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Gravity

A collection of articles related to the Prime Theory trilogy

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Preface

This new book is in fact a collection of my latest articles (that were written in the past couple of years), all of them being necessary additions, corrections or particularizations of the Prime Theory's concepts and hypotheses. All of the book chapters are therefore representing those full articles, specially adapted and placed in chronological order. It is my intention to clarify, as much as possible, all the aspects related to the coherent framework this theory has built as a solid foundation for modern physics, the special, long-awaited connection between the fabric of reality and all quantum mechanics - general relativity models. *Gravity*, as a direct resultant of the granular movement, is a fundamental and special force that has built the entire mechanics of our Universe, at any scale it would be regarded.

1. The First Bangs

A distributed model of the Universe's genesis

1.1. Introduction

There are lots of very accurate data about our Universe and its internal structure that have accumulated mostly from the observations of the last years. The measurements carried out by astrophysicists now generate, in my opinion, many results that are in contradiction with the current model (Big Bang) of the universe's formation. It also comes very clear that my previous model [2] - a Big Bang generated by a supermassive black hole in an already formed universe - is no longer compatible with the current measurements. We have now a pretty good idea about the total quantity of matter existing in the observable universe (stars, cosmic gas clouds and dust, galaxies, not taking into account the black holes), and this value exceeds by several orders of magnitude the mass of the largest black holes discovered until now (around 20 billion solar masses). As a result, a new model of the universe's genesis is needed today; it should be compatible with the latest astronomical observations and it should fully integrate into the causal and deterministic framework of the "Prime Theory" [1]. This model will not be about a multiuniverse; anyway, we may still call it the First Bang, as it will propose a *single* type of event related to the creation of our Universe. What does this new model have to explain? For now, it has to elucidate the first moments of the formation of space and matter, and this is because the inflationary model seems to be satisfactory from a certain moment - the appearance of the structured matter - up to the present time, as it has been adapted by "The Universe" [2].

Some data, assumptions and comments to start from in shaping this new model:

a) We still are in the Prime Theory's premises area, where space has a granular component (material) and a geometric one (framework).

b) The total amount of visible matter (structured), compared with that of all supermassive black holes.

c) The assumption that the supermassive black holes from the beginning of the universe could not increase so much in a relatively short time, but in fact they all were born directly at this size. They shall still be regarded as some huge granular agglomerations, as "The Universe" [2] described them in detail, but several new features differentiate them from the "normal" ones (those resulting from the collapse of regular stars).

d) The hypothesis that the density of granular space has had a maximum value in the beginnings, then it decreased continuously over time (seen within the isotropic frame of the closed universe). This assumption rests on at least two important findings:

- The spontaneous emergence of quarks during the first seconds of the universe (relatively big particles that were stable over time inside composite particles and which could no longer spontaneously appear now).

- The redshift of light coming from the distant galaxies, which is explained by the current physics especially by their movement (the Doppler effect) and by the "expansion" of space between them and observers during the long periods of time those photons have traveled.

e) The observation of a high degree of uniformity in the intensity of all gravitational fluxes, along every spatial direction - at a given moment. As long as the influence of the big cosmic bodies (they reflect and diffuse) on the distribution of granular flows is dependent on the square of the distance (the so-called "gravity"), the variations of these fluxes at a certain distance will get below a fixed value, i.e. they will become negligible.

f) The new estimate of the number of observable galaxies is around 2 trillion (as in [6]), 10 times higher than it was previously thought.

g) The rotation plans of the spiral galaxies, assumed to be determined by the rotation plan of their central black hole, do not intersect in a common point - and thus they are not reflecting a common, central point of origin, i.e. a radial direction of some initial linear momentum.

h) A very recent analysis, still controversial, regarding the brightness of some supernovas suggests that the expansion of the universe is not accelerating, as previously assumed.

1.2. Additional assumptions

There are two important assumptions to be mentioned now:

- The units of measurement of all physical quantities used to describe the beginning of the universe are abstract; they have absolute values and they will bear the same names as the current ones. However, in the definitive relativity we face inside a dynamic and closed universe, there will always be a perpetual uncertainty upon their absolute values.

- As it was previously stated in the "Prime Theory" [1], space does not expand in itself; only new zones are added to the edges of the sphere it supposes to form. However, its granular density changes over time, being affected by at least two components: the total number of granules in relation to the size of the three-dimensional space (by definition) and the number of the free granules that are integrated into particles (i.e. in the structured matter, and photons are not included). The consequences of these variations in density are numerous; to an observer, the most important effect is the change of the speed of light in a vacuum. As the granular speed ***C*** is an absolute speed, the velocity of photons will also have this special trait; this means they must have an absolute direction and a constant speed value in the areas of constant granular density.

1.3. The speed of photons

In order to calculate this speed, we will consider now a cube of side ***l*** (having a big value, expressed in granular diameters ***d***) that contains inside n^3 granules. Other scalar quantities have been denoted as follows:

C - the absolute granular speed, a constant

v - the current speed of photons

ρ - the linear granular density (n/l), $\rho < 1$, includes the collision probability

τ - the average time of a granular collision, $\tau \geq 1/C$, a constant

The formula of the absolute speed of photons simply results:

$$v = C / (1 + \rho \tau C)$$

It is very easy to see that this speed is always lower than the constant ***C***; moreover, it does not have a linear dependence on the granular density - as it may be clearly observed in Figure 1.

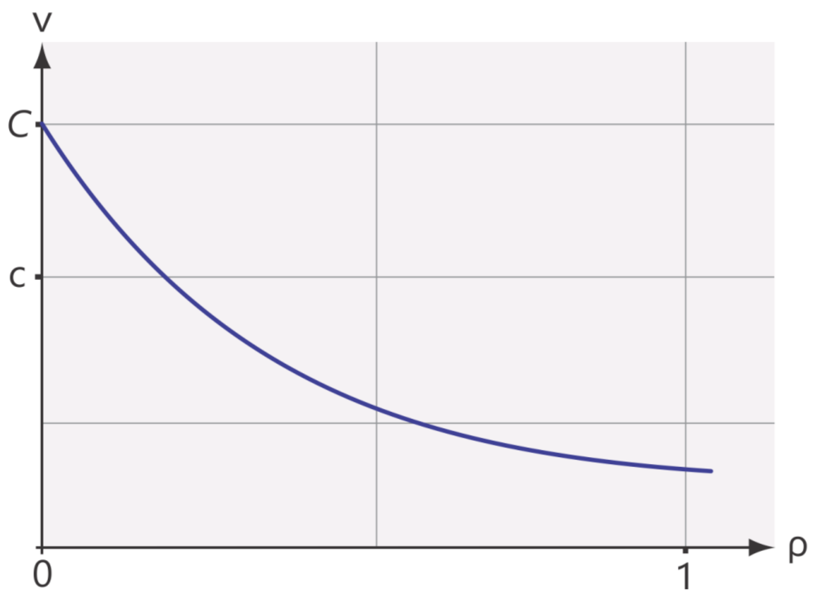


Figure 1 - *Speed of light - granular density graph*

Both the speed of light and granular density will therefore have a significant variation in time, as it is reflected (ideally) in Figure 2 from year 0 to year 14 billion (some rapid changes in density were ignored there - the moments when the first material structures formed and when the particles and antiparticles annihilated). We have to mention one more thing, the universe was considered a closed sphere that contains a constant number of granules and whose radius linearly increases in time. A similar graphical representation could be obtained if the horizontal axis would be the distance traveled by the light.

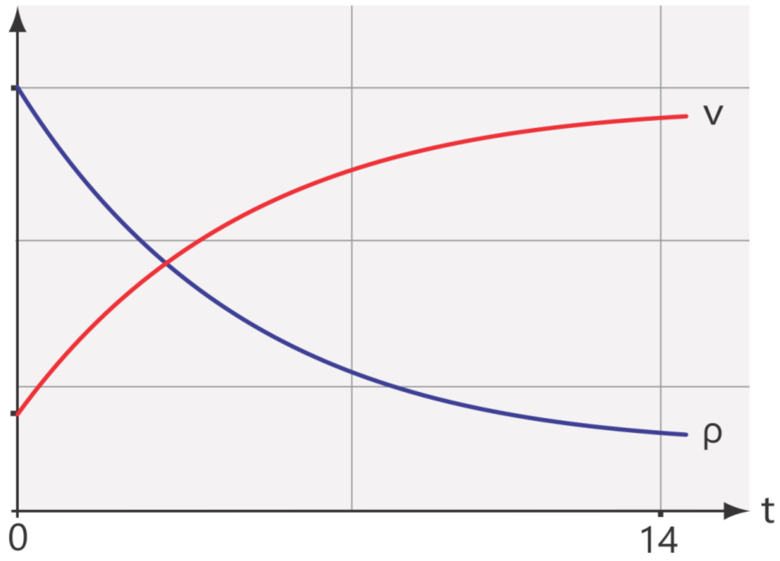


Figure 2 - *The speed of light and the granular density over time*

Remark

The laws of physics for all material structures are invariant in time. What changes in time, once the granular density decreases (and hence the intensity of the fluxes), is the absolute values of the physical quantities and constants involved in the mathematical formulas that describe their connections. It would have been a real cosmic beauty if all these measures were invariant or if they would change proportionally in time, but the reality of our Universe has a different, nonlinear dynamics.

1.4. The decrease of granular density

Here are a few consequences of the decrease of the granular density in time (the intensity of granular fluxes is also decreasing); all of the physical quantities included in this analysis are considered to have absolute measures.

- The mass of all elementary particles (and implicitly of the structures they belong to) will decrease. This produces, paradoxically, a surplus of granules that will persist continuously in the areas surrounding the massive bodies (stars, cosmic dust and galaxies). It simply results that the space around and inside galaxies will always have a higher granular density than the empty space (at equilibrium), and this may be a good explanation for the gravitational lensing effect (and for the "dark matter") produced by galaxies. This phenomenon manifests in addition to the usual increase of granular density in the vicinity of cosmic bodies (caused by the partial diffusion of granular flows - the omnidirectional reflection on matter's constitutive atoms and molecules, which is related to the "classic" gravity).

- The electric charge is very likely to decrease due to the reduced surfaces of charged particles.

- Time, seen as a resultant of the proper oscillation and vibration of particles, will have a higher rate.

- The electric and magnetic fields: their intensity will decrease.

- The size of the physical bodies: it will increase a little due to the lower intensity of all fields.

- The speed of photons will increase (it was shown in the previous chapter).

As it was already stated, all these variations cannot be measured as long as they have a common cause - the granular flows - which equally affect the metrics and the measuring instruments we are using. This generalized relativity, which makes these variations to be unperceivable to observers and prevents the acquisition of their absolute values, still has a component that allows us to compare those quantities over extended periods of time. It is about the *finite speed* of light, a feature that was always present in our universe and to which we should add the huge distances the light can travel. This combination of things allows us to peer deep into the past, to see the formation of the first stars and galaxies and even the radiation emitted by the first particles.

1.5. Observations and analyses

In the light of the above statements, here are a few remarks about the latest astronomical data collected by astrophysicists:

- A truly supermassive black hole lies at the center of most galaxies; these "old" stars actually allowed the galaxies to form, shaping them from the beginning. As these special black holes (the prefix *proto* will be added to their name) were not born normally, from some collapsed stars, it is reasonable to consider a different birth mechanism. Even if the granular density would have been, let's say, ten times higher (is the year one billion) than it is now, the size of these proto-black holes (billions of solar masses) could not have a real theoretical justification in the current physics.

- The almost equal intergalactic distances could not be justified by a sort of "central" explosion, in which the entire "energy" concentrated within that strange "singularity" would have spread through space to this degree of uniformity.

- As stated in Chapter 3, under the assumption of a higher granular density in the past, it is possible that the frequencies of light emitted by the first galaxies (one billion years old for example) to be different (a lot smaller) than those of today. If we corroborate this thing with the decrease of the granular density in time and with the increase of the speed of light during its journey towards today's observers, we may conclude that the recorded redshift of the light coming from distant galaxies no longer means so big distances and neither so big get-away speed. Consequently, we simply need to recalculate the size of the observable universe. Moreover, as the galaxies are not moving away and from each other the way we thought before, the main justification for the Big Bang model and the related cosmic inflation is no longer valid and therefore this whole scenario has to be reconsidered.

- The same thing happens to the other radiations emitted at the beginning of the universe, e.g. those of the 21-cm line (H) - which are now reaching us with much longer wavelengths.

- Interestingly, Hubble's law is not seriously affected by the variation of the speed of light over time. That proportionality deducted for the big cosmic distances is still valid, but their absolute values will decrease and we should fix them by using the new formula for the speed of light.

A more precise quantitative analysis should be made here, as the photons emitted at the beginning of the Universe have a different internal structure and they underwent several modifications during their journey of billions of light-years. For accurate information about the age and speed of the distant galaxies - both deducted from the color of the received photons - some important factors should be taken into consideration to correctly adjust the cosmological data:

- The speed of light at the time of emission was smaller than today, as the granular density of space had a higher value in the past.

- The frequency of those photons, for a today-equivalent atomic transition (color) at an identical rate of time, is smaller. This has caused the first redshift of that light, which practically depends only on the age of the distant galaxy.

- The length of those photons emitted in the past may change significantly as the granular density of space decreases during their journey. Their internal structure will be generally maintained, except for the substantial dilation along the direction of propagation; therefore, their intrinsic energy - related to the granular density - remains unchanged over time.

