wave
*are of **different matter**.*

In that case, the wave-particle duality can't be explained. It is an enigma.



Example 2
A drop of water (corpuscle)
and a water wave
*are of **identical matter**.*
Water has either a corpuscle behavior or a wave behavior.

In this particular situation, wave-particle duality is explained with logic and consistency.

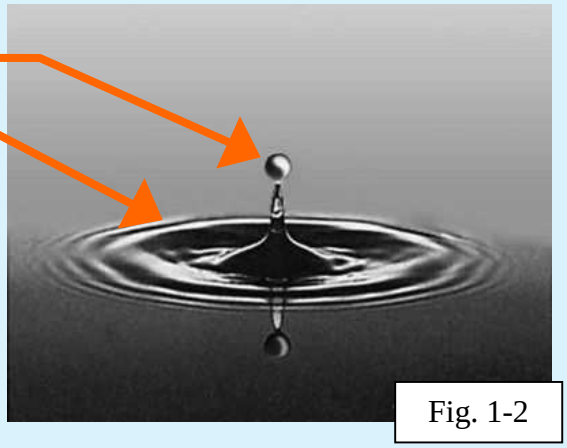


Fig. 1-2

1.3 Example of a swimming pool

A toy boat is in the middle of a swimming pool. If you want to capsize it, you have two possibilities: to launch stones (particle concept) or to make waves (waves concept).

Let's replace the stones with a high-pressure washer. The water that is emitted from it can be considered a particle and has a corpuscular behaviour. In fact, we can capsize the small boat by pointing the hose towards it.

Now let's put the nozzle in the water in the swimming pool. The water emitted from the hose, which was like a particle in the air, will also be like a particle in the water. This operation does not change the corpuscular nature of the water that is emitted from the nozzle.

If, moreover, we activate the pressure washer for a short time, comparable to the action time of a particle, we can see that the small jet of water emitted from the nozzle becomes a single wave.

We can observe that the water is transformed gradually into waves. As we can see in this example, the water has either a corpuscular or a wave behaviour.

1.4 Example of Niagara Falls

Nature offers us identical situations: the water of Niagara Falls has a particle behaviour during its fall and, once it has reached the river down below, the particles become "eddies", or waves.

1.5 Opposite example

The opposite situation also exists.

Let's consider for example an almost empty swimming pool. If we make only one wave in the residual water, some amount will spill out of the drain valve. Thus, the wave is transformed into a short filament of water, or "particle". The water coming out of the drain valve is obviously not a wave. Yet, it is the same water that, a few seconds ago, was a wave.

1.6 Summary

All these examples have a common point:

- When the particle and the wave are of different matter, like a stone and water, the mystery of wave-particle duality can't be explained.
- On the contrary, if the particle and the wave are of identical matter, like water/water in our examples, the wave can be transformed into particles and the converse.

However, in our example of swimming pool, water coming out of the nozzle can't be transformed into waves if the experiment is done in the air. This transformation is possible only if the medium is also water.

In other words, the medium must also be in the same composition as the particle and the wave. This is a necessary condition. In other words:

Wave – particle duality appears only in the very particular situation where the wave, the particle and the medium are of identical matter.

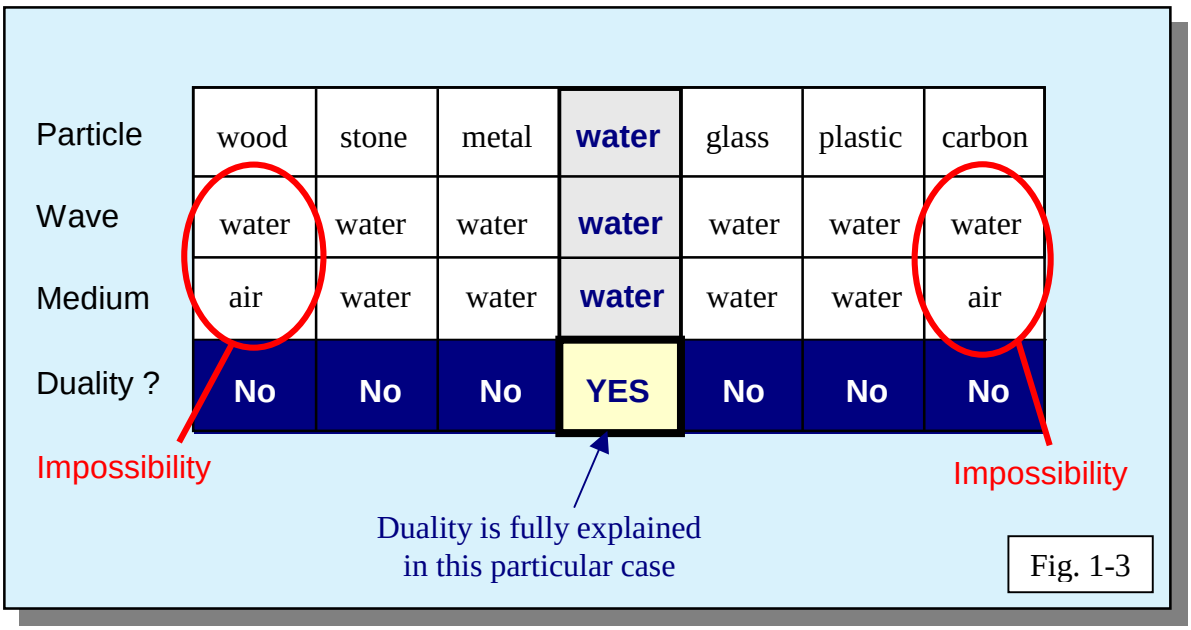


Fig. 1-3

As shown in Fig. 1-3, we have a duality in the following cases: water/water/water, air/air/air, or spacetime /spacetime/spacetime, the latter being useful later. If one of these three objects is different from the others, the duality can't be explained logically and becomes a true mystery.

Note: Medium and waves are obviously of identical matter. However, we will separate them for teaching purposes. Sometimes, we will use the wave concept, for example when we are talking about 511 KeV gammas, and sometimes we will use the medium concept.

1.7 First principle of duality

1

Wave-particle duality can exist if, and only if,

- **the particle,**
- **the wave,**
- **the medium,**

have the same constitution.

1.8 Second principle of duality

As we saw in the preceding example of the pressure washer, the wave state appears only if the particle is moving. Otherwise, **if the particle is motionless, it remains in a corpuscular state**. Hence:

2

When the particle is moving, it becomes a wave

This principle is very important since it solves many enigmas of modern physics. For example, electromagnetism only appears when the charged particle is moving. If the particle is at rest, electromagnetism doesn't exist.

1.9 Third principle of duality

In the swimming pool example, the water of the pressure washer is transformed gradually, in intermediate phases, from a particle state into a wave state. Obviously, all these states of transition between particle and wave cannot coexist. It is either one or the other but not several states together.

Experimentations on particles confirm this fact. Indeed, the particle and wave states never appear simultaneously. So, resulting from experimentation, we can say:

3

The element concerned can exclusively take one, and only one, of the three following states:

1 - Particle state, when it is motionless
2 - Wave state, when it is moving
3 - Halfway state between wave and particle, during the transition.

1.10 History

(The following two sections may be bypassed on first reading).

Why, since 1905, has this enigma never been solved?

In fact, the real question arising is: “Is there not the possibility that we are in the particular case where waves, particle and medium are of the same constitution?”.

The answer is YES.

There is perhaps a probability of 1 per 1000, but this possibility exists.

Unfortunately, since 1905, physicists have great difficulty solving this enigma because **they have generalized a particular case**. Indeed, trying to understand the wave-particle duality with, for example, a stone and water, leads to a true enigma.

As we see, the only way to explain logically the wave-particle duality is to consider that, in quantum mechanics, we are in the particular case where waves, particles and medium are of the same constitution.

1.11 Conclusions

Duality has always been regarded as a burden for the physicists because no one has been able to explain it rationally. This enigma is summarized as follows:

> *"We note a wave-particle duality, which is very strange. However, this is a normal situation since quantum mechanics is, by definition, illogical and irrational".*

This document does not share this "theory of irrationality" of some physicists concerning quantum mechanics. It transforms this disadvantage into an advantage. Instead of regarding duality as a burden, it regards it as fortuitous, the great opportunity to solve the mystery of matter. Indeed, this enigma, which is no longer a mystery, is summarized as follows:

> *"Since we note a wave-particle duality in quantum mechanics, we can deduce from this that **waves, particles and medium** have the same constitution. This is a necessary condition. Thus, if we find the constitution of the medium, we will know the constitution of waves and particles and the converse".*

-o-o-o-o-o-

Note
The Young Slits Enigma is covered in Part 4 "Electromagnetism".

2 Speed of Light

Electromagnetic (EM) radiations are mathematically described with a high degree of accuracy, but no one is able to explain the constitution of photons, EM waves, and why the speed of light "c" is constant: c = 299,792,458 m/s.

To solve these enigmas, we will proceed by an indirect method. In this chapter, we will try to understand why "c is invariant. There is a good probability that the solution to this enigma will lead us to the constitution of EM waves.

Since the first principle of wave-particle duality shows that waves and particles have necessarily the same constitution, the knowledge of the constitution of EM waves leads us directly to the knowledge of the particles. So, the solution to the c invariance, although interesting, is not an end per se but rather a method of investigation by which to solve the mystery of the constitution of particles.

Note: this chapter doesn't cover the photon enigma which is covered by Part 4.

2.1 History

(This section may be bypassed on first reading).

The nature of EM radiations has always been the "pet peeve" of physicists. To this day, this problem has not been solved.

- Newton, during his time, thought that light was made of particles.
- In the nineteenth century, physicists favoured the wave concept. EM waves were propagated in aether, an unknown propagation medium.
- In 1905, continuing the works of Max Planck (Nobel Prize - 1918), Albert Einstein (Nobel Prize - 1921) built a particle theory of EM radiations. The concept of aether became obsolete since photons do not need any aether to be propagated. However, some problems, like Young's experimentations for example, were still not solved with the photon concept.
- Later, in 1922, Einstein returned to aether. He was confronted with the problem of duality since the photon is incompatible with the wave, and therefore with aether.
- In 1959, 39 years later, Louis de Broglie (Nobel Prize - 1929) proposed the idea that the aether was made of neutrinos.
- Around 1980, physicists verified once more the constant speed of light with quasars, using embedded systems and telescopes in satellites.

These recent experiments show that the propagation of EM waves and the enigma of the constant speed of light are still not solved. The aether concept would help but no one is able to give an exact definition of it.

Finally, since 1905, the enigma of the constitution of the light has been so persistent it prompted Louis De Broglie to say: *"Science will make a great step ahead the day that it can explain a simple ray of light"*.

2.2 Method of investigation

One of the peculiarities of the EM wave is that it can be propagated in a vacuum. But in a vacuum… there is nothing… and the EM wave cannot exist in the absence of a propagation medium.

The introduction of the photon partially solves this problem. Indeed, like any particle, the photon can move in a vacuum. However, if an EM radiation behaves like a particle in 90% of the cases, it also behaves like a wave in the remaining 10% of cases, as in Young's slits experimentation. The enigma thus remains unsolved for these cases.

In quantum mechanics, lacks of understanding basic phenomena don't occur in one's, two's or three's, …but in ten's (What is Mass, Gravitation, Electromagnetism, Young Slits, EPR, why "c" is constant…). In such a case, the only thing to do is to **forget the classic schemes of physics and restart with a blank sheet**, ignoring the few laws of quantum mechanics that are inconsistent with logic and good sense but bearing experimentations in mind.

Therefore, to understand the nature of EM radiations, we must return to the early 1900's, when Einstein explained the photoelectric effect and discovered special relativity, but taking into account all these experimentations conducted since 1900's.

As stated, the particle aspect of EM radiations, namely photons, will be discussed in Part 4.

2.3 Separation of media

The problem of velocity additions suggests that we are in the presence of two distinct media:

1 - "Apparent medium"

This is the visible medium that carries out the experimentations, and from where the EM wave is emitted. For example, in Fizeau's experimentation, this medium is water, and in Michelson's, it is the Earth's atmosphere moved by the Earth itself.

2 - "Real medium"

EM waves are propagated in a "real medium". For example, this *"Real Medium"* could be the De Broglie "Neutrinos Sea".

This consideration leads to consider that the *"apparent medium"* and the *"real medium"* are overlaid (fig. 2-1).

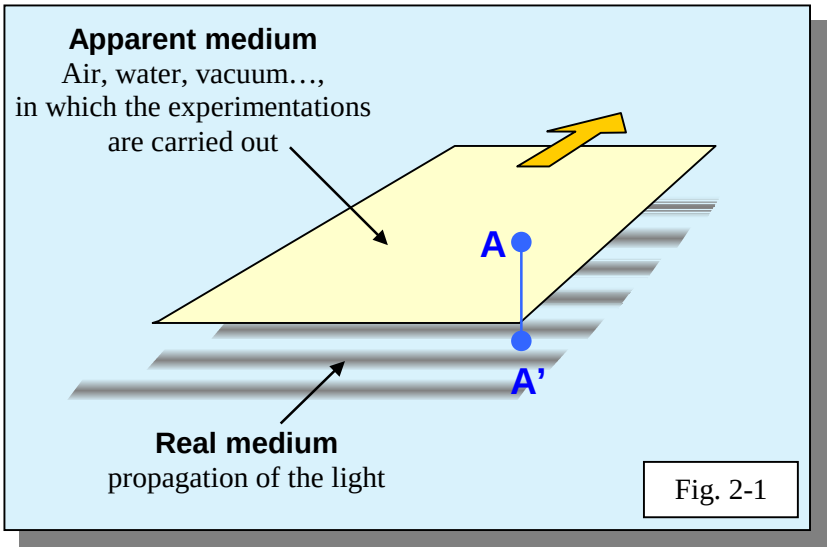


Fig. 2-1

2.4 Properties of the "Real medium"

The *"real medium"*, if it exists, must have at least the following two properties:

1 - To be present everywhere

Since EM waves are propagated everywhere, the *"real medium"* must also be present everywhere, in air, in water, and even in a vacuum[1].

2 - To have propagation properties

We know that any wave needs a propagation medium. Since spacetime has the properties of elasticity (Einstein), it could be a propagation medium.

Therefore, spacetime[2] is an excellent candidate to support EM waves.

Important note

Gravity and EM waves do not curve spacetime in the same manner. Gravitation is covered by Part 1 whereas EM waves are covered by Parts 3 and 4. Here, the structure of spacetime has been deliberated simplified for pedagogical purposes.

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[1] The real medium is not "aether". To avoid any confusion, we will use the term "real medium" instead of aether.

[2] We should not have any confusion between the word "motionless" used in the context of the global universe, which is correct, and the same word used in Special Relativity, which is not relevant in that study.

The spacetime of the universe, sometimes called "global spacetime structure", is the one that was created about 13.9 billion years ago, and not the local spacetime of special relativity. So, in this document, the word "spacetime" will always refer to "global spacetime structure of the universe", as in Friedmann-Robertson-Walker Definition.

2.5 Constant speed of light

Let's imagine the emission of a beam, L, from a laser diode (fig. 2-2). The diode, A, is fixed on a motionless *"apparent medium"*. The beam reaches the point L via the real medium: A → A' → L' → L.

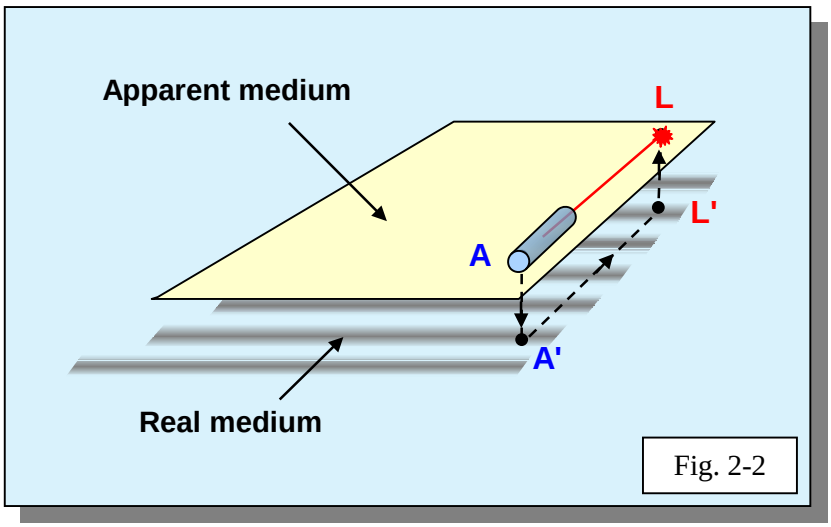


Fig. 2-2

Now let's consider that the apparent medium is moving with the velocity "V" (Fig. 2-3). An external observer, such as Fizeau or Michelson in 1900's, could think that the speed of the apparent medium V is added to the speed of light. In reality, the speed of light from A to L' will be constant, whatever the speed of the apparent medium V.

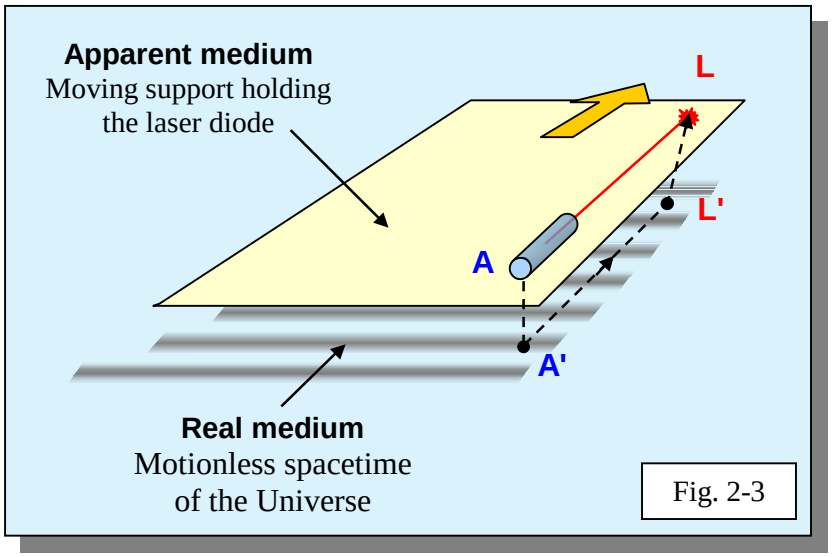


Fig. 2-3

Indeed, since the light is propagated in the *real medium*, its speed depends only on the nature of this medium, and nothing else. In reality, the permittivity of free space ε_0 is not a "vacuum permittivity" but rather a "spacetime permittivity", a physical constant that defines the spacetime propagation characteristics, as the "spacetime permeability" μ_0.