- As their wavelength has increased, these photons will have a lower frequency and, apparently, smaller quanta of energy are transferred to the receivers.

As all the parameters of matter vary with the change of granular density over time, a new mathematical model to describe their evolution becomes absolutely necessary. These new formulas might compensate for the global relativization of all physical quantities in time and thus we will be able to compare data of the same kind, of absolute nature.

1.6. The distributed birth model

If space would have expanded by an increase in itself, the matter (in any form) could not have been moved in the process and, at the same time, to remain at relative rest. The theory of cosmic inflation cannot be accepted for this very reason; moreover, it postulates another unacceptable thing, namely the space has expanded in the first fractions of a second after the Big Bang with superluminal speeds... We know, the geometric space is not something material, and therefore it does not have a speed limit. On the other hand, space has been created in this very explosion by the expanding "energy", and it would simply result that this strange energy does not have a speed limit too! Furthermore, all of the existing "energy" concentrated into an infinitely dense point, an infinitesimal "singularity"... these things do not quite fit into the framework of a causal and uniform physics (which would be normal and which may apply at any moment), even on a speculative level.

The observations and assumptions mentioned above led me to an alternate birth model of the universe, in which the actual astronomical measurements are all included and reflected. Fortunately, this model can be developed without the help of a mathematical formula expressing the decrease of granular density and the absolute variations it induced to the other physical quantities over time.

Since we are not able to define the primordial "nothingness" (The Universe [2]) - due to principled reasons and due to the lack of concrete references - as being the source of the empty space and the granular matter, the initiation of a cosmic genesis will actually remain with no logical and energetical justifications. In order to compensate for this and to give coherence to the distributed birth model, my previous theory will be changed a little bit by the addition of a few new assumptions.

a) The primordial "nothingness" will be considered from now on as a primordial "something", namely an elementary form of matter being in a certain state, which already occupies a certain "place" and already contains mechanical energy. Whether the "sum" of matter and space is zero or not (i.e. these two physical components have emerged from nothing) represents a big issue that will remain open to debate. Similarly, what is the size (the amount) of this raw material? Is it infinite or not? Whatever its size would be, this primordial material - which will hereinafter be referred to as "*essence*" - has two special features: perfect elasticity and three-dimensional form (the white background of Figure 3A).

b) The essence, which may now be imagined as a uniform and very dense "cloud", undergoes a continuous process of expansion, and therefore its density may reach a minimum value, a threshold below which this raw material can no longer hold its internal cohesion (Figure 3B).

c) At a certain moment, this process of expansion produces a multitude of "ruptures" in the fabric of that primordial essence, i.e. some tiny spherical holes, uniformly distributed, which are expanding themselves along with the raw material (Figure 3C).

The assumptions above actually represent the initial stages of the *implosion* event this cloud will go through, indicating a distributed process that gave birth to our granular Universe. What happens next inside these hypothetical empty spheres? And what are they exactly?

Obviously, these formations actually represent some volumes of absolutely empty space, i.e. what remains there after the raw material withdraws. We cannot define now all the properties of these things, but we may state instead they are the source of the uniform and isotropic *space*, of those places where the matter of any kind can freely move. From a geometric point of view, space may be perceived as being a three-dimensional framework of Newtonian type, perfectly linear, which does not interact with matter in any way. Unfortunately, at this moment we cannot say whether this space is infinite or not, nor if it would have been existed anyway - even in the absence of the primordial matter - as a "place", as a truly fundamental "nothingness" or as a kind of support for all the future material things.

Note. If space (seen this time as absolute nothingness) would have been there anyway and if the amount of essence would have been finite, we then could have taken into consideration the existence of other primordial clouds and their baby universes - but we are not ready yet to speculate so far.

Each of these spheroids described above will undergo a process named *First Bang* (a kind of *localized implosion*) that occurred almost simultaneously throughout the entire volume of the essence. Thus, this implosion phenomenon seemed to propagate at a very high, yet finite speed (we cannot compare it now with the speed of light). Here are some specific characteristics of this distributed process that has generated the space and matter:

- Those primordial "bubbles" of space, i.e. the "empty" spheres that have been formed within the entire volume of the essence, were almost evenly distributed; moreover, all of them grow very fast, increasing in size at a constant speed.

- The whole surface of these "bubbles" goes through a change of state (we can also name it division); the essence of these areas undergoes a transition from a contiguous-type material to a granular one. This phenomenon is quite similar to the well-known evaporation process that occurs when a liquid reaches the boiling point. In other words, the essence-space interface will continuously generate granular fluxes that are normal to the tangential plane of the emitting surface (Figure 3D, where you can see these fluxes).

- The omnidirectional, very dense granular fluxes will start to flow shortly, concentrating into the center of each sphere of empty space; thus, their granules will soon come to bump into each other. As the granular density will become extremely high in this area, all the incoming fluxes will curve and will thus converge towards the center. Therefore, many huge vortexes will form in this particularly dense granular material (via a process similar to the formation of elementary particles, but the scale is much higher) and will concentrate in the central zone (Figure 3F). Taking into account the possible granular unevenness, these vortexes will soon get a global movement of rotation in the dominant direction at that time. The "solid" body that is born this way is "fueled" by the new fluxes and keeps increasing in size until a state of equilibrium is reached (a balance between the centrifugal forces and the external pressure).

- These compact granular structures are in fact the proto-black holes of our Universe, primordial supermassive formations that were born directly *big* and which will soon gather the nearby clouds of structured matter. They will continue to grow (not significantly) by accretion, "eating" the gaseous matter around and other nearby stars. Likely, their diameter will additionally increase with the global intensity decrease of the granular flows.

- Each of those "bubbles" of space grows rapidly and, at a given moment, will merge with the adjacent ones; thus, they eventually form a single huge bubble, *the space*, an empty volume that is only populated by proto-black holes. The granular flows will overlap and join together, getting even in a relatively short time. This new scenario of the Universe's birth may have two different continuations, depending on the size of the primordial cloud of essence:

1. Infinite size - an open or closed universe is no longer relevant; however, in this case, we cannot justify the expansion of space and the decrease of the granular density in time.

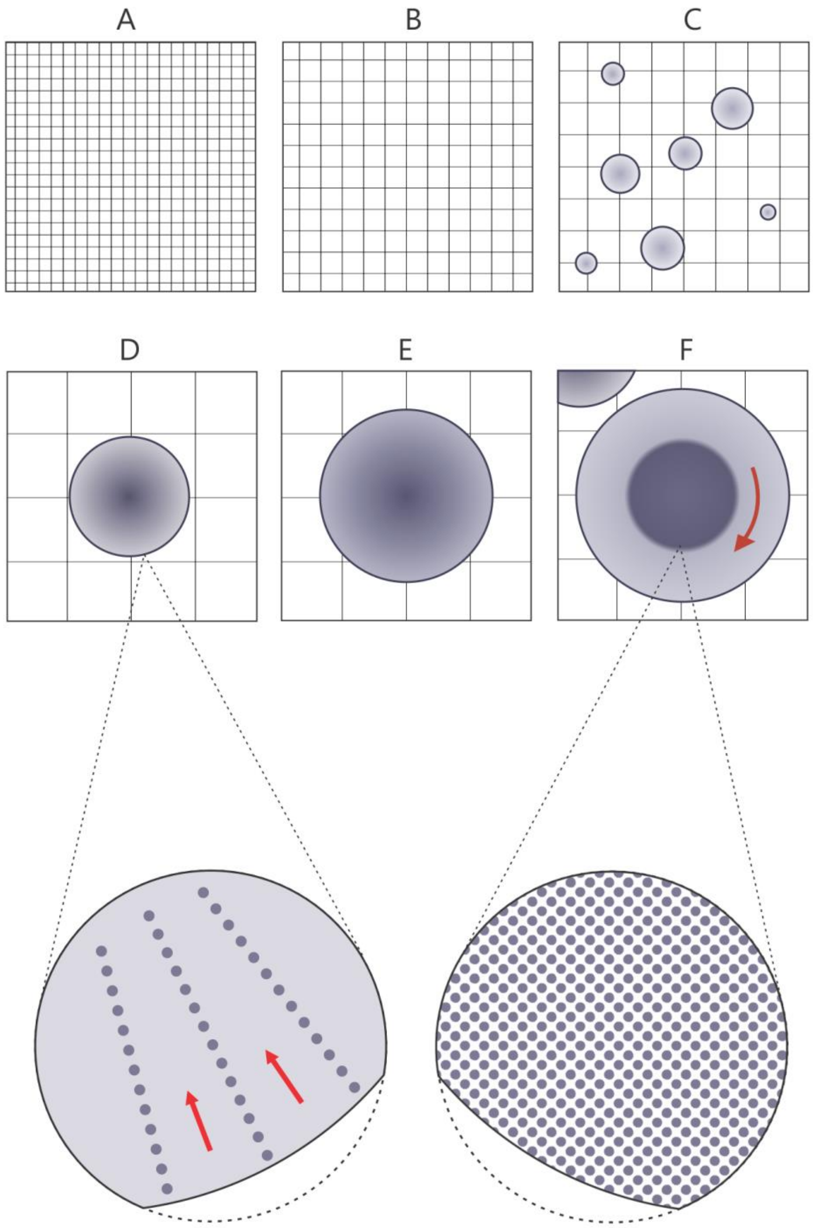


Figure 3 - *The initial stages of a First Bang*

2. Finite size - now we can make an important distinction:

a) Closed universe - the most likely case. The granular material is no longer generated (the number of granules and their energy will be conserved), but the granular pressure will determine a continuous expansion of space - which justifies the rate of decrease of the granular density.

b) Open universe - all the granular material would have been spread continuously in the great cosmic emptiness and thus the average density would have dropped much faster - the unlikely case.

A birth model that is based on a distributed process of creation allows the newly formed universe to support all of the granular laws and postulates [1]. As the local granular impulse is quasi-null in those embryonic zones of space, the grand total will also be null at the merger moment and afterward.

The most important aspect of the process described above is the *uniqueness* of the primordial cloud of essence and the attribute of *absolute* it generates. This natural attribute is inherited by the newly born universe, becoming an intrinsic quality. Therefore, the physics of this new universe will have an absolute spatial reference that must be reflected in any law and theory we draw, at any scale, in correlation with another intrinsic quality, namely the *relativity* imposed by the great uniformity of space [2].

Note 1. The gravity exerted by the proto-black holes, seen as a perturbation in the uniform distribution of the local fluxes, has a maximum possible value and it no longer depends directly on the star's mass. As this value is only determined by the opacity and the diameter of the stars (assumed spherical bodies), gravity will no longer depend on their internal structure - which thus can be reduced to an *empty* spheroid. If a black hole expands with the decrease of the spatial granular density, this inner emptiness may also grow in size and the star's peripheral speed may decrease until the dynamic equilibrium is reached.

Note 2. This First Bangs model justifies a sort of macro granularity of space in the beginning if we take into account the very big distances between the proto-black holes (thousands, even millions of current light-years) and their small initial linear momenta. If there will be a global expansion of these newly formed galaxies, it will be only caused by the gravitational gradient that is present on very large cosmic distances.

Note 3. No more black holes may form through this mechanism; the special conjuncture - a huge granular density and a massive concentration of fluxes in a limited area - can never be repeated in the actual universe.

1.7. Conclusion

The model we have shown here has mainly started from this question: why there is a massive black hole located at the center of most galaxies? Trying to answer that, this model has succeeded to integrate my granular theory and all of its laws, being also in harmony with the newest celestial observations (of the distant galaxies and of the cosmic background radiation). Furthermore, the concept of absolute is maintained during the distributed birth of the universe, being a key element in explaining the emergence and the evolution of structured matter. The First Bangs hypothesis starts from a very small number of assumptions and possesses a real logical consistency; it also provides full explanatory solutions for the first moments of the universe and its evolution laws. Once again, the new granular physics has helped us decipher the deep mysteries of the surrounding nature, allowing the development of a complete, deterministic and rational theoretical model of the universe.

2. The Theory of Granular Gravity

A granular model of the gravitational field

2.1. Introduction

Let us suppose that the universe is correctly described by the Prime Theory ([1] and [2]) and the newly introduced granular postulates and laws are all valid. The definition of gravity, as an effect of the directional fluxes that have a sub-quantum granularity, is also kept. Clearly, the gravitational field is the fundamental, primordial field of the universe, the generator of all components of the matter - the elementary particles, being at the same time the cause and support for the propagation of all the other known fields. This field's energy shaped up the matter and then concentrated it into large cosmic objects, i.e. into stars and planets; at a later moment, all these bodies formed some even bigger structures, the galaxies. Matter, in any form, has evolved and transformed, sometimes quietly, sometimes violently. Anyway, all of these changes were due to the special properties of this fundamental field called *gravity* and due to the existence of a spatial framework where its interactions can be exerted.

2.2. The three-dimensional space

Space will be further regarded as a dual concept, being at the same time a truly empty framework of Newtonian type and a granular fluid with particular properties. The number of dimensions of space is not a consequence of a cosmic "arrangement" generated by the balance of the primordial energy or matter. It is just a "given" of this universe, the effect of a phase transition occurred within the entire volume of *essence* - from a continuous form of organization to a discrete one. This change produced the well-known empty space, the cosmic vacuum in which the granules of essence may freely move in any direction. If we would use a reference system with three perpendicular axes (which seems natural, as we are understanding space in left-right, top-down and near-far parts) we could mathematically describe the movement of the objects in *any* direction within this framework. Our imperative need to formalize, associate, extrapolate and make everything abstract has led to the idea that there could exist, not only virtually, more than three dimensions. It is obvious that we could imagine models and make mathematical calculations in *n*-dimensional spaces, but the objective reality has nothing to do with them, it is fundamentally and definitively built as a *three-dimensional frame;* and this is the only place where matter can "work", i.e. can interact by obeying simple mechanical laws, much less exotic than previously thought. Humans are "looking" around and observe via their own senses a physical reality that may be described by a three-dimensional system, but we are dealing in fact with only one fundamental dimension of space, namely the *space* itself. And yes, we can say that it is *one-dimensional* in this perspective. Space is practically a "place" generated by the lack of matter (the raw material in contiguous form), a place that is currently filled with a fluid containing essence in granular form. Consequently, there is no empty, isolated space somewhere in our Universe. As it was described in Chapter 1, at time zero, we could assimilate everything with an unlimited quantity of essence in motion. In order to maintain a dynamic equilibrium at the time of transition, multiple *gaps* were formed throughout the entire body of essence; they subsequently have fused together and their volume has rapidly increased. All of these have eventually created the *spatial frame* and the *granular-type matter*, i.e. the fundamental physical entities that will be further used within this theory.

2.3. Characteristics of the granular fluxes

The granular fluxes have already been described in my previous works, but all their characteristics should be placed now in a uniform typology to allow us to create a complete mathematical formalism of the gravitational field. Depending on the dimensional scale, a distinction should normally be made between the discrete, discontinuous nature of these granular fluxes (in time and space) and the final effect that results from their interactions with the structured matter (which is averaged and thus has continuous values). Once we know the granular nature of these sub-quantum fluxes and the rules governing their interactions, all the effects they produce may formally be expressed directly at the quantum scale; no important feature of the physical phenomena, neither as value nor as causality, can be lost in this way.

Fundamental properties:

a) If space is uniform, all granular fluxes propagate *rectilinearly* and their absolute velocity has a constant value (the speed of light in vacuum).

b) All of the granular fluxes that cross a specific space and which ideally have equal intensity in any direction form the *gravitational field*.

c) The granular flows in a particular direction are generated at a cosmic scale and therefore they do not have a local character; however, they act at any scale of matter, and in the same way.

d) The global intensity of granular flows (in a state of equilibrium) is correlated with the average density of the granular medium at the cosmic scale.

e) The granular fluxes may change their direction when areas of different granular densities are crossed; moreover, they are fully reflected on the surface of elementary particles.

f) The directional uniformity of granular fluxes is deeply affected inside and in the vicinity of some massive cosmic bodies, and this thing produces the well-known phenomenon of *gravity*.

g) The actions of the gravitational field on matter have several consequences:

- the structural integrity, the form and the uniform motion of particles and material bodies are all maintained over time through the uniform transfer of granular impulse.

- different amounts of impulse are transferred due to the nonuniformity of the gravitational field, and this is equivalent to a force acting on the material bodies; therefore, they are being accelerated in a particular direction.

- the gravitational field generates the entire support and propagation means for all the other known fields.

All these characteristics allow us to describe the gravitational field as a three-dimensional *vector field*, continuous and omnidirectional; its interactions with matter may be quantified by the local, finite perturbations manifested within its uniform spatial distribution. These interactions and the effects they produce may be correctly treated only by using an absolute system of reference, as was previously described in [2]. The relativity and its high-speed effects are present and they all can be used in the usual descriptions of the gravitational interactions with the material bodies and elementary particles.

The gravitational field may have these kinds of perturbations:

a) *Additivity*. The intensity of this field in a certain direction can be increased by the presence of an additional flux or can be diminished by removing a part of the flux.
b) *Divergence*. The degree of divergence (which is zero normally) of this field changes in the vicinity of electrically charged particles.
c) *Reflection or absorption*. It is produced at the surface of any elementary particle.
d) *Rotation*. It occurs during reflections, due to the granular movements.
e) *Diffusion.* A phenomenon that mostly occurs at the surface of any dense macroscopic body.
f) *Attenuation.* This global phenomenon occurs during the passage of granular fluxes through any material body.
g) *Deflection*. The directional fluxes change their direction in areas with nonuniform fields.

The effects of these perturbations on matter:

a) *Gravitational* interaction, which directly results from the local granular flux's nonuniformity.
b) *Electric* interaction is produced by the electric field and it results from the divergent fluxes reflected by the electrically charged particles.
c) *Magnetic* interaction, a resultant of the electric field's intensity variations.
d) *Photonic* interaction occurs on the photon-particle contacts (photons being granular structures that move at speed **c** due to the additivity feature).
e) *Strong/weak* interaction cumulates several types of field properties and perturbations.

2.4. Gravitational interactions

2.4.1. Granular fluxes

As it was already stated, the interactions of the granular fluxes with matter are present at any scale, starting from the quantum level up to the macroscopic world. These fluxes have actually created all elementary particles and gave them a stable form, being also responsible for all their interconnections through different fields. The elementary particles and all of their structures, from atoms to the biggest cosmic bodies, are "immersed" in the spatial granular fluid that governs in fact all their interactions. We can now try a graphical description of the actions caused by the gravitational field to matter, at all scales, paying more attention to the movement of material structures. We have to keep in mind three fundamental ideas for this analysis:

1. The granular fluxes do not have local sources; it can be assumed that they originate from points located at infinite distances.

2. They are propagating in an absolutely straight line, at the constant absolute speed **c** (in a uniform medium).

3. All interactions of this fluid with the structured matter are only of mechanical nature.

In order to outline the particular characteristics of these interactions and to subsequently describe them by mathematical formulas, we have to analyze first all the specific situations in which they are present. Let us now consider an ideal flat surface of area **S**, as shown in Figure 4a, which will reflect all incident fluxes in accordance with the well-known law of reflection (optics). Both sides, **A** and **B**, will therefore reflect the fluxes coming from either the left or right side. The presence of this ideal surface, i.e. a fully reflective one, does not practically shield the incident fluxes and neither affects their even distribution; it would only change their point of emission. The surface of real materials, like the one shown in Figure 4b, reflects only a small part of the incident fluxes, while the part remaining crosses it unaffected. As the reflection occurs on the surface of all elementary particles and they have a dynamic and random orientation, the fluxes will come back in every possible direction, diffused ($\boldsymbol{\phi}_i$ is the *incident flux*, next to the *emerging* and *diffused* ones).

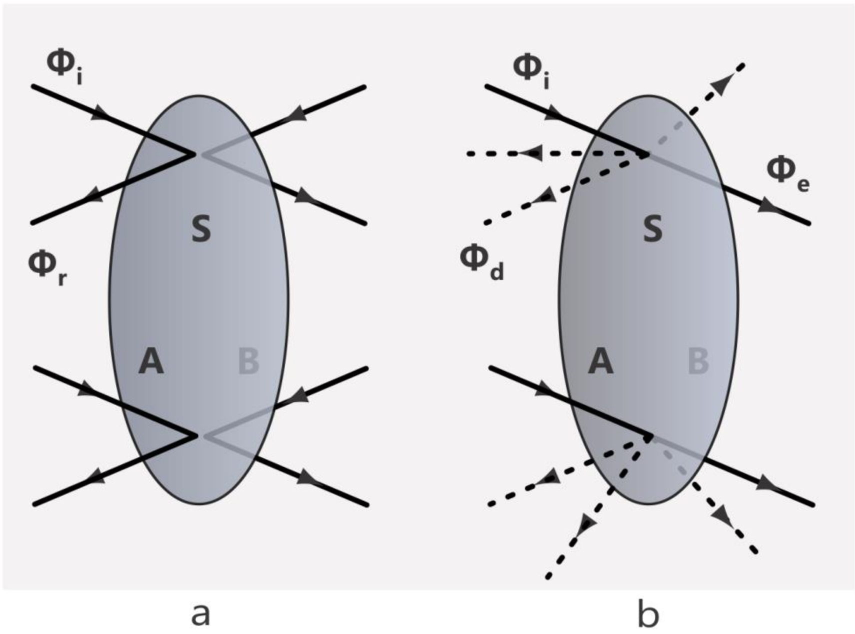


Figure 4 - *Reflection of the granular fluxes*

2.4.2. The electric field

This chapter tries to improve the descriptions and formulations that were previously made in my first books - Chapter 4 [1] and Chapter 6 [2].

If we are to analyze more closely the flux - elementary particle interaction, we may see a larger number of phenomena that could influence the granular fluxes. Let be a real elementary particle, a positron for example, as in Figure 5. The incident fluxes **A**, **B** and **C** will undergo a more complex reflection process, and here are some of its particular traits:

- reflection is of *relativistic* type, as any particle has a fast intrinsic precession and a global motion.

- there is a *rotational* component that adds to the reflected fluxes **A'**, **B'**, **C'** (indicated by the dotted lines) due to the conservation of the total impulse during collisions.

- the gradient of granular density around particles will additionally *curve* the incident and reflected fluxes all alike.

- the reflected fluxes will *diverge* due to the electric charge (curvature) of the particles.

We now may clearly see that an electric field (of a positive electric charge in this case) is in fact a perturbation of the uniform local flow; this perturbation has a rotational component (which is synchronous with the movement of the particle - the intrinsic rotation and global translation) and a nonzero divergence value. The variations of this electric field in space and time represent the magnetic field. Thus, we may say that the source of all known fields (including the electric one) is in fact *the perturbation or the nonuniformity of the local flux*.

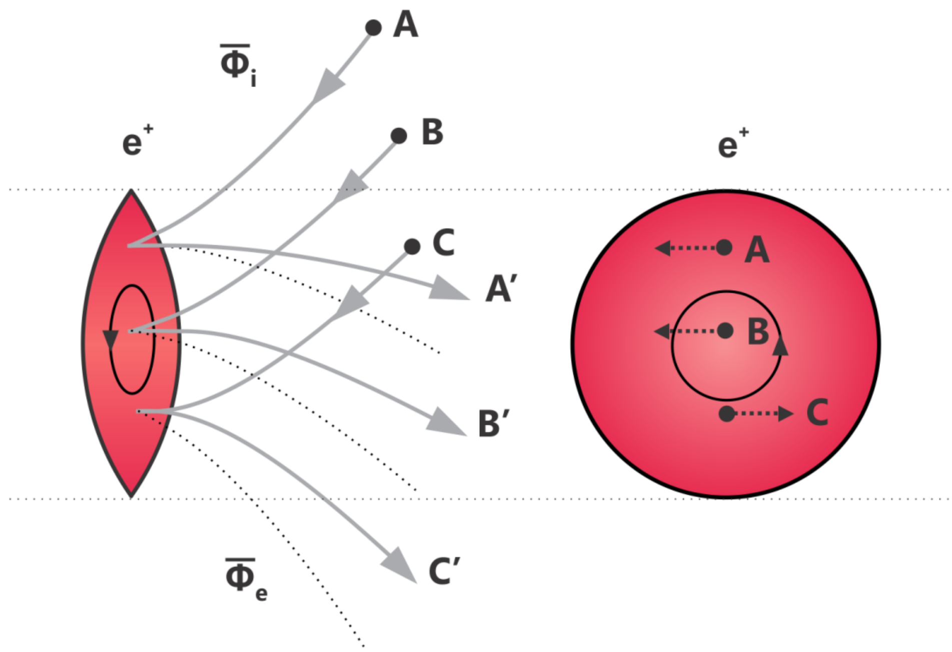


Figure 5 - *Granular reflections on electrically charged particles*

The local flux is perturbed by the presence of any particle - elementary or composite, with or without net electric charge. Consequently, the nearby particles are influenced in several ways through complex interactions (whose intensity changes with the distance). Thus, the force exerted on particles determines their movements and their trajectories in accordance with the well-known principles of mechanics; however, the final effects are also depending on the mass of each particle.

As it was already stated in [1], the mass of a particle depends on the number of constitutive granules. The acceleration one microscopic entity gets in a force field depends on its mass and on the impulse transferred by the field through granular collisions. A particle that is freely moving within the granular fluid of space constantly receives an even impulse from all directions and therefore it can maintain its current state of motion indefinitely (i.e. the intrinsic rotation and precession, along with the global translation). In conclusion, the granular fluid has the capability to preserve the uniformity of the movement of any particle or material structure; actually, the causality is better expressed in this way: the laws of mechanics are given by the properties of this fluid and its fluxes.

But what happens when a supplemental flux acts on a particle? The additional momentum that is transferred to the particle's surface will change the angle of velocity vectors to all internal granules; therefore, the particle will speed up, having a nonzero acceleration over the entire duration of the flux. The acceleration is directly proportional to the strength of the flux and inversely proportional to the particle's mass. All these things will be linear within the nonrelativistic range of speeds; however, the mass increases at relativistic speeds, reaching an infinite value at the speed limit **c**. What physical explanation has this relativistic phenomenon?

If the speed changes, from value $\mathbf{v_1}$ to $\mathbf{v_2}>\mathbf{v_1}$ for example, the future position of the particle in the moving direction will also change (it will be located a little bit farther away than usual). Due to this "jump" made within the surrounding fluid, the particle experienced a greater number of granular collisions on the average direction of travel, which means it has received a bigger impulse in that direction. In other words, the instantaneous "mass" of that particle (seen as the bigger momentum required by that change in speed) will increase, more as we are getting closer to the speed of light in this granular medium. If the particle would reach the speed limit **c**, a "wall" of granules would form in its frontal region and the "free" motion between the collision moments will no longer be possible. This is the logical explanation for the "infinite" value of mass gained once the speed limit is reached.