2.6 Case of two reference spaces

Fig. 2-4 shows a photon which is emitted from an apparent medium A to another apparent medium B. The two apparent media are moving in the opposite direction. In this case, no one can explain why the speed of this photon is constant.

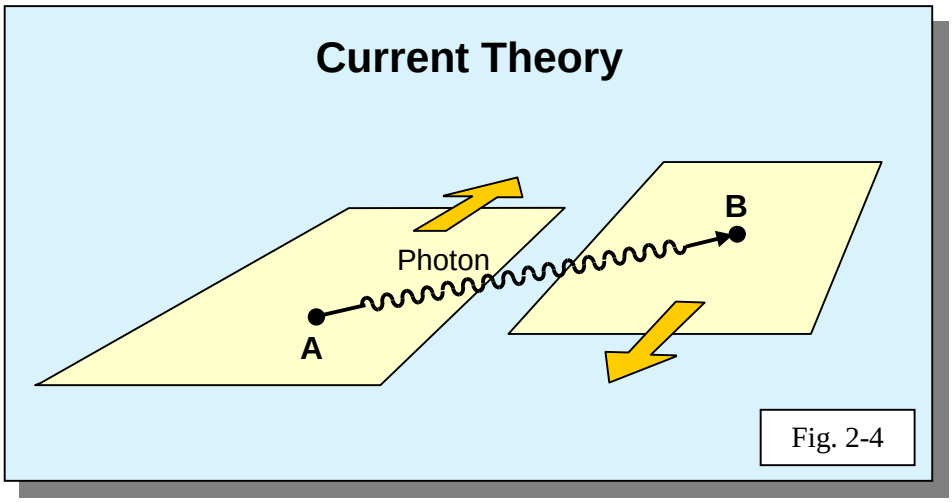


Fig. 2-4

Fig. 2-5 shows the proposed theory. The light is not propagated in the apparent medium, which supports the sources of light A and B, but in the real medium, which is **global spacetime of the universe**. EM radiations do not consist of photons but of EM waves (as said before, the photon concept is covered in Part 4). As a result, the constant speed of light is easily understood. The velocity of light is a function of the real medium characteristics, i.e. spacetime permittivity ε_0, and spacetime permeability μ_0. Thus, the speed of light is always 300 000 km/s, whatever the relative velocity of the two apparent media from where the light is emitted.

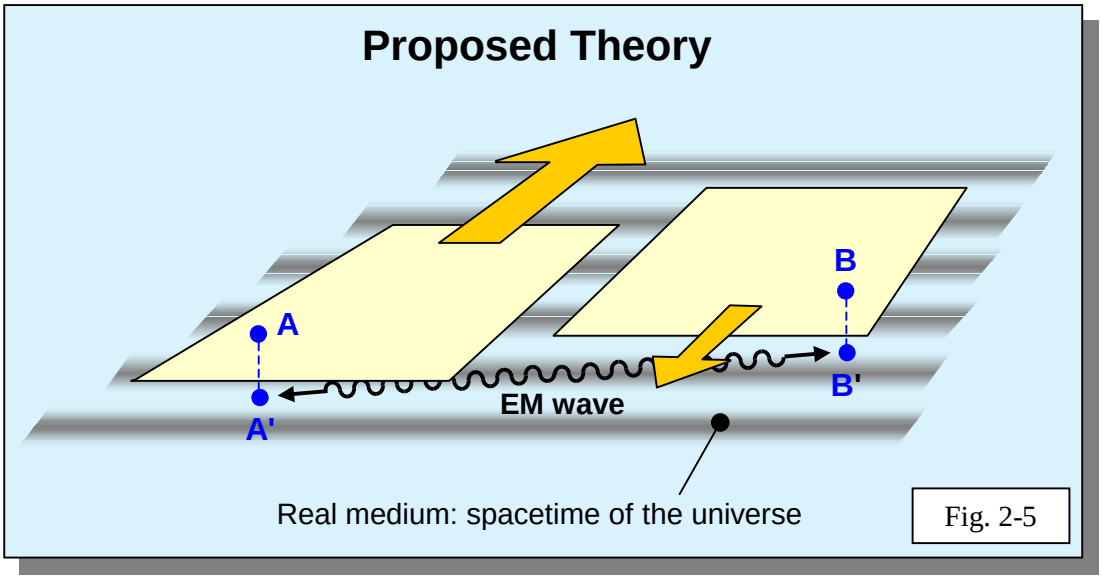


Fig. 2-5

2.7 Atoms

Fig. 2-6 explains what happens when an EM wave goes from an atom "A" to another atom "B". Here, the same principle as above may be used to solve the enigma of the speed of light. According to the wave-particle duality, the light doesn't move as a photon, which doesn't make sense[1], but as an EM wave.

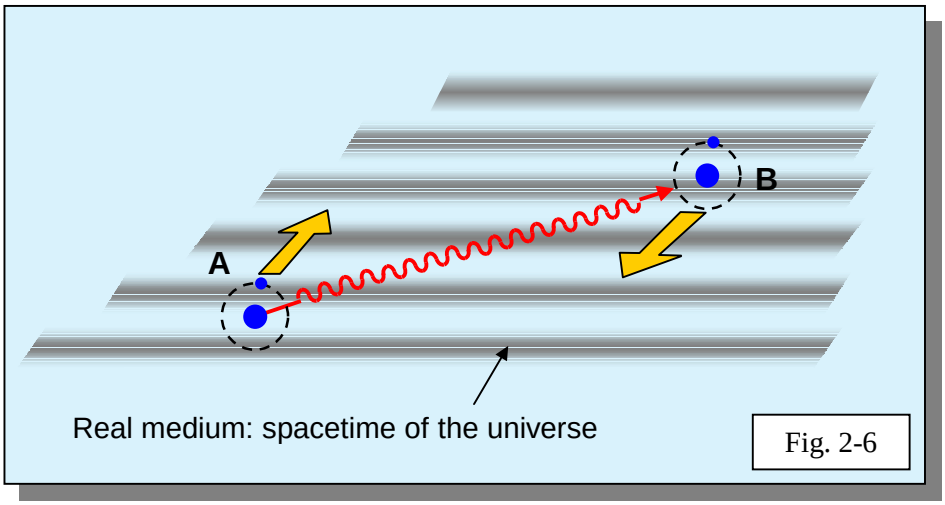


Fig. 2-6

2.8 Conclusions

- EM waves are emitted from an *apparent medium* but are propagated by the *real medium,* which is global spacetime of the universe.
- In this *real medium*, the speed of light is 300 000 km/s. Its invariant velocity is only a function of the permittivity ε_0 and the permeability of spacetime μ_0.

Therefore, although it amounts to the same thing, it would be more accurate to write:

"The speed of light is 300 000 km/s in spacetime[2]"

rather than:

"The speed of light is 300 000 km/s in a vacuum"

[1] In Part 4, we show that the photon is inconsistent at least on 10 points.

[2] Under certain conditions, EM waves may move at a speed different than 300 000 km/s. For example, using Bose Einstein condensats made up with sodium atoms at -273.15°, Lene Vestergaard Hau, from Harvard University, USA, slowed down EM waves to 17 m/s. In the same way, EPR also is an exception to the theory. See Part 4, "Electromagnetism", to understand these few exceptions.

3 Movements in Spacetime

This chapter affords the reader a more concrete vision of the role of spacetime in EM waves. The deduction developed in chapter 2, i.e. EM waves = spacetime movements, will lead us directly to the knowledge of the constitution of the elementary particles.

3.1 Fields in spacetime

Two different fields are transmitted by spacetime:

1. **Electromagnetic field**
   This field is responsible of the electromagnetic (or "electroweak") force. The behaviour of this field is well known by physicists but its origin and mechanism of propagation are still an enigma. EM concerns only charged particles.

2. **Gravitational field**
   This field has been described by Einstein in 1910-1915 by Einstein Field Equations (EFE). It is responsible of the gravitation force. The nature of this field and its mechanism of propagation is described in Part 1, "Mass and Gravitation". Gravitation concerns all particles, charged or not.

This raises the following question:

"How spacetime can transmit simultaneously these two types of fields, 1/ an EM field for charged particles only, and 2/ a gravitational field for all particles, charged or not ?"

The only solution to this problem is that spacetime must have a substructure.

In Parts 3 and 4 we give some suggestions to this sub-structure. This suggestion is interesting because it explains the antimatter of the universe and many other enigmas of physics. In this chapter, for pedagogical purposes, we will simply ignore this sub-structure considering that EM waves are supported by spacetime.

3.2 Movements in spacetime

The universe is filled with EM and gravitational waves of all kinds. Thus, spacetime is not motionless but is vibrating continuously. As said before, in this chapter, we will only consider the vibrations of EM waves, not those due to gravitational waves. So, this simplified view of the structure and sub-structure of spacetime must be taken with reservations.

EM waves are “movements” in spacetime, like "whirlpools" or "eddies" in water. The propagation of EM waves in spacetime is similar to that obtained by a stone that makes rings when thrown into the water (Fig. 3-1). On this figure, wave 1 is the main wave, and waves 2, 3, 4… are secondary waves, if they exist. The wave is propagated from left to right. We see that these vibrations are **variations of the density of spacetime** (concerning the EM sub-structure, not the gravitational structure).

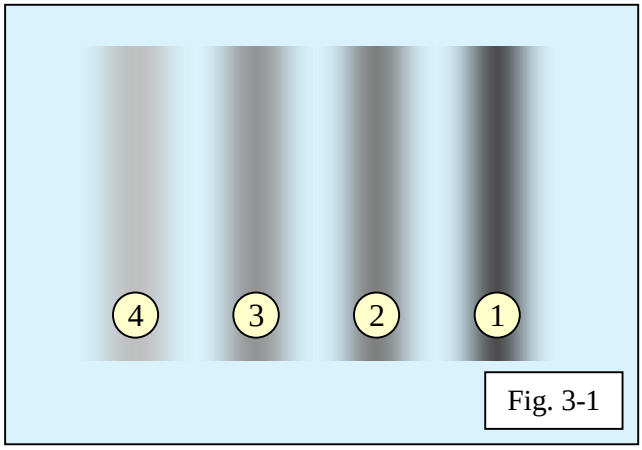


Fig. 3-1

3.3 Mathematical formalization

From a quantum mechanics point of view, we have a "wave packet" (fig. 3-2). In reality, the form of EM waves depends on the phenomenon that created it.

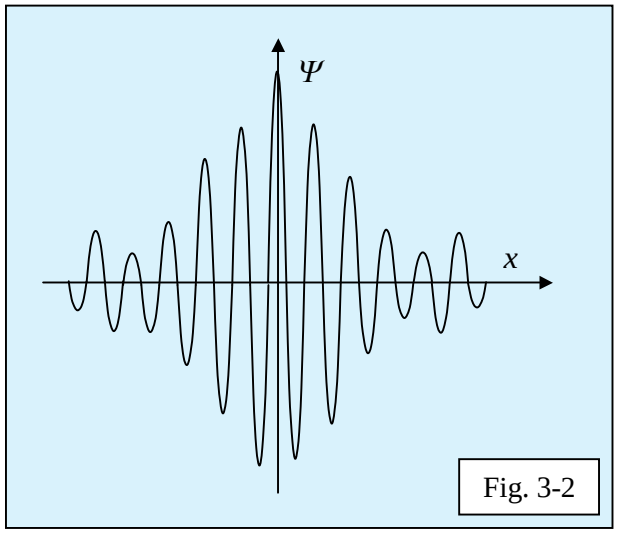


Fig. 3-2

For our further demonstrations, we will take the simple form of a damp sinusoid (fig. 3-3 and 3-4 on the next page), even if these figures are not fully exact. Figure 3-3 represents the periods, from 1 to 4, of the wave in figure 3-1. Figure 3-4 is the same wave but with only one period.

Note: The reader must keep in mind that these graphs are only for teaching purposes.

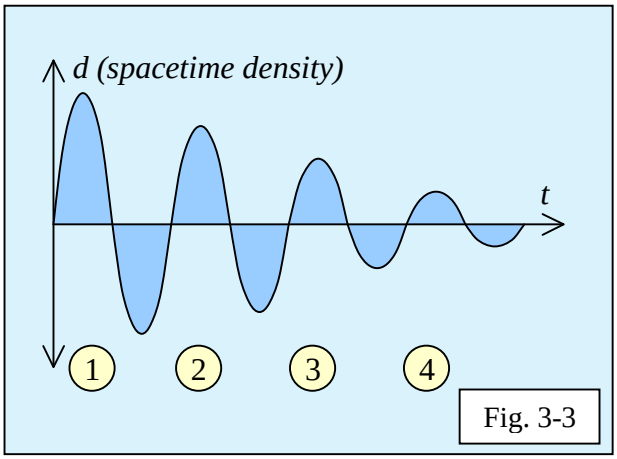


Fig. 3-3

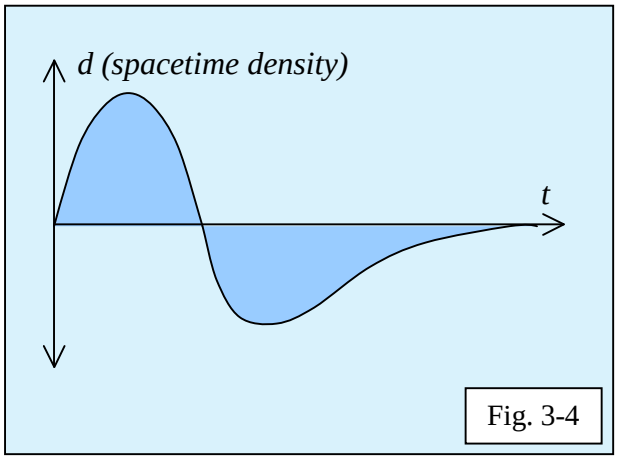


Fig. 3-4

3.4 Polarity of spacetime

The following graphics (Fig. 3-5 and 3-6) are identical to the preceding ones (Fig. 3-3 and 3-4). Sign "+" was inserted in areas of high relative density of spacetime and sign "-" in areas of low relative density.

Spacetime has a neutral density before the arrival of the wave. The positive and negative variations of the wave are relative to this reference. This is why the word "relative" was used.

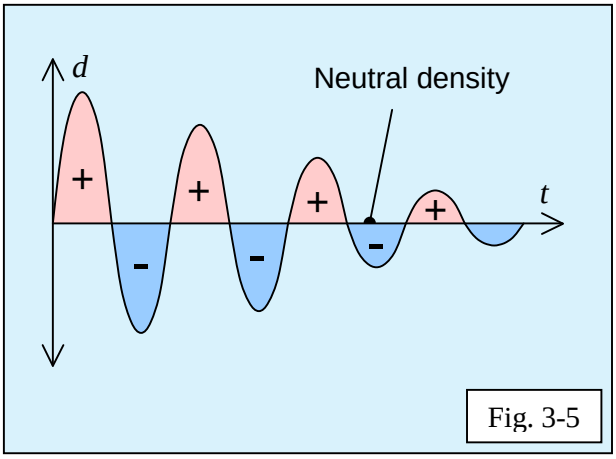


Fig. 3-5

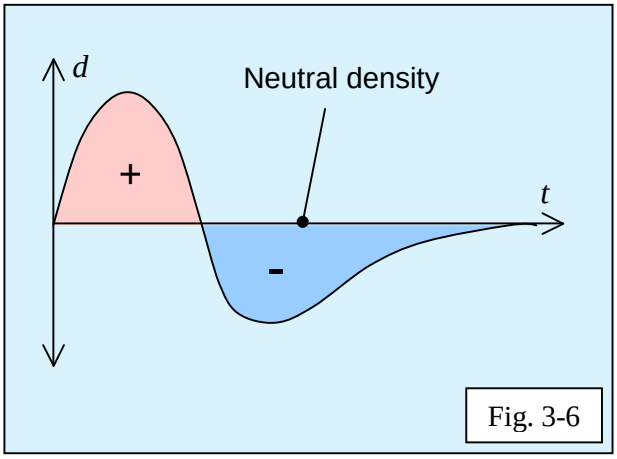


Fig. 3-6

3.5 Example of air cubes

Let's imagine that ambient air is divided into small cubes. In this example, the EM wave is replaced by a soundwave.

Each cube has a density of air. When a soundwave arrives, the pressure of the air inside each cube changes in a combination of positive and negative pressures, or high and low pressures. After the passage of the soundwave, the pressure of cubes falls back to its initial value.

This initial value of density of air is called "neutral density" on figures 3-5 and 3-6. The small cubes of air could be identified to the sub-structure of spacetime described before.

3.6 EM vs. Gravitational waves

In the previous example, a sound wave makes a periodic displacement of air into each cube that can be identified to EM waves.

The presence of an object, such as a house, also makes a displacement of air. The phenomenon is different and can be identified to gravity.

In reality, these two displacements of air are two different phenomena. They can be assimilated to electromagnetism (the soundwave) and the curvature of spacetime in general relativity (the house).

As it as been said, the difference between these two phenomena is fully explained in Part 1 “Mass and gravity”, and Parts 3 and 4 for the sub-structure of spacetime and "Electromagnetism".

4 Forces in Spacetime

The three fundamental forces are gravity, electroweak force (unified in 1972 by Weinberg and Salam, Nobel Prize – 1979) and the strong nuclear force.

This chapter covers one of these three forces. Differences of high and low densities of spacetime necessarily produce a force. We have the same phenomenon in our last example: the difference of air pressures produces a force which is the wind.

We do not know the character or the properties of the force described in this chapter. At the present moment, we will be satisfied to understand it. We will try to identify this force later, in the following two chapters.

4.1 Principle of the Least Action

The principle of Maupertuis[1] in 1744 indicates that nature always tends towards the least action. Transposed to spacetime, this principle becomes:

Spacetime tends naturally towards the least action

4.2 Principle of the Least Density

The principle of least action can be stated in a different way, which will be useful for us, later in this document. Since the density of spacetime in the Universe is neutral, areas of polarized[2] spacetime will tend to a neutral density.

Spacetime tends naturally towards a neutral density

[1] Koenig, De Fermat, Liebniz, Euler, Lagrange, Jacobi and Helmholtz have written similar principles.
[2] In this document, we will presume by convention that a high density of spacetime corresponds to a positive polarity, and a low density to a negative polarity.

4.3 Example

For teaching purposes, the two figures in the preceding chapter (Fig. 3-1 and 3-5) are grouped in Fig. 4-1 which represents an EM wave on the left, and its simplified mathematical representation, on the right.