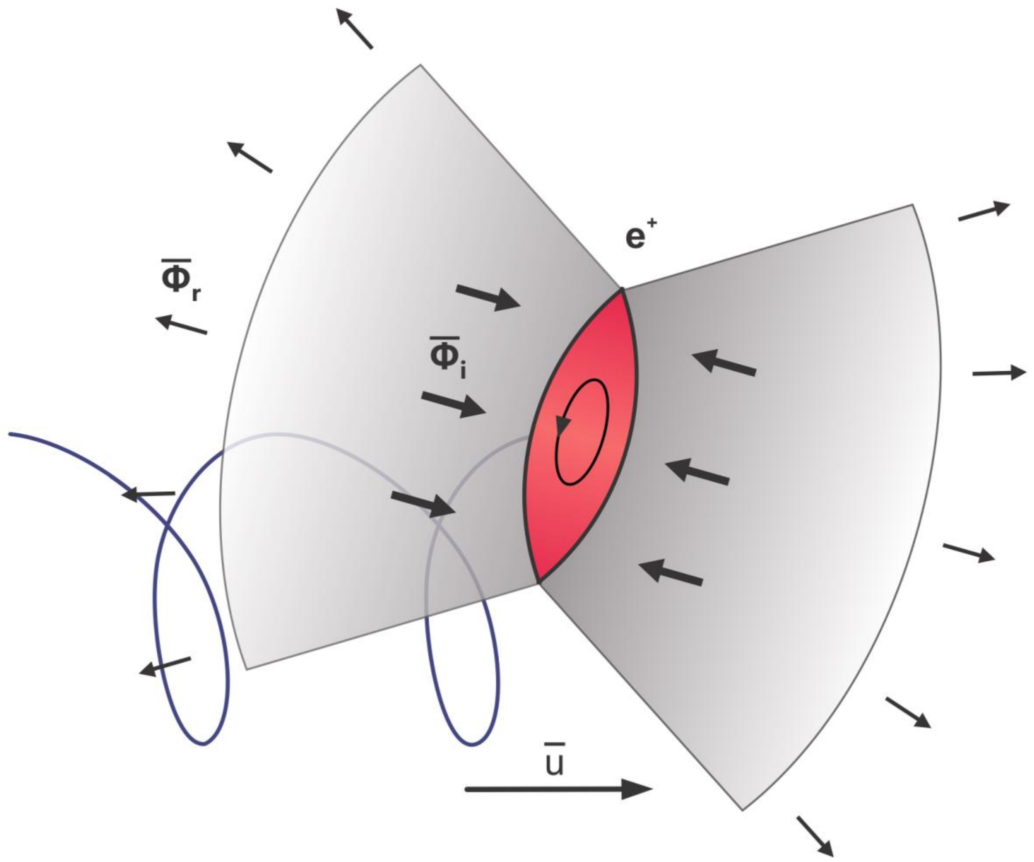


Figure 6 - *The electric field of positrons*

Simply put, we may consider that space surrounding a positively charged particle contains a rotating divergent field, exactly like the one shown in Figure 6. This electric field interferes with any other nearby charged particle and the intensity of this action will depend on the amount of charge, distance, instantaneous velocity and spin orientation. However, all these things are more complicated in fact and there are three more directions to follow in a comprehensive analysis:

a) The omnidirectional gravitational fluxes are reflected from the charged particles' surfaces in the same way the light reflects on a concave or convex mirror; therefore, some concentrated and focused fluxes form around the particle and propagate radially, as shown in Figure 7.

b) The charged particle emits this symmetric field from both sides, in a continuous manner. As this field is synchronized with the particle's motion of precession, its averaged distribution will be nearly circular in shape; moreover, the field will be composed of some "wave bursts" that move on *spiral* paths away from the current location of the particle.

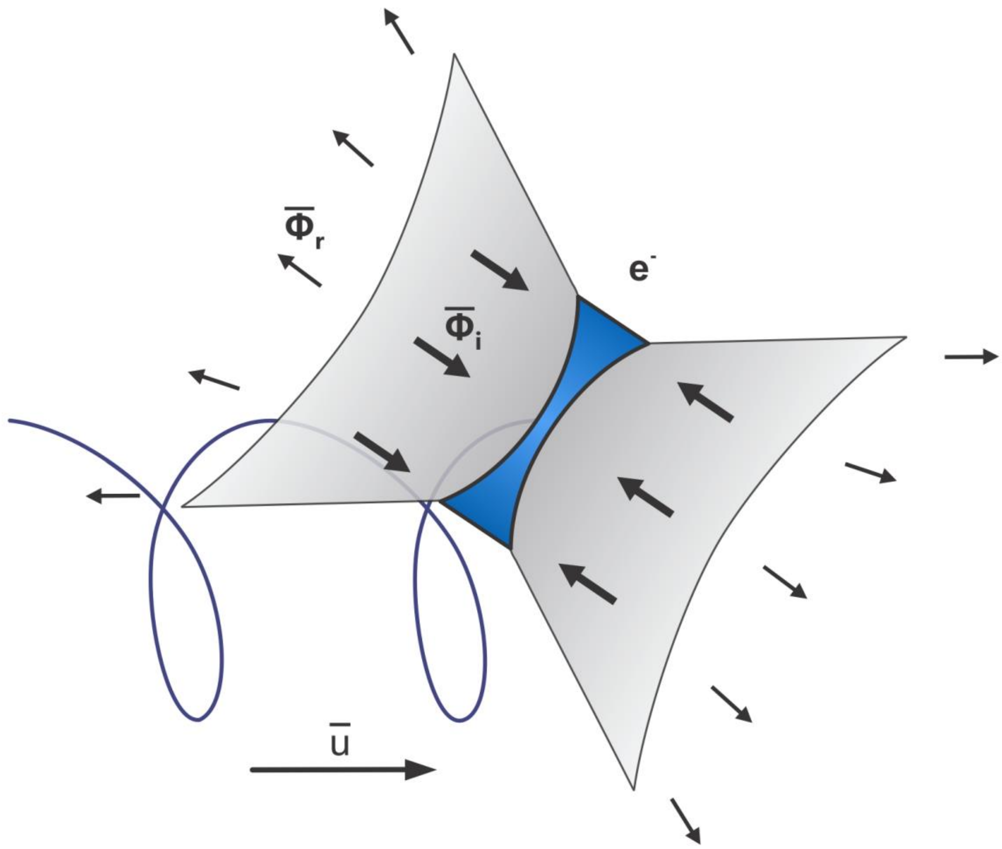


Figure 7 - *The electric field of electrons*

c) We also have to analyze the electric field and its action on other particles (with and without net charges) quantitatively, as a function of distance, in order to have a correct picture of this kind of interaction at the atomic level.

The electrophotons and their properties:

- The granular structure of all electrophotons is similar to the photon's spiral structure (Figure 8, where you may see several granular layers that were emitted at different moments during the particle movement of precession); electrophotons can propagate and thus produce the interactions of the electric field (electromagnetic in fact, the magnetic part results from the variations of these structures).

- Electrophotons are practically produced by the granular fluxes that reflect on the charged particle's surfaces, their internal structures being in fact successions of granular layers of variable density.

- Electrophotons may be represented by a divergent vector field that propagates within a certain range of solid angles.

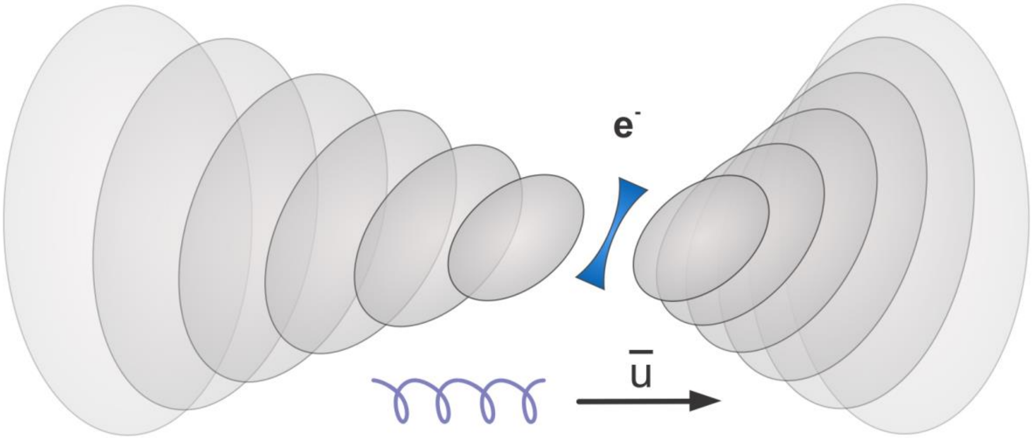


Figure 8 - *A few component layers of the electrophotons*

- The interaction mediated by electrophotons decreases in intensity with the square of the distance (due to the decrease of their granular density).

- All electrophotons move in a straight line with the speed of light, **c** (this speed is given by the local spatial fluid).

- Electrophotons are emitted continuously in almost every direction around the charged particle; they accurately follow its movements, the precession and global translation.

- No energy is required to create the granular structure of an electrophoton; its internal layers are simply built when a part of the local flux is concentrated during the reflection on the particle's surfaces. If there are no interactions with other electrically charged particles, all electrophotons dissipate after a while into space and their structures practically disappear.

- The granular layers of an electrophoton contain the exact polarity (the type of curvature) of the emitting particle.

- The electric field is additive; the independent actions of two or more electrophotons of the same polarity add up, while the fields of opposite polarities subtract.

- Photons of this kind are continuously emitted by any charged particle, whether it is elementary or composite, free or atomic. The succession of these divergent photons has a certain frequency, following in fact the emitting particle's intrinsic precession rate.

- In quantum physics, the electric field is being transmitted by some "virtual photons", special bosons that are known to be the force-carriers for the electromagnetic interaction; in contrast to this, the electrophotons above are real things, concrete objects with certain granular structures. The calculations that lead to the Coulomb's law (the electric field is proportional to the density of the virtual photons) are all correct if averaged quantities are considered, but we now have a complete physical explanation of this phenomenon.

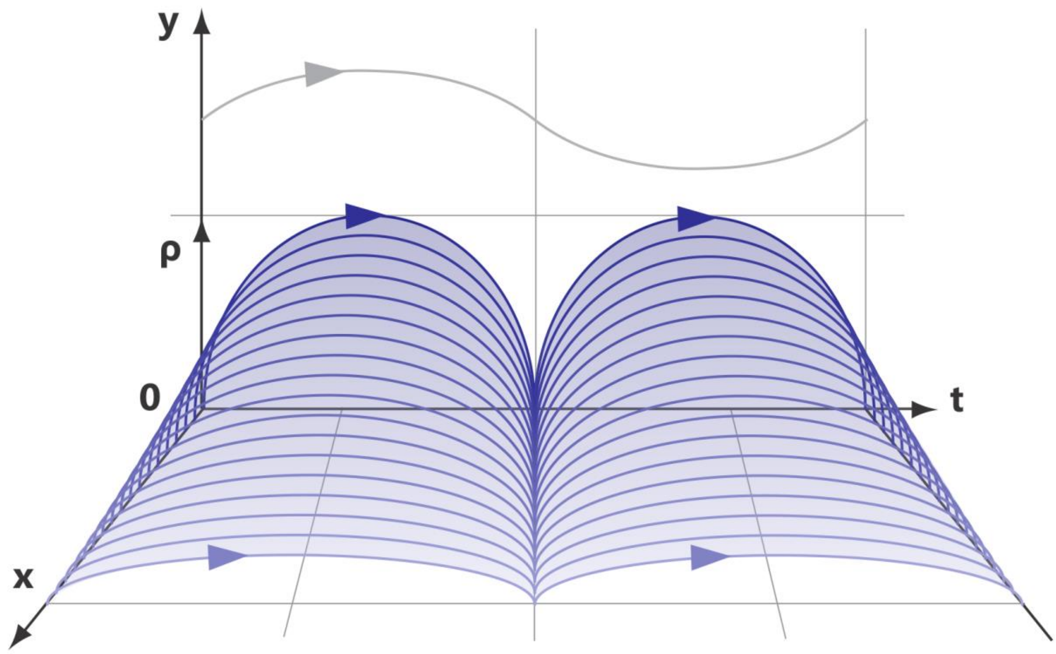


Figure 9 - *Propagation of electrophotons*

In conclusion, this particular kind of photon - the electrophoton - is a granular structure that is *continuously* emitted by any electrically charged particle in the surrounding space. As the trajectories of their component granules have a certain divergence, all electrophotons will feature a decrease in density during propagation (at the speed of light), slowly "dissolving" into the spatial fluid. Electrophotons are generated in pairs from both sides of a particle and their *spiral-shaped* trajectories accurately follow the particle's movements of precession and translation. Two electrophotons are emitted by a particle while it makes a complete rotation (the precession), as shown in Figure 9. We may see on the vertical axis the current value of **ρ,** the granular density of the photon; the blue lines are representing the decrease of density with the square of the distance **x** over time (the horizontal **t** axis).

A good analogy can be made between the flux reflected by the electrically charged particles, i.e. the way electrophotons are generated, and the light emitted by a lighthouse. Both of them are periodically spreading photons in the surrounding space as variable, but concentrated beams that are simply propagating over long distances.

The interaction of electrophotons with charged particles:

The internal layers of an electrophoton have the same shape as the surface of the emitting particle, the same polarity; therefore, the electrophotons may be described as positive or negative (concave or convex - relative to their direction of propagation). Being additional granular fluxes, this kind of photon interacts with a nearby particle and transfers it certain granular impulse (proportional with its flux's density). The direction of this global impulse will depend on the electrophoton's direction of propagation and the particle's polarity. The electrical interaction is a more complicated process and it has to be analyzed dynamically, taking into consideration a few more key elements:

1) Electrophotons are emitted by the electrically charged particles; they propagate at the speed of light, their actions are independent and their effects are additive (the superposition principle applies).
2) Let us suppose now that a charged particle emits a single electrophoton during a complete precession cycle. This movement takes place at relativistic speed, very close to **c**. We may therefore assume that the frequency of the precession motion would be constant for a certain type of particle, and it is its wavelength that will only depend on the particle's global speed. This is why we are going to have a kind of synchronism between particles that interact electrically and a certain alignment of their spin vectors.
3) The interaction of electrical type depends on the relative speed of particles and therefore the relativistic effects will all be present at higher speeds.
4) The magnitude of the electric field at a point decreases with the square of the distance from the source; this phenomenon, which happens due to the divergence of the beam of electrophotons, complies with Coulomb's law (both scalar and vector forms):

$$\mathbf{E = e / 4 \pi \varepsilon_0 r^2}$$

Similarly, the well-known formula of the electric force (both scalar and vector forms) **F = q E** will work fine at low speeds.

Let's consider the case of two positrons $\mathbf{e_1}$ and $\mathbf{e_2}$ that are electrically interacting, as shown in Figure 10. The first positron may be at rest or it may move slowly at speed **u**, while the second positron is at rest. A particular position has been chosen, as the particles continuously spin during precession, when the photon's plane is aligned with the positrons' plane of rotation. What happens exactly in this process? The electrophoton emitted by $\mathbf{e_1}$ (while it travels and rotates between the two positions **a** and **b**) "sweeps" the surrounding space and, as it propagates rectilinearly, brings a variable granular flux onto the surfaces of particle $\mathbf{e_2}$. Its granular layers of variable density (the gray semicircles, which have the shape of the emitting particle) interact with the particle $\mathbf{e_2}$ and transfer it a continuous impulse in a certain direction. This impulse varies in time, as magnitude and distribution, and therefore we will only consider its average value. We may easily notice how the granular layer that hits the frontal side of the particle $\mathbf{e_2}$ will transfer a maximum amount of impulse (due to the "unmatching" type of concavity), while the layer coming from behind will have minimum interaction with the particle's surface (as they both have the same shape). The continuous action of these electrophotons is equivalent to a force **F** exerted on their direction of propagation. If two electrons would interact electrically (they have negative charges), things will be quite similar - the same *repelling* force will be exerted. These repelling forces make the particles move away from each other; the magnitude of the acceleration will be proportional to the strength of the forces above and inversely proportional to the masses of those particles.

The most interesting case is the interaction between particles of different electrical charges, as depicted in Figure 11. The electron $\mathbf{e^-}$ is subjected to the higher pressure of the granular layer from the rear (whose shape does not match the particle's surface) and therefore the equivalent force will have an opposite direction. These particles will *attract* each other, moving faster and faster on a collision trajectory (normal photons may be emitted in this process). A maritime analogy can be made in this case as well: the trajectory of a charged particle moving towards the source of opposite-sign electrophotons is similar to the path of a sailing boat that moves forward when the wind is blowing against it. If we are to consider a composite particle, the actions upon each of its components will add up; in the particular case of a neutral particle (as neutrons), the forces exerted on the components (quarks) of different electrical charges will cancel each other out.

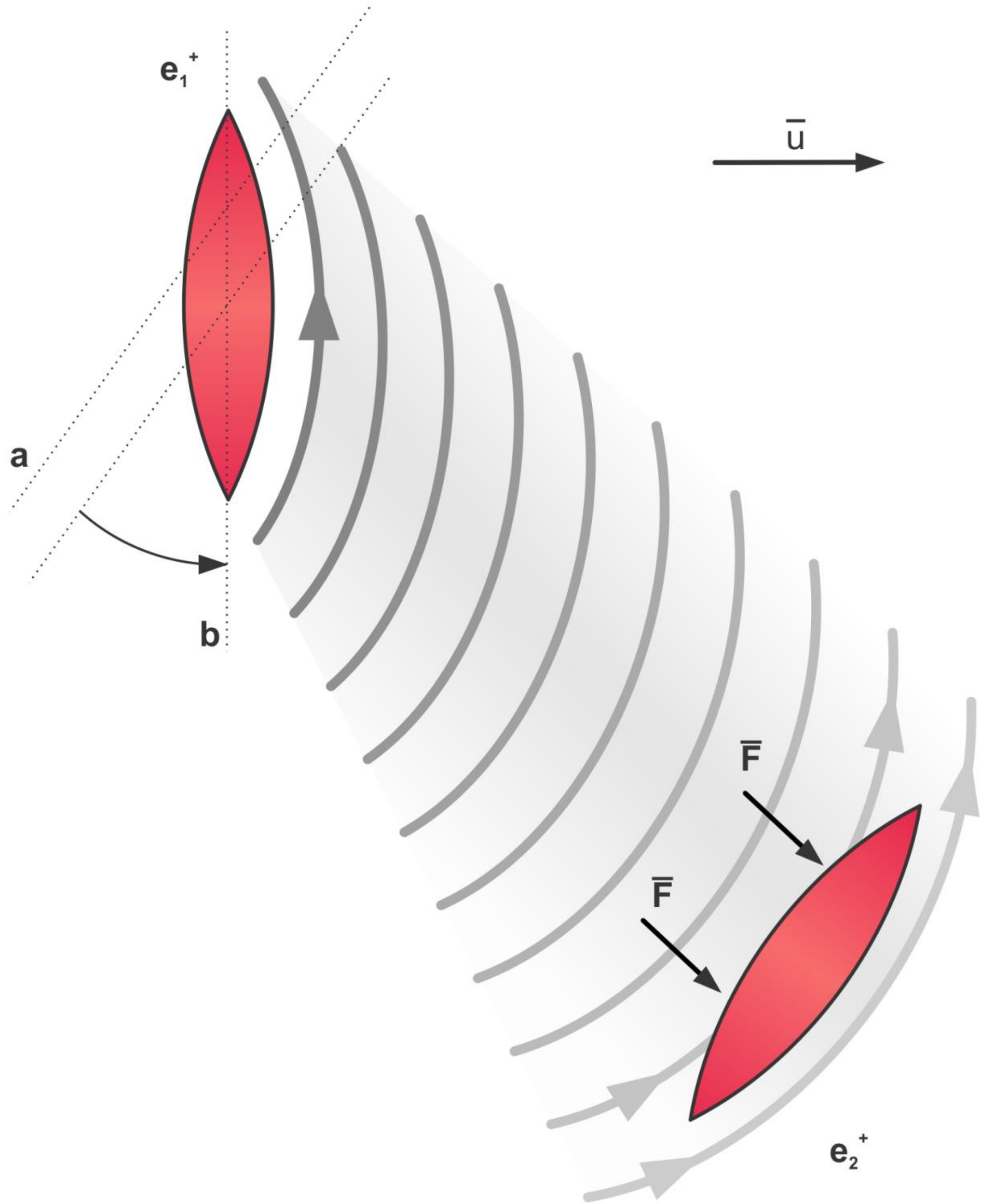


Figure 10 - *The positron - positron interaction*

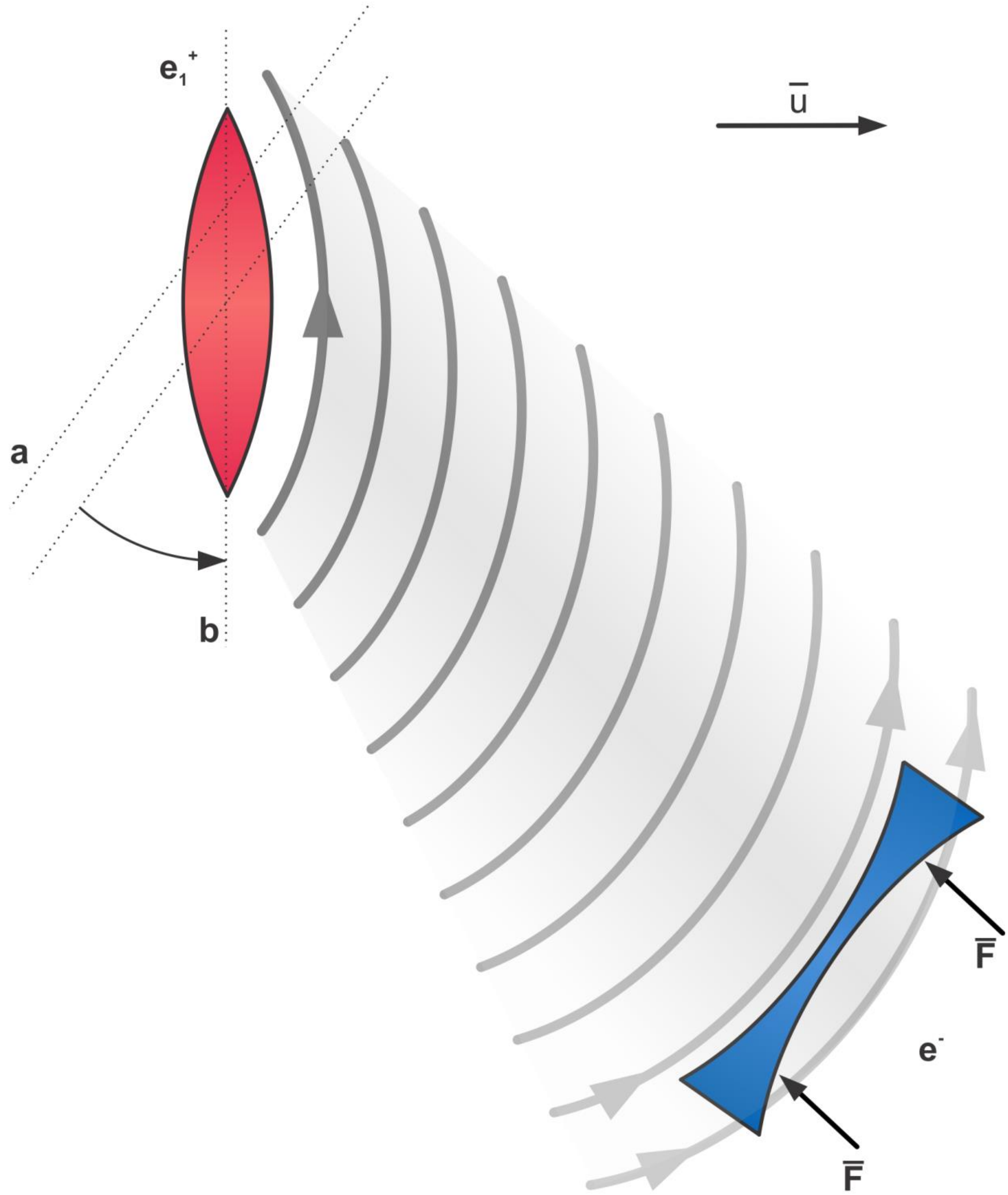


Figure 11 - *The positron - electron interaction*

2.4.3. The magnetic field

In order to give a correct description of this field, there are a few aspects that have to be mentioned at this point (implicitly assumed in this subsection):

1) The magnetic field is only produced by the electrically charged particles *in motion*.

2) All magnetic interactions are transmitted by the same granular structures described above, the *electrophotons*.

3) Similarly to electric interactions, the magnetic interaction propagates at the speed of light and its effects will depend on the relative velocity of the electrically charged particles that are involved; therefore, the well-known relativistic phenomena will all be present.

4) As the nature of this granular interaction is purely mechanical, the effects of the magnetic field produced by two or more electric charges in motion will combine together.

5) The parameters of a magnetic field and its effects on particles depend on the amount of positive and negative charge that is involved.

Let's consider a simplified representation of two positrons, $\mathbf{e_1}$ and $\mathbf{e_2}$, as shown in Figure 12. The first particle moves upwards with the global speed **u** (measured in our laboratory's frame of reference), while the second particle is at rest. At time $\mathbf{t_a}$, the first positron emits an electrophoton that "catches" the other particle and, as described above, exerts an electric force on it ($\mathbf{F_a}$). At a later time $\mathbf{t_b}$, the first positron emits another electrophoton toward the second positron, but from a different position and under a different inclination angle. As both particles have performed their intrinsic precession movement between those moments, they now have a different orientation in space. At this moment, a new force of magnitude $\mathbf{F_b}$ is exerted on the positron $\mathbf{e_2}$, in the direction that currently connects the particles.

Seen as a dynamic process, the electrical interaction was continuously exerted on the interval between those two moments we have considered, producing an additional effect upon the second particle due to the *change in direction* of the electric force.