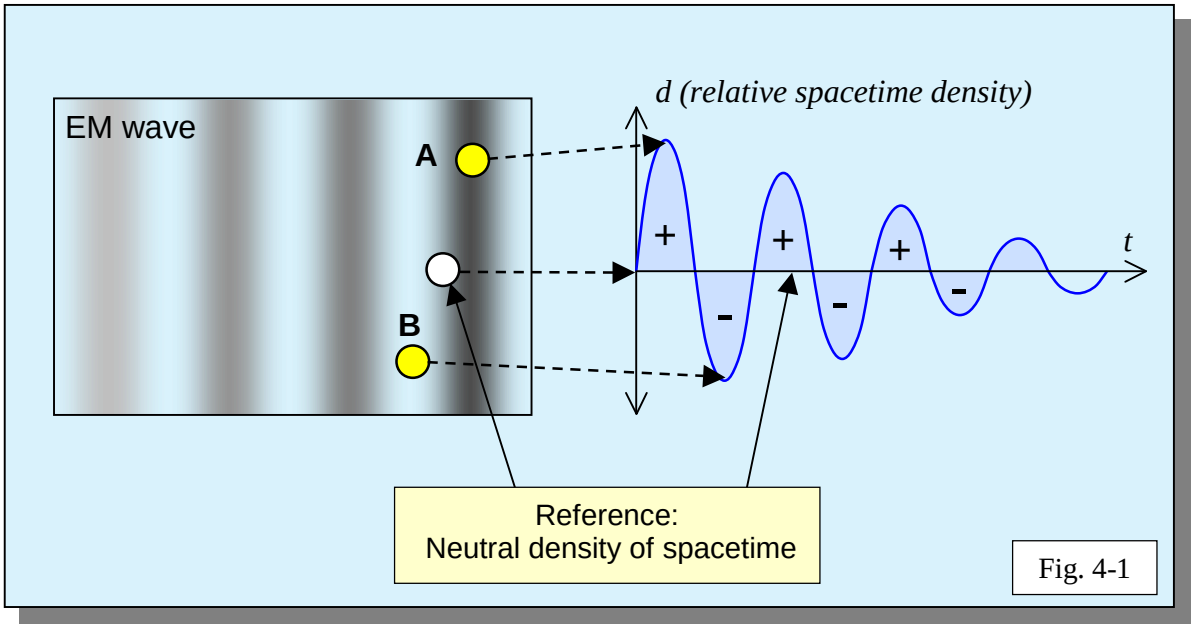


Fig. 4-1

4.4 Annihilation process

Let's imagine that we take the two "pieces" of the above EM wave noted A and B (Fig. 4-1 on the left). These two small parts are represented in figure 4-2. What happens if we put these two areas, A and B, in contact?

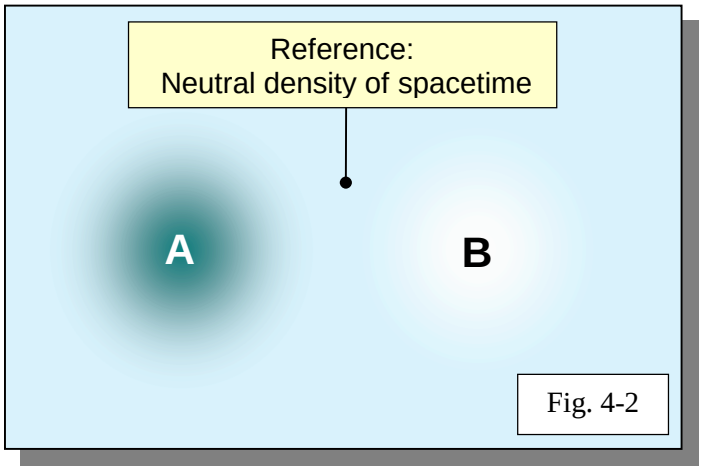


Fig. 4-2

Intuitively, we might think that these two areas will cancel out each other. The area of high density of spacetime in A will annihilate the area of low density of spacetime in B.

We can also demonstrate that this phenomenon is in accordance with the Maupertuis Principle adapted to spacetime: The only way to get the least difference of density of spacetime is when areas A and B annihilate each other.

4.5 Example of Annihilation

To better understand the phenomenon, let's consider the example of an acoustic wave. As we know, it is a succession of pressures and depressions in air.

Let's isolate two small cubes of air, one in a pressure half period (A), and the other in a depression half period (B). Now, let's put them in contact. Intuitively, we might think that these two areas, A and B, will mutually cancel out each other. The result will be two neutral areas with zero relative density, like our "reference" in Fig. 3-5, 3-6, 4-1 and 4-2.

The same phenomenon occurs in spacetime when we put together two areas, one with a high density of spacetime, and the other with a low density.

4.6 Attractive force

We know that the two areas A and B (fig. 4-3) represents two areas of EM fields. Since we know since 1850's that a positive area (A) is attracted by a negative area (B), demonstrations has already been made.

Here, we show that, in reality, these two areas of EM fields are two areas of spacetime with opposite densities. The principle of least relative density of spacetime confirms this attraction.

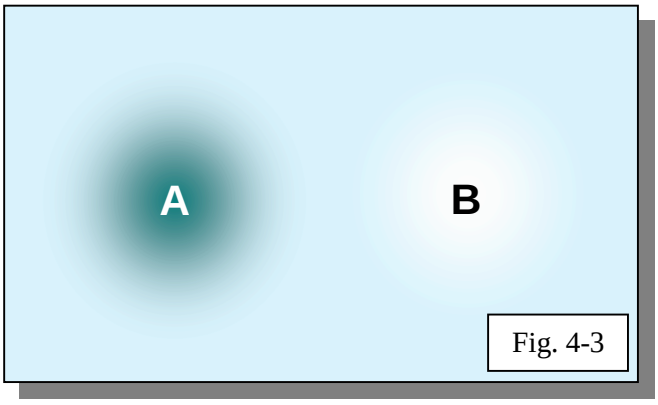


Fig. 4-3

4.7 Repulsive force

In the same manner, two areas with the same polarity of density of spacetime will tend to push each other away (fig. 4-4 next page).

The principle of least relative density of spacetime confirms this repulsive force.

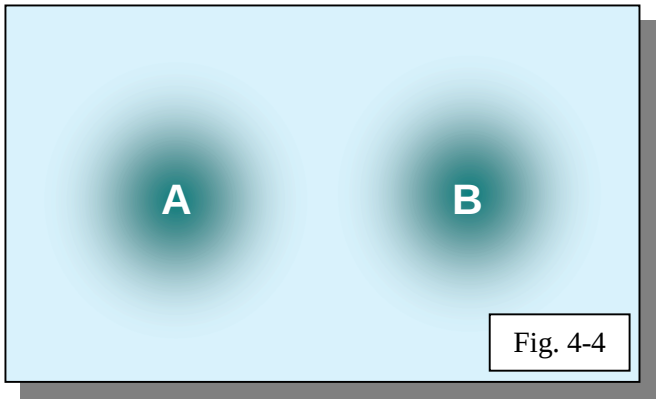


Fig. 4-4

4.8 Fusion

Under certain conditions, two areas of identical polarity can merge (fig. 4-5).

For example, if the energy of one area is higher than the "barrier" of another, this barrier can be crossed over and fusion becomes possible. Thus, under some conditions of proximity, repulsion can become a fusion. This phenomenon of fusion is well known by physicists.

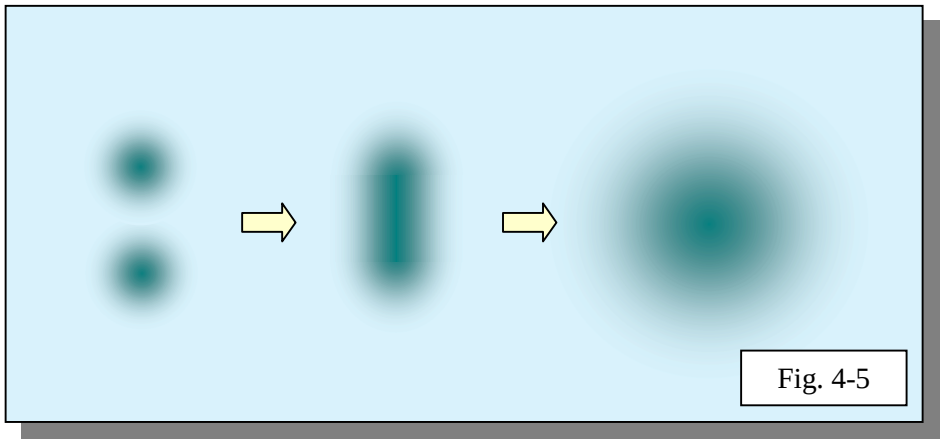


Fig. 4-5

5 Electron-Positron Annihilation

In this chapter, we propose a scenario using the attractive and annihilation forces seen in the preceding chapter, including the explanation of wave-particle duality covered in chapter 1. More precisely, we will try to imagine what occurs when two areas of opposite density of spacetime are put together.

For the moment, we do not know the character of this interaction. In the following chapter, we will try to describe the phenomenon and compare it to something known.

5.1 Scenario

Let's consider two areas of the same dimension, A and B, taken from an EM wave (fig. 5.1). These two pieces are made of high and low density of spacetime respectively. Area A comes from a positive half-period and B from a negative one.