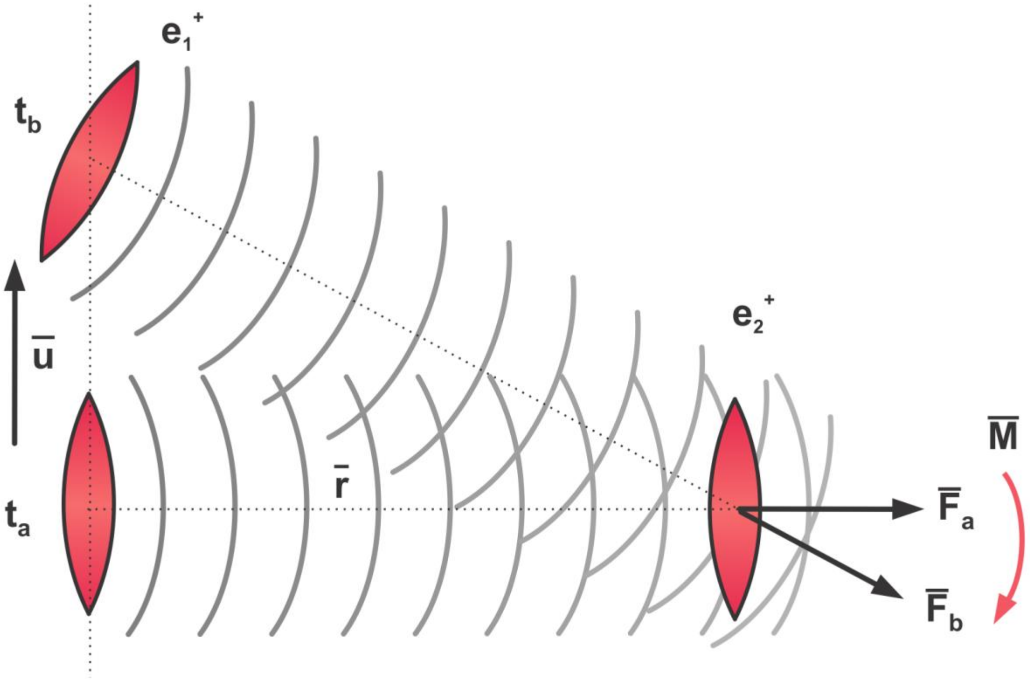


Figure 10 - *The magnetic interaction of two positrons*

An additional, averaged torque **M** acted this way upon the second particle and caused a slight *rotation*. If this particle would have been in motion, having a nonzero component of velocity in the plane formed by the $\mathbf{e_1}$'s velocity vector and the $\mathbf{e_2}$'s position, it would have described a circular trajectory (helical if seen in space) with a radius that would depend on the intensity of this new *magnetic* field. If its velocity were perpendicular to that plane, no magnetic interaction would exist - as the sequence of electrophotons tries to rotate the particle $\mathbf{e_2}$ in the exact direction it already rotates intrinsically. Therefore we notice that a charged particle, under the action of a certain magnetic field, is not practically subjected to an acceleration force - as only the direction of its velocity vector rotates. It can be geometrically inferred that this torsion momentum, called magnetic induction and denoted with **B**, is proportional with the electric charge and the speed of the emitting particle and inversely proportional with the distance: $\mathbf{B = q\,\mu\,v / 4\,\pi\,r}$

The force exerted upon a certain particle (which determines its continuous rotation) is thus proportional with its charge, speed and with the magnetic induction **B** at that point:

$$\overline{\mathbf{F}} = \mathbf{q}\,\overline{\mathbf{v}} \times \overline{\mathbf{B}}$$

What we can say in conclusion about these fields, the electric and magnetic ones? Practically, they are a single physical phenomenon that is generated by the charged particles and mediate by the divergent granular structures called electrophotons (positive or negative). The key feature of these fundamental interactions is the nature of the intrinsic motion of all charged particles; this special motion allows them to execute extra translations, rotations and oscillations under the influence of the different types of electrophotons. The electric field may be seen now as a simple emission of divergent granular structures - the electrophotons - which is characteristic to any charged particle. If the charged particles have a certain relative speed, their electrophotons will be emitted in different directions; thus, these photons are dynamically creating small granular vortexes that constitute in fact the magnetic field, as shown in Figure 13 (there is my new graphical representation for these vector fields). If some charged particles enter into a region of uniform magnetic field, their velocity vector will rotate, but its magnitude will not change; the direction of rotation is given by the polarity of the electrophotons and by the sign of the particle's charge. Moreover, a change of the magnetic field is equivalent to a change in position or speed for the particles that generated it, which is a change in their electric potential. Therefore, an electric current can flow in the case of electrically conductive materials and, consequently, we may see a kind of virtual reciprocity of these two fields transported by electrophotons (**rot E = - dB/dt**).

The great importance of the explanations for this type of granular interactions is only exceeded by their effects at quantum and higher scales. These fields represent the working mechanism of all atoms in the universe, building in fact the materiality of this world and the variability of its chemical elements. We may notice once more that the granular fluxes and their spatial structures, the normal photons and the electrophotons, guarantee the stability of all components of matter and allow their various interactions - as concrete manifestations of the fields described above.

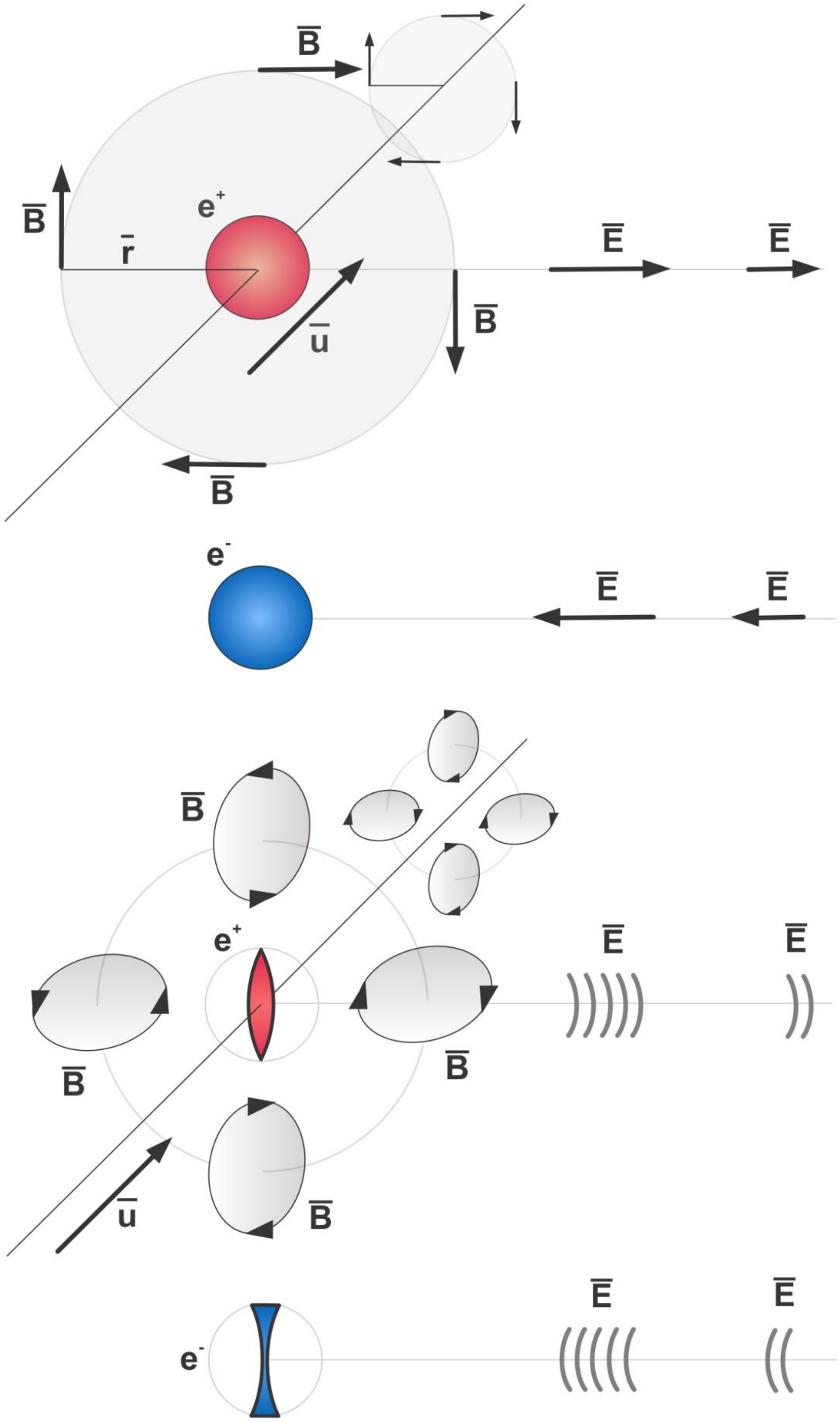


Figure 13 - *New symbols for the electric and magnetic fields*

2.4.4. The gluonic field

There is another fundamental interaction, namely the strong interaction, which also acts between elementary particles as a field - the gluonic field. It can be found at the level of the atomic nucleus, holding together the constituent quarks of protons and neutrons. Considering the new perspective on the electric field (Chapter 2.4.2), Annex 2 of [1] has to be adapted and completed by the following statements:

- Once two quarks got very close under the influence of their electric fields (the electrical attraction between charges of opposite signs), the space between them is rapidly filled by the gluonic field. Therefore, the electric force **F2** (the force that corresponds to the electric field) is getting very weak and it practically no longer counts in the dynamic equilibrium of the whole structure. The granular density increases very much in the region between quarks, preventing the electrophotons to form and propagate properly.

- The gluonic field and the gluons that mediate its actions are thus creating a stable balance between the "external" pressure of the granular fluxes (which may be considered of gravitational nature due to the mutual shielding of particles) and the "internal" one (created and multiplied by the repeated granular reflections on the quarks' surfaces).

- The same type of equilibrium also exists inside the atomic nucleus, between protons and neutrons; it is maintained by neutrons, which are shielding most of the electrophotons that would normally exert repelling forces between protons. Positive electrophotons are still emitted outside the nucleus; therefore, its total positive charge is entirely exposed and conserved.

2.4.5. The gravitational field

Seen as a group of granular fluxes crossing a specific region of space ([1], Chapter 5.2), the gravitational field is responsible for the mechanisms behind the formation of elementary particles and for their stability in time; at the same time, this primary field is the physical support for all the other known fields. Let's imagine an isolated area of space, a place where is a minimum influence of the cosmic bodies and the distribution of the granular fluxes may be considered uniform. The perfect symmetry of these fluxes and their granular consistency could likely allow us to identify their *unitary intensity*. Taking into consideration the granular size and impulse, it is obvious that we may only work with meaningful periods and space-averaged quantities. Let's add in that region an ideal material surface $\mathbf{S_u}$ (that has, for example, an electron-like area size); its faces will be evenly pushed by the equal fluxes $\boldsymbol{\phi_u}$ (i.e. the number of incident granules within a specified period of time) that flow inside a certain solid angle $\boldsymbol{\Omega_u}$. The granular flows acting within this solid angle onto our material surface are equivalent to a constant force $\mathbf{F_u}$ (the force component that is perpendicular to the surface) that continuously pushes and compresses it.

Figure 14 shows all these physical quantities above for the upper hemisphere (of radius $\mathbf{r_u}$), a region of space that is bounded by the plane of our surface $\mathbf{S_u}$. The solid angle included in this hemisphere (of value $\mathbf{2\pi}$ sr) may be divided into a very large number, let's say **n**, of unitary solid angles $\boldsymbol{\Omega_u}$ (i.e. $\mathbf{n\ \Omega_u = 2\ \pi}$), specially chosen to cover its whole interior. A certain solid angle has the inclination angle $\boldsymbol{\beta}$ to the surface $\mathbf{S_u}$. The pressure exerted onto that surface by the granular fluxes that flow inside those solid angles is cumulative and may be assimilated with some forces that act simultaneously in all possible directions; therefore, the total force shall be given by the resultant, the vector sum of all these unitary forces $\mathbf{F_u}$.

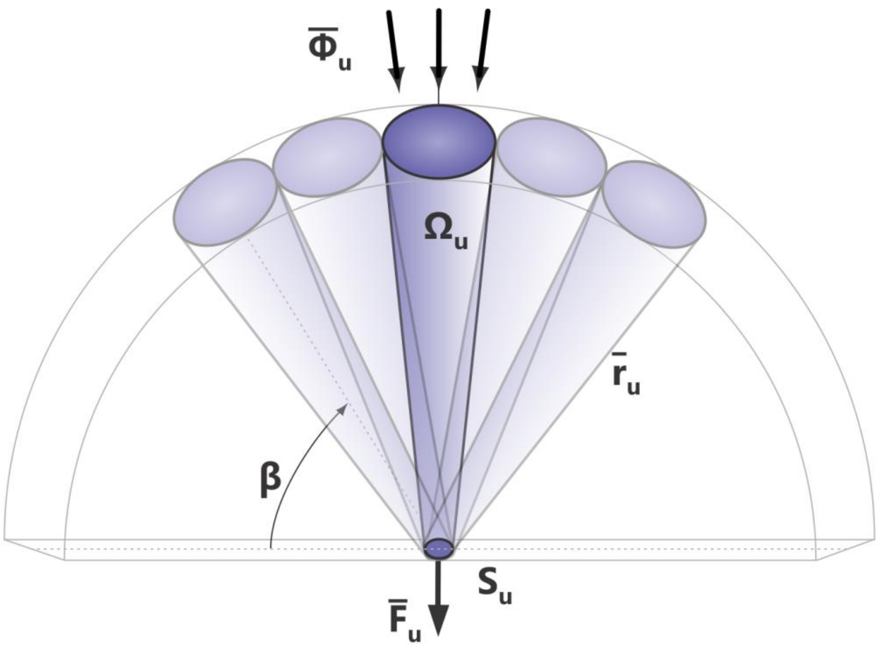


Figure 14 - *The unitary gravitational field*

This sum may be expressed as either a vector or a scalar equation:

$$\boldsymbol{\overline{G}_A} = \sum_{i=1}^{n} \boldsymbol{\overline{F}_{ui}} \qquad \boldsymbol{G_A} = \sum_{i=1}^{n} \boldsymbol{F_{ui}\, sin\, \beta_i}$$

G_A is the resultant gravitational force acting on side **A**, as shown by the upper picture of Figure 15 in a simplified two-dimensional representation. Due to the absolute spatial symmetry, this force equals **G_B**, the force acting in the opposite direction on side **B**. The sum of all normal components is a force that presses on the surface, while the tangential components cancel each other out and compress the same surface. Globally seen, these omnidirectional unitary forces of equal magnitudes press onto the whole surface of real elementary particles and help them maintain perfect stability over time.

If there is a significant nonuniformity in the distribution of the unitary forces, as the presence of a massive body (the star **S_1**) in the proximity of our surface could produce, the resultant force **G** will no longer have a zero magnitude (Figure 15, the lower part):

$$\boldsymbol{\overline{G}} = \boldsymbol{k}\,(\boldsymbol{\overline{G}_B} - \boldsymbol{\overline{G}_A})$$

and its vector will point towards the center of the star (considered a body of uniform density). The constant **k** is a multiplication factor that expresses the area of surface **S** relative to **S_u**, i.e. **$S = k\ S_u$** (an area of a small value). The unitary forces from within the solid angle that star disk covers are smaller than the usual ones, as all the granular fluxes coming in these directions are diminished by the stellar matter. In fact, this is the secret of *gravity* **G**, the traditional "attraction" between a material body and a large cosmic mass.

More explicitly, the unitary force is acting in every direction and on any material surface, mostly on the baryonic matter composing the object. Each elementary particle, free or not, is uniformly "pushed" by **F_u** from all directions (the total force exerted on the particle is zero) and this maintains the particle's perfect stability over time. All the constituent particles of a material body are evenly affected by the gravitational field in this way. However, if there is an irregularity in this field (as **S_1** has produced and which we actually call gravity), it will affect each particle and will cumulate throughout the whole body, giving rise to the well-known force of gravity (all the atoms in that solid body are presumably bound by electromagnetic forces).

Does this asymmetry of the gravitational field change the shape and the movement of the elementary particles, considering their particular disk-shaped structure? The answer is composed of three parts:

1) The nonuniformity of the gravitational field, under normal circumstances, is very low in comparison with the magnitude of the unitary force acting on the same surface. This irregularity produces very weak forces at the quantum scale, much smaller than those of electromagnetic nature.

2) Any elementary particle has special dynamics, it continuously executes the intrinsic precession movement; therefore, that asymmetry in question here will exert an evenly distributed action on the two sides of a particle, under all possible angles - so its effect becomes practically negligible in time.

3) A more important effect may be observed in the trajectory of the free particles; no matter their type, they "fall" at exactly the same rate under the influence of gravity, having a constant acceleration.

As most of the elementary particles have discoidal shapes, the gravitational force exerted on them will directly depend on their surface area and indirectly on their mass (which is proportional in fact to that area). In the case of the larger and denser objects, where some granular fluxes are blocked and reflected, the formula of their opacity is more complex. A simple analogy for the gravitational field intensity could be the degree of white in the X-ray pictures - which is brighter in those areas where the exposed object is denser. The real intensity of the unitary force may be correctly estimated at the scale of the atomic nuclei; for instance, this force pushes on the external side of a quark and equilibrates the strong force from the other side. Normally, if we choose a fixed value for the area $\mathbf{S_U}$ and a large enough **n** (to accurately describe any variation of the gravitational field), the force $\mathbf{F_u}$ could be declared a *universal constant* in our region of the universe, at this moment of its evolution. Gravity is a subquantum-scale phenomenon that has effects at any scale, from the elementary particles up to the universe. As the ratio of the largest scale to the smallest scale in our Universe is huge, the number used to "split" the gravitational effects of the granular fluxes should be huge as well.

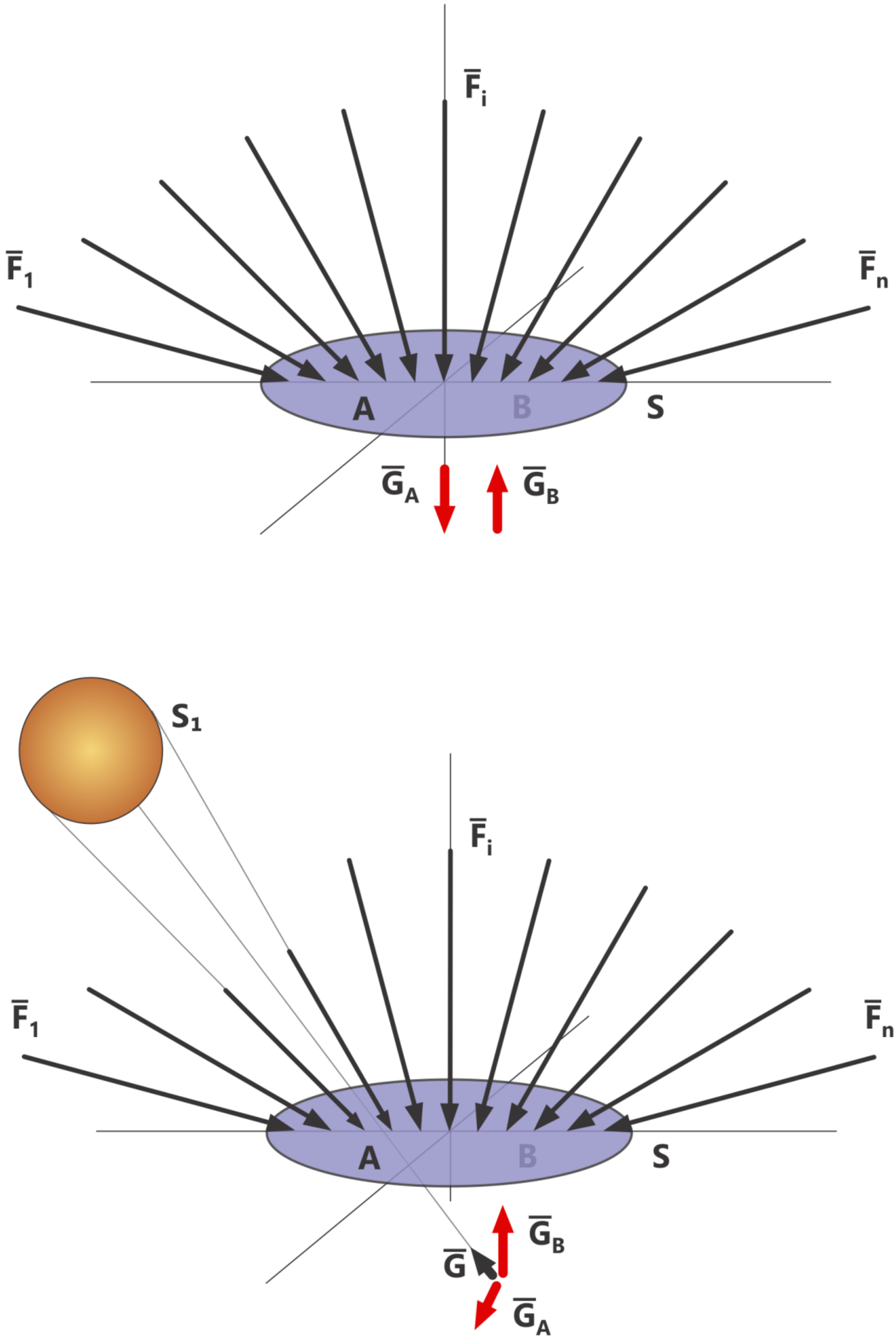


Figure 15 - *Gravitational forces on real surfaces*

Figure 16 shows how deformed are the spherical distributions of the unitary forces near a normal star $\mathbf{S_1}$ and a black hole $\mathbf{S_2}$. These deformations have simple shapes, but the passage of granular fluxes through stars is a much more complex phenomenon; we have to know the exact "opacity" and whole dynamics of the stellar mass, as it was mentioned above. It may be easy to observe that the attenuation of the granular fluxes coming from the black hole has almost reached an *absolute maximum* value (a point of saturation), causing a maximum level of gravity ($\mathbf{G_2}$, the red arrow) at distance **r** from the star.

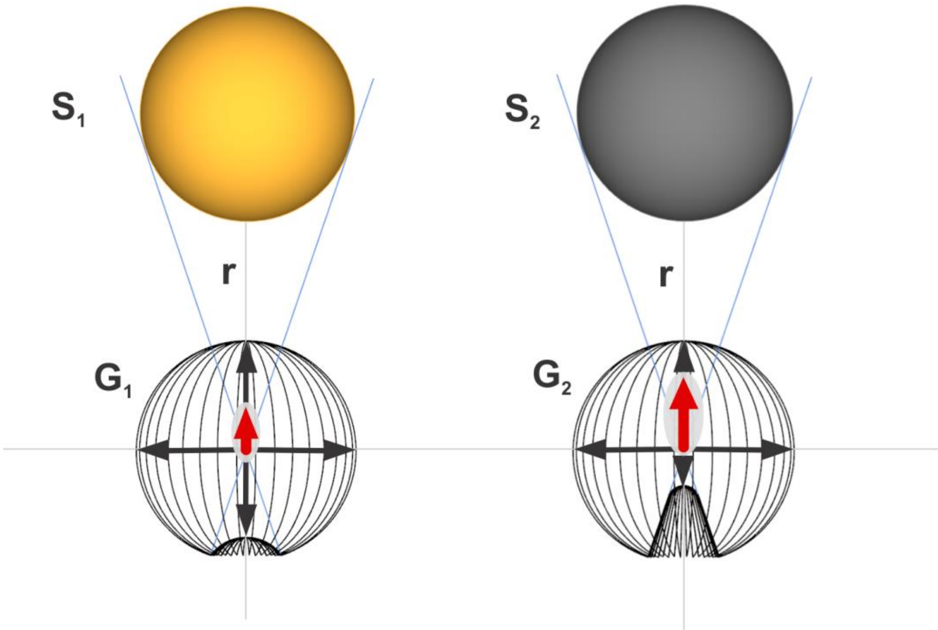


Figure 16 - *Two distributions of the gravitational field*

As shown before, the diffusion of granular fluxes on stars creates certain divergent and rotational components in their gravitational field. Any regular star contains, at least in its upper layers, some structured matter - quarks (most probably), atoms and molecules that move continuously. Furthermore, as all these layers are quickly spinning (at relativistic speed in case of some black holes), a certain circular modulation pattern is imprinted on the reflected fluxes. The reflected fluxes are also dispersed at a granular level, and this seemingly increases the granular density around these cosmic bodies. Figure 17 shows a planet **P** and the nonuniform distribution of granular fluxes (**ɸ**) that is produced by the black hole **S**. A very strong force of gravity (**G**) pulls the planet and distorts it to the shape of a pear. The enormous gravitational gradient produces the so-called "spaghettification" of the nearby objects; during their fall into the star, there is a certain moment when they pass beyond the point of no return - the event horizon. Besides this part with diminished fluxes, the diffusion process adds a rotational component to the fluxes reflected on the star. A certain point **C** will therefore be "swept" by fluxes of variable granular density (the shades of gray in the circular detail) with the star's angular speed **ω**. Over long periods, this thing will cause significant tangential forces that will synchronize the movement of the planet (this dragging-effect may be the explanation for the particular rotation of stars in galaxies with supermassive black holes at their centers). Furthermore, the dispersion of these fluxes changes the granular density around the star, which will additionally curve the trajectory of the photons crossing this region.

The extreme gravity also produces the dilation of the local time for any physical body that lies in this strong, non-homogeneous field. The nonuniformity of the flows that cross the body causes significant variations of the instantaneous "mass" of its particles, which will thus be dependent on the direction of travel; therefore, these particles will move, rotate and oscillate slower, with lower speeds and accelerations - and this thing is equivalent with the dilation of the local time. Any granular flux, either normal or additional, propagates at the same speed light does in this granular fluid. Therefore, any granular structure these fluxes would form ("rigid" or not) and which may be assimilated to a wave of some type, it will have the same speed (of value **c**); all the same, it results that the information associated with the presence or absence of some gravitational fluxes will have the same maximum speed. A celestial body creates certain asymmetry to the fluxes crossing a specific point in space, and this variation depends on its opacity and on its solid angle (the magnitude decreases with the square of the distance). Considering the cosmic distances, any gravitational influence a star would have (black holes included), it eventually gets under a certain limit and integrates into the background "noise" of the spatial fluid.