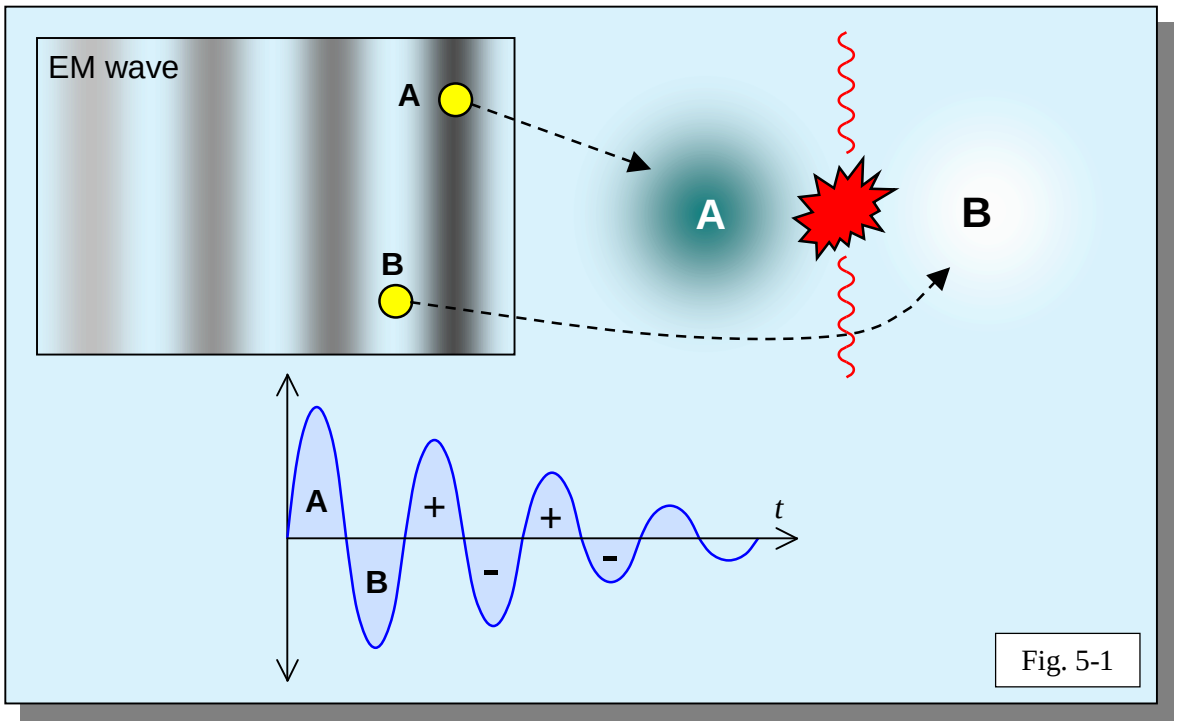


Fig. 5-1

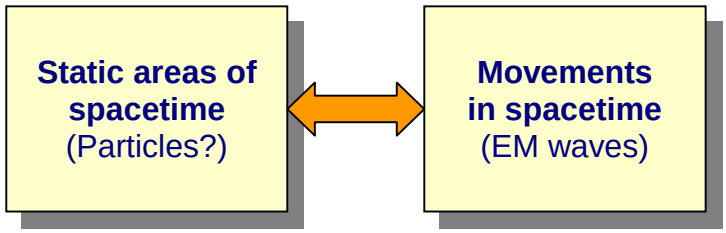
As we can imagine, these two area will annihilate each other since they have opposite polarities. This annihilation produces movements in surrounding spacetime. We have the same process when an anticyclone comes into contact with a depression; annihilation always produces wind, sometimes storms, and disturbances in the surrounding space.

We must note that all the elements of figure 5-1 are made up of spacetime:

- The areas A and B are "parts" of the EM wave, therefore areas of spacetime
- Surrounding space is also made up of spacetime
- Since everything is spacetime, the two vibrations (Fig. 5-1 in red) produced by the annihilation are also made up of spacetime. These movements are like an eddy or whirlpool in water.

The loop is thus closed:

1. The two “pieces” of waves, areas A and B, are annihilated,
2. … which produces movements in spacetime,
3. … movements which are EM waves.



5.2 Different volumes

Let’s suppose now that one of the areas has a volume of 0.1% superior to the other (not represented in the figure). What would occur?

It is simple: the excess 0.1% will not be annihilated.

For example, let's take an area of a volume equivalent to 511 KeV[1], and the other 509 KeV. After annihilation, it will remain an area of 2 KeV. This area will be ejected in a direction that preserves the momentum, in relation to the two other disturbances.

5.3 Interpretation

Background about antiparticles: Each particle has its counterpart antiparticle which has the same mass ("closed volume" more exactly, see Part 1), but an opposite charge. The positron is the antiparticle of the electron. So, its charge is +1 instead of –1. Another example is the antiproton, which is nothing but a proton with a charge of –1 instead of +1.

[1] Please see Part 1 "Mass and Gravity" to get the relationship between mass or energy to volume.

The above scenario, which is purely intuitive, coincides curiously with that of an e+e- annihilation.

- The two areas of high and low density of spacetime could be the positron and the electron.
- The movements of spacetime due to annihilation could be the two gammas of 511 KeV created during an e+e- annihilation.
- The volumes A and B disappear. In physics, the positron and electron disappear too.
- The volume of the movements in spacetime corresponds to the volumes destroyed. Part 1 explains with simplicity the transformation of a "closed volume", i.e. mass, in waves (See Part 1, section $E = mc^2$, and Part 4, chapter "Waves and Complements", section $E=mc^2$).
- The remainder, if volumes are slightly different, could be the neutrino, more exactly an antineutrino in theory. Indeed, we don't have the proof that the positron has exactly the same mass as that of the electron[1], but we have proof that the neutrino exists. Further discussion of the neutrino is covered in Part 3 "Quarks and Antimatter".
- If the neutrino comes from an electron or positron, it must also have a spin = 1/2. This is exactly what the experimentation proves.

Such a coincidence between the theory here described and the experimentation is disconcerting but not sufficient to validate a theory. We will make further deductions in the following chapter. These conclusions confirm that the present scenario describes, word for word, an e+e- annihilation.

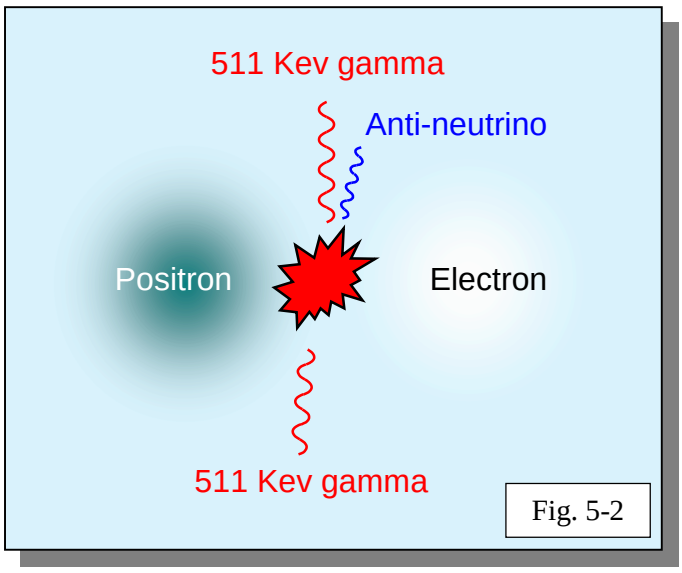


Fig. 5-2

Note: If this scheme is correct, the neutrino should have a very light charge, so light that it could be very hard to detect. This eventuality is covered in the chapter concerning the neutrino, in Part 3 "Quarks and Antimatter".

[1] The accuracy of measurement is: $|me+ - me-| /m < 8.10^{-9}$, with a CL of 90%.

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6 Nature of Particles

We know of about 300 elementary particles. Among those, physicists have favoured the electron. It seems that the electron, and its antiparticle the positron, are the basic particles of the universe. For this reason we have also chosen the electron and the positron with which to continue our research into the constitution of particles.

This chapter synthesizes the preceding deductions.

6.1 Constitution of particles

The following deductions, made in five different ways, always lead to the same conclusions: particles are areas of spacetime.

1) 1st principle of duality

This principle, which fully explains the enigma of wave-particle duality, states that particles, waves and medium must have the same constitution. Since the medium is spacetime, **particles and waves are necessarily made of spacetime**.

2) Electron-positron annihilation

We have studied, in the previous chapter, the annihilation of an electron and a positron. Since the result, two gammas of 511 KeV, are a movement in spacetime, **the origin, or the electron and the positron, is made up of spacetime too**. This experimentation is a simple conversion from spacetime (particles) to spacetime (gammas), in accordance with the wave-particle duality explanation of chapter 1.

3) Electron-positron (e-e+) pairs production

This experiment is the contrary to that described in the previous paragraph.

We know that when a high-energy gamma passes near a nucleus or any charged particle, it can decay into an electron-positron pair.

This phenomenon is very simple to explain (Fig. 6-1 and its simplified view, Fig. 6-2, next page). The positive Coulomb Field of the nucleus attracts the negative areas of the EM wave and pushes back the positive areas, namely the areas of low and high density

of spacetime. Thus, **the wave decays in two parts**. These two “pieces of wave” are an e+e- pair.

Obviously, it is impossible to create particles from nothing[1]. The electron and positron come from somewhere, and this "somewhere" can only be the original EM wave, i.e. spacetime vibrations.

So, since the original EM wave is made up of spacetime, the electron and the positron are necessarily made up of spacetime too.

We can deduce that:

The electron and the positron are made up of spacetime

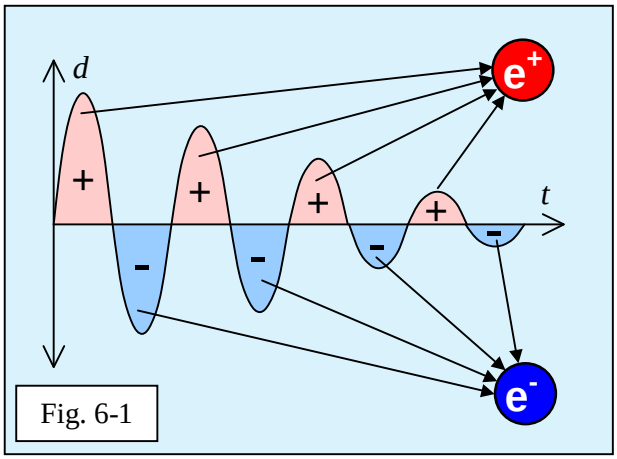


Fig. 6-1

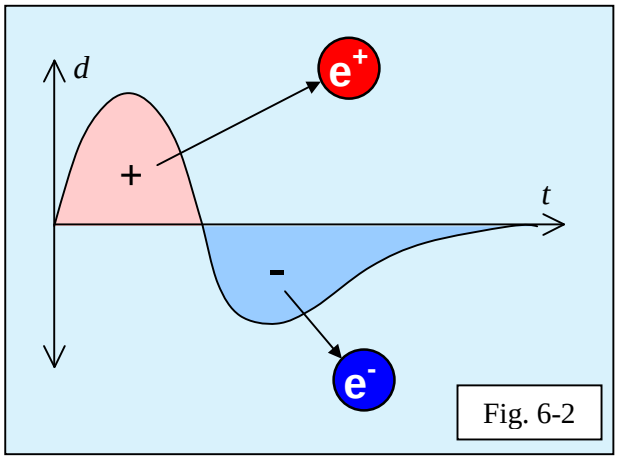


Fig. 6-2

4) De Broglie Waves

In 1924, Louis De Broglie had the idea that any particles could have an associated wave similar to the EM wave. For De Broglie, all the waves have a comparable constitution. The experimentations of Davisson (Nobel Prize - 1937) and Germer in 1927 confirmed De Broglie's theory. So:

- Particles and matter waves are of the same constitution (first principle of duality).
- "Matter waves[2]" and EM waves and are of comparable constitution (De Broglie).

By association, we deduce that particles have the same constitution as EM waves, i.e. **they are made of spacetime** since the EM waves are vibrations in spacetime.

---

[1] Spacetime is not considered as "nothing".
[2] The subject of EM and matter waves is covered in the two following documents: Part 3 “Quarks and antimatter”, and Part 4 “Electromagnetism”.

5) Coulomb's Force

Let's return to the scenario discussed in the preceding chapter and try to identify this force. What is this unknown force that brings closer the two areas A and B until their complete annihilation? We have four possibilities:

- **Gravity?** The scenario of chapter 5 couldn't work with two areas of identical polarity. Since gravity disregards polarity, this unknown force is not gravity.
- **The strong nuclear force?** In chapter 5, we never mentioned nuclei or quarks. Thus, this unknown force cannot be the strong nuclear force.
- **The weak nuclear force?** In the same way, it is not a question of interactions with bosons Z°, W+ or W-. This unknown force is not a weak nuclear force or, more precisely, the weak nuclear component of the electroweak force.
- **The EM force?** By elimination, there is the EM force.

We deduce that the unknown force discussed in the preceding chapter is the Coulomb component of EM force. This conclusion seems logical since the two areas, A and B, are "pieces of EM waves", which are related to EM force.

Since the Coulomb Force acts only on charged particles, we deduce that the two areas A and B are charged particles. Since these two areas are “pieces” of an EM wave, i.e. spacetime, we naturally conclude that **the particles are made up of spacetime too.**

6.2 Einstein's point of view

Let's note this remark by Einstein, which tends to confirm our deductions: *"Matter cannot exist without spacetime"*. Thus, the proposed theory is far from being unrealistic since, in the 1920's, this great physicist thought that matter was directly connected to spacetime.

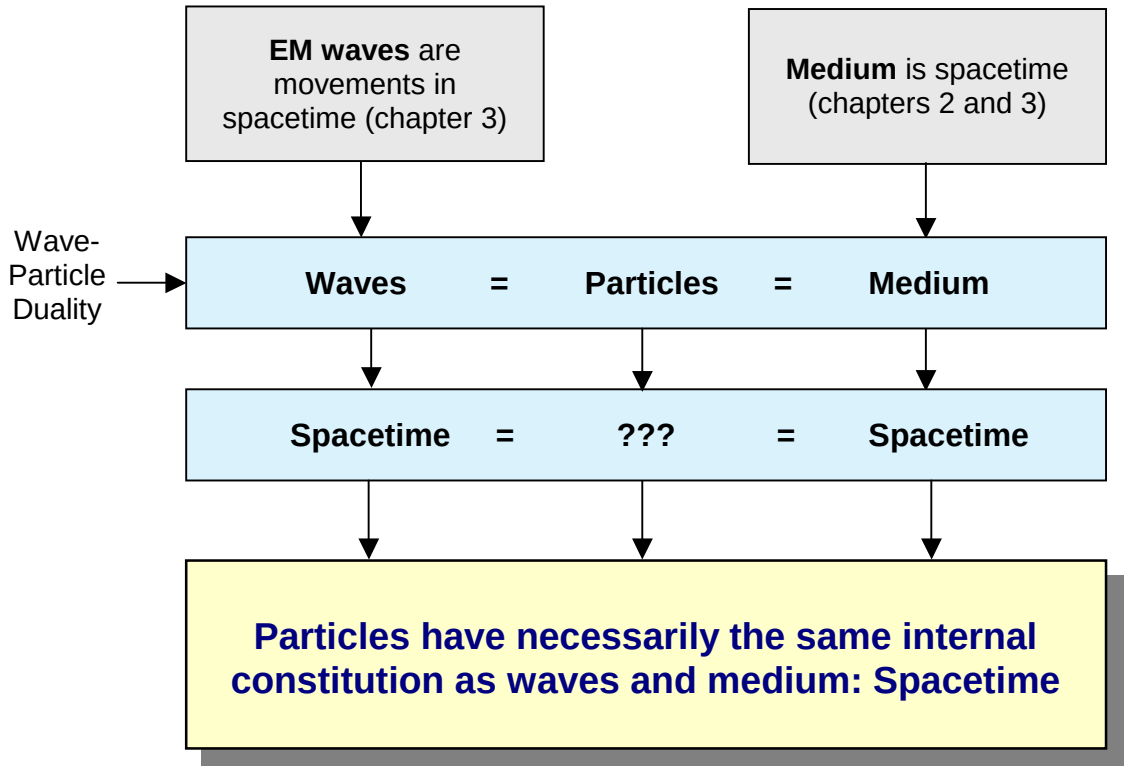
6.3 Conclusions

The conclusion is that Nature is founded on only one basis, which is summarized below.

EM waves and elementary particles are made of

Areas of high and low densities of spacetime

- Particles = Static areas of spacetime
- EM waves = Dynamic areas of spacetime (vibrations)



6.4 The fifth dimension?

This conclusion also corroborates our simple model of the universe based upon spacetime and using only four dimensions. Indeed, we are faced with the following alternative:

- Either the charge is independent of the four known dimensions and thus cannot be expressed by the form $q = f_{(t,x,y,z)}$. It is then necessary to envisage a fifth dimension, independent of the others four, which is the charge, q. In this way, the universe variables would be t,x,y,z,q.
- Or, the charge is a function of four known dimensions and can be expressed by the form $q = f_{(t,x,y,z)}$. In this case, we can remain in these four well-known dimensions. All particles are then expressed with the four spacetime variables: t,x,y,z.

Except for the few years of his life when Einstein was interested in the Kaluza Theories, he believed the universe had only 4 dimensions. The previous demonstration shows that he was right. It is not necessary to add a fifth dimension to explain the charge.

The observation that the charge is nothing but differences in density of spacetime is in full agreement with Einstein's ideas.

7 Clarification

As the discussion stands now, the reader may take the following stance:

> *"This does not mean anything… When I take a hammer, I see that this hammer is made of matter, and not of the so-called areas of high and low densities of spacetime…".*

This chapter is probably the most difficult to understand of the theory since it tries to explain to the reader that all the matter of the universe is made up of spacetime areas and that we are living in a virtual world. This is far from being obvious.

7.1 What we know

For the past 50 years, what we have known is particularly disconcerting:

1 - The atom

Due to quantum effects, it is very difficult to measure the diameter of an electron. However, the following approximations are generally accepted. In an hydrogen atom, the relation between the nucleus (proton) and its diameter is about 1/40 000, and the relationship between the electron and the proton is 1/1000. To get an idea of these relationships, we can imagine a daily-life representation of an hydrogen atom:

- The diameter of the nucleus is 1 m.,
- The diameter of the electron is 1 mm.,
- The diameter of the atom is 40 km.,

So, the electron (1mm) turns around the nucleus (1m) at a distance of 20 kms. It means that the atom is mainly made of 99,999% vacuum.
If we eliminate all the vacuum of atoms (99.999%), the size of the human body would be reduced to a pinhead…

2 - Waves

In accordance with De Broglie, matter and waves are identical. Thus, the human body, at least the 0.001% that remains after all the vacuum is removed, would be nothing but waves…

3 - Energy

As we know, $E = mc^2$. So, this pinhead would be identical… to pure energy… (see Part 1 to understand $E=mc^2$).

To summarize, experimentations and Einstein and De Broglie Theories show that matter is made of:

- A vacuum : 99.999%
- Waves or matter-energy : 0.001%

Under these circumstances, is it logical to continue considering matter as a physical concept?

Of course not.

It is obvious that we can't continue to call "matter" something that is 99.999% vacuum and 0.001% waves or energy…

It would be more reasonable to consider that what we call "matter" is nothing but a virtual concept since a vacuum and waves don't exist in concrete terms. So, if a vacuum and waves are both virtual concepts, we are living in a virtual world.

Please, note that this is not a new idea. These conclusions were well known in the last century, in particular when Davisson and Germer demonstrated in 1927 that matter and waves are identical.

> It seems that we have great difficulty accepting the idea that we are living in a virtual world made of two virtual elements:
>
> 1. A vacuum (99.999%)
> 2. and waves or energy (0.001%)

Note: *This enigma (99,999% of an object is a vacuum) is fully explained in Part 3 "Quarks and Antimatter".*

7.2 Examples

To help understanding this strange phenomenon, lets consider the air. Are we able to built something with air? The immediate answer to this question is "No" since in air, we don't see anything.

A more logical answer would be "Yes" because:

- Air has water vapour,
- If we extract this water vapour, we obtain water,
- Water may be transformed in ice,
- And ice in things such as igloos.

So, with air, we can build igloos.

Can we built something else? Here also the answer is "Yes", because:

- Air carbon dioxide (CO_2),

- We already have carbon and oxygen,
- Air contains also hydrogen,
- With carbon C, oxygen O and hydrogen H we can build a lot of things since these three atoms are the basic elements of the universe.

For example, the chemical formulae of sugar is $C_{12}H_{22}O_{11}$. Therefore, it is possible to extract C, O and H atoms from air and, with some adapted chemical processes, we can synthesize sugar.

These examples are provided to understand that, in our daily life, what we see and what we think are not necessarily the truth.

7.3 The Spacetime Model contribution

The current theory doesn't change our point of view about atoms, which are always made up of a vacuum (99.999%) and waves (0.001%). Nothing has changed and matter, or its counter-part waves, remains a virtual concept.

This Part 2 of the Spacetime Model is a little more precise regarding the nature of waves (Fig. 7-1).

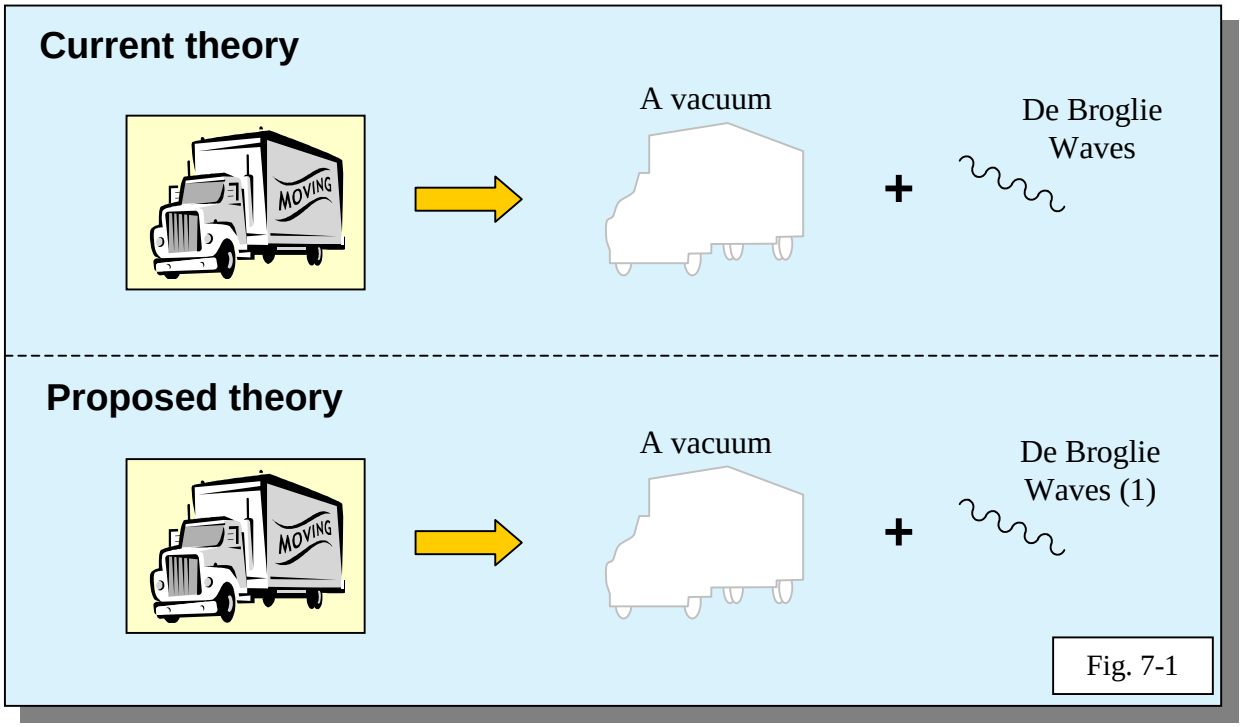


Fig. 7-1

(1) The two explanations are close to each other, but the constitution of matter and many puzzles of quantum mechanics are fully explained if we consider that waves are nothing but variations of spacetime. Please also see Parts 3 and 4.

So, the major difficulty doesn't arise from the Spacetime Model per se, but from what we have known for 50 years: **99,999% of matter is made of a vacuum.**

We already know that gravity has its origin in spacetime (Part 1). Here we show that spacetime is also curved by EM and De Broglie Waves. Therefore, the Spacetime Model simply extends the Einstein Concept to all components of the universe, stating that

All is spacetime

7.4 Matter vs. Spacetime

It could be strange to consider that matter is made of spacetime. Let's examine the main physical characteristics of matter:

1 - Mass

As explained in Part 1, the mass effect of an object is a virtual quantity, such as speed, force, pressure… It is a consequence of the curvature of spacetime made by its closed volumes. So, the origin of mass is a kind of volume, i.e. Mass = f(x,y,z).

2 - Weight

The weight is also a consequence of the curvature of spacetime made by some types of volumes. So, we also have Weight = f(x,y,z).

3 - Volume

The volume has the expression: Volume = f(x,y,z).

4 - Colour

The colour is a reflection of the light on objects with a modification of the wavelength. These waves are defined as: Waves = f(x,y,z,t).

5 - Temperature

As we know, the origin of a temperature is a thermal vibration of molecules which are expressed as: Vibrations = (x,y,z,t).

As we see, all these physical characteristics are defined as: Matter = f(x,y,z,t), i.e. in 4D. In other words, it is possible to build all kinds of matter with only the four dimensions of the universe x, y, z and t.

7.5 Forces vs. Spacetime

In our daily life, beside matter we also have forces. Forces are virtual quantities built with combination of the four dimensions of the universe. The dimensional quantity of a force is $[ML/T^2]$, i.e. mass x length / time². Forces alone generate all forms of communication experienced in human life:

- Intelligence: chemical interactions in synaptic transmissions (Coulomb Force),
- Sound, music, speech… (vibrations of air),
- Pain (electrical currents in the sensory nerves),
- Joy (hormones which are specific molecules issued from the Coulomb Force),
- Heat (infra-red EM waves),
- The touch: Coulomb Forces between molecules.
- Human power (electrical currents in the motor nerves),

Of course, all these forces are invisible, as those of two magnets, but they exist and must be taken into consideration in any explanation of our life and what we call "matter".

7.6 Importance of forces in spacetime

Let's try to understand the importance of these forces in life but by another way. If we remove all these forces from the human body, what would remain?

- If all the EM force disappeared, we would not have any more light. We would be blind.
- Acoustic waves are propagated in the air by forces. If these forces did not exist, we could not hear noises, music, or speech.
- We know that nerves propagate electric potentials. If our hands were disconnected from our brain, we would not have any feelings (sensory nerves), or movements (motor nerves).
- But the chemical interactions between neurotransmitters of our brain are Coulomb Forces. Thus, our brain would no longer function.
- Molecules are associations of atoms thanks to the Coulomb Force. Thus, the human body, life, and all the objects that surround us would not exist since there would be no association of atoms in molecules.
- Moreover the atoms themselves could not exist since it is still the Coulomb Force that maintains the electrons on their orbital. If we remove the Coulomb Force from the nucleus, we will have independent nucleons and electrons.
- At last, nucleons are quarks associations thanks to the nuclear force.

Thus, if all of these forces did not exist, the universe would only be made of free electrons and positrons[1], i.e. of low and high densities of spacetime.

To summarize, we can say that **Nature = Objects + Forces**. Objects are defined in 4D with an expression as Object = f(x,y,z,t), and forces are a virtual concept also defined by an equation as: Force = f(x,y,z,t). Various combinations of objects and forces make up atoms, molecules, and finally the universe and life.

> *"As a magician makes us believe that an object is on our right whereas it is on our left, nature makes us believe that* ***all is matter*** *whereas* ***all is "virtual" 4D objects and forces*** *produced by spacetime."*

[1] We show in Part 3 "Quarks and Antimatter" that quarks are made up of positrons and electrons.

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