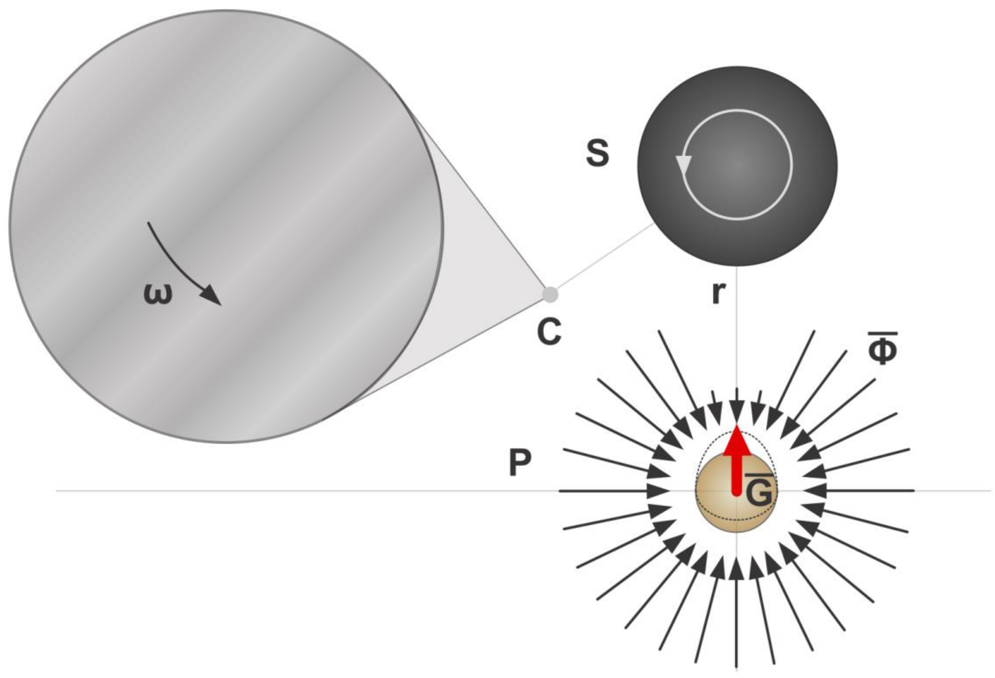


Figure 17 - *Effects of the gravitational field*

Remark 1

From a technical perspective, it seems impossible to separate and isolate the granular fluxes crossing a certain point in space on a particular direction, to measure their intensity. We can only observe their *global variation* in the vicinity of a massive body being at rest or during its movement. Gravity, seen as the force exerted on a test body at that point, has an *averaged direction* and its value is *much smaller* than that of the unitary forces whose resultant vector it is in fact.

Remark 2

It is obvious that the value of the unitary force is not constant throughout our Universe. The gravitational field in a certain point of the universe generally means:

- the intensity of the unitary force, which mostly depends on the granular density in that region of space and on the other characteristics of the granular fluxes (divergence, form, dispersion).

- the distribution of this force in every direction, which may be uniform or not.

It was previously assumed [1] that there is a global gradient of the unitary force across the universe, its magnitude getting lower to the edges; its spatial nonuniformity increases to the edges, and this might be the explanation for the recession of distant galaxies (now explained by the presence of the hypothetical dark energy). However, large variations of these parameters may be seen in all galactic regions or near the supermassive black holes, along with some other intrinsic nonuniformities of the universe due to its emergence process. If there is a tendency in this not-so-uniform universe for the granular density to get uniform (based on the divergent propagation and eventual dissipation of fluxes), we should notice that these "settling" processes are not instantaneous, they have the speed of light in that region. Therefore, it seems natural that, at the huge scale of the cosmic distances, some nonuniform regions of space still exist; moreover, all actual galaxies are continuously perturbing the distribution of the local granular fluxes.

Remark 3

Significant differences may exist between the effects of the gravitational field and those of a generic field on a certain body, not only as intensity but also as physical quantum and subquantum phenomena. And we will no longer consider here the fundamental role of the gravitational field as general support and stabilization means for matter. We have to discuss now about another important thing, the equivalence between the "gravitational mass" and the "inertial mass" of a body, namely about the acceleration produced by the different types of forces (fields). Are these fields equivalent? Or, is the "mass" (seen by different fields) of a material object always the same?

Let's make our analysis on free solid objects of regular shapes, with a uniform distribution of mass; considering their macroscopic dimensions, the effects of the gravitational field will be compared with those of a generic force field (and we will also check if Newton's third law of motion applies).

Case 1: Small bodies, the orders of magnitude of their size and mass are meters and respectively kilograms.

The force of gravity is acting evenly upon all the molecules of these bodies and exerts - due to the asymmetry of the granular fluxes - an identical action on each of them. These fluxes push on the surfaces of each particle; the effective areas involved in this process are directly proportional to the mass of the respective particles. This thing is totally equivalent to a new force (the sum of all of these forces) that would be exerted on the whole rigid body (on its total mass). According to *Newton's second law of motion*, this force will cause certain acceleration to that body; if a molecule were separated from that body, it would have the same value of acceleration (the field is considered uniform).

A pushing force (caused by another field) that would act upon that body as a whole, of the same magnitude as above, would determine the same acceleration. This new force would be distributed through the intermolecular bonds to every molecule of the body, and thus it would "see" the same value of mass - so generating a perfectly equivalent effect. Therefore, these two types of forces are acting upon the same mass at the quantum level.

Case 2: Medium celestial bodies, the orders of magnitude of their size and mass are solar radiuses and masses (yet less dense than neutron stars).

The atomic nuclei block some of the granular fluxes crossing these bodies, especially in their central regions. The intensity of these fluxes will therefore decrease, as well as their possible asymmetry caused by another cosmic body. As the forces exerted on the central baryonic matter are smaller than those acting on the surface, the overall value of the gravitational force will be lower than the normal value, so the acceleration it will produce.

A pushing force of mechanical nature would have a uniform effect, evenly distributed across the matter of that body, and the inertial mass computed from the acceleration this force produces should be considered a real, correct value.

Case 3: Celestial bodies of maximum density (the black holes), whose inner layers are presumed to be made of unstructured granular material.

In this case, the granular fluxes are only crossing the upper layers of the star (those made of very close quarks and nucleons), being reflected or absorbed by granular accretion. This type of star has an actual mass significantly greater than the value that would result from its gravitational influence over a nearby cosmic body.

Considering all these cases above, there are some more parameters to be added to the formula expressing the gravitational force. The exact situation is depicted in Figure 15 (the lower part); we know the area of the surface **S**, the unitary force and surface, **F_u** and **S_u**, also the area of a normal cross-section through the star **S_1**, denoted by **P**. In real terms, the value of **P** is much bigger than **S**, **P >> S**, and thus we may write **$S = k\, S_u$**. There are **n** vectors of unitary force inside the entire solid angle covering the sphere, which all should be added in order to obtain the resultant force **G**:

$$\overline{\boldsymbol{G}} = \sum_{j=1}^{k}\sum_{i=1}^{n}\overline{\boldsymbol{F}}_{uij} = \boldsymbol{k}\sum_{i=1}^{n}\overline{\boldsymbol{F}}_{ui}$$

(due to the superposition principle), and $\boldsymbol{F}_{ui} \leq \boldsymbol{F}_{u}$.

We may write $\boldsymbol{F}_{ui} = \boldsymbol{\alpha}_i\, \boldsymbol{F}_u$, where $\boldsymbol{\alpha}_i \leq \mathbf{1}$ is an opacity coefficient that has the value 1 for those unitary angles that are not enclosing any part of the star's surface. As it was already specified, the granular shielding is a complex phenomenon that includes at least three components: attenuation, reflection and absorption; these components will be further denoted by **β**, **γ** and **δ** (all having subunitary values). Therefore, the final force formula is:

$$\overline{\boldsymbol{G}} = \boldsymbol{k}\sum_{i=1}^{n}\alpha_i\,\overline{\boldsymbol{F}}_u = \boldsymbol{k}\sum_{i=1}^{n}(\boldsymbol{\beta}_i + \boldsymbol{\gamma}_i + \boldsymbol{\delta}_i)\;\overline{\boldsymbol{F}}_u$$

2.4.6. Gravitational waves

We have observed that the celestial bodies (planets, normal stars, supermassive black holes) change the homogeneous distribution of the granular fluxes in their vicinity, increasingly more as their mass is bigger. As we have previously seen, a precise formulation [1] would have to state that the perturbation depends on the degree of transparency that body has to granular fluxes. Therefore, it should be about the average area of the baryonic matter contained in that body, which, until the density (particles are overlapping in a certain direction) reaches an upper threshold, is in fact directly proportional to the mass (this phenomenon also depends on the actual distribution of mass within that cosmic body).

The spatial perturbation of granular fluxes approximately copies the shape of the celestial body and, seen as field magnitude, decreases proportionally to the square of the distance. This granular unevenness around a celestial body (distribution and density) represents the way all the gravitational fluxes interact with matter; actually, the surrounding space is not "distorted" at all and its geometry is not changed. However, the nearby bodies and even the photons will undergo different effects due to the nonuniform gravitational field. A body that freely moves through space (a spheroid that may rotate or not on its axis, for example), does neither consume nor radiate energy; it only creates gravity - a certain nonuniformity in the nearby gravitational field to be more precise. If another body cosmic comes close enough, we may now easily describe how the forces are acting in this binary system. By mutual reference, the new body will have a certain potential energy in the conservative gravitational field created by the other, energy that will directly depend on the distance.

Let's consider a fixed black-hole-like body **S** that is situated at a great distance from Earth (Figure 18, top-left). As we know its mass and the distance, an object **C** from our laboratory will be attracted by the force **F** that can be easily calculated. If the star would have a circular orbit (as in the top-right picture), the magnitude of this force would have an approximately sinusoidal waveform, of the same frequency as the star's revolution. What if this star will be part of a binary system, orbiting around a twin star at a known distance (as represented in Figure 18, the bottom-left picture)? For simplicity, the inclination of its plane of rotation to the earth-star axis will be considered very small. The resultant force **F** will have a similar evolution, only its magnitude is now greater. The average distance between the stars **S_1** and **S_2** decreases substantially over time (mostly due to the tidal effect), and stars will spiral toward each other until they finally merge. Between the beginning and the end (1 and 2) of this process, the resultant force **F** has a sinusoidal oscillation of increasing frequency and intensity; after the merger time (2), when the newly born star is no longer moving, the force **F** will be having again a constant value.

This scenario and the evolution of the resultant force are similar to the cosmic event that was detected by the **LIGO** observatory on September 14, 2015, when the first-ever direct observation of "gravitational waves" (a signal from the collision of two black holes) has been made. The astronomical data and the exact parameters of the measuring devices are fully described in [7]; now, only a few personal observations will be added, all being related to the physical phenomena and quantities that have been measured at that moment. First of all, it has to be mentioned at this point that it *is not* about traditional "waves", neither in the classic nor in the quantum sense of physics. The space between the test masses did not "stretch" nor "contract", meaning these objects did not have any measurable displacements. Space is not an elastic medium where the mechanical waves may propagate, as the sound waves travel through the air; moreover, gravity propagates at the granular level as simple fluxes, not as complex structures (like photons or electromagnetic waves)! The signals recorded by the LIGO detectors are all real, but they actually represent the manifestation of the gravitational field that propagates through space over large distances (of the *asymmetry* caused to granular fluxes by the presence of the two black holes). And here is a forced analogy: the LIGO detectors measured something similar to the height of a tidal wave made by the Sun and Moon on the surface of the Earth. While this variation was very slow (like the majority of cosmic phenomena), its faint signal was very difficult to be detected and evaluated; the speed of that merger, however, has brought this process in the range of the measurable frequencies, about tens up to hundreds of Hertz. The divergent gravitational fluxes coming from those black holes (their infinitesimal and variable decrease in our direction, more precisely) had insignificant effects on the test masses and on the atoms they contain. The small variation of the granular fluxes has neither accelerated nor moved the atoms on such a large distance that would become measurable with the laser interferometers. In my opinion, the granular fluxes that were modulated by the accelerated movement of the black holes have all propagated through space as "waves" and eventually reached the region crossed by the laser rays of the LIGO detectors, producing an extremely low variation in the *granular density* of that space. These changes have affected the *speed* of photons in those rays and this effect has become measurable due to the high sensitivity achieved by the resonant optical cavity built in the arms of the detector.

This wave is not in fact a normal wave, for which a certain amount of energy would have been consumed at the source; it is just a simple propagation of the variable gravity produced by those two stars. These stars neither consume nor radiate "gravitational" energy while rotating on their circular orbits; they only cause a change in the local flux, a variation that spreads in all directions and decreases in intensity with the square of the distance. Before the merger phase, the potential energy of the stars has gradually turned into kinetic energy - which has been finally assimilated into the new body in the form of mechanical and thermal energy. The masses of these two stars practically added up and no part of the total mass turned into "gravitational energy" (in accordance with the famous formula of equivalence), even if this process reached relativistic speeds. Moreover, no quantum phenomena involving a transformation of mass and a release of energy happened, there was only a unification of pure mechanical nature. Some quarks in the upper layers of stars could have recombined during the transition period before the merger, and some radiations and particles could have escaped the fuzzy event horizon, but these things will not significantly affect the total stellar mass. Also, some jets of matter can be ejected from the poles in certain cases. If the final mass is proved to be smaller than the sum of the initial stellar masses, the explanation may be found in Remark 3, namely that the gravitational mass and the inertial mass (that directly depends on the quantity of matter) do not increase similarly. Therefore, the variation of mass in that cosmic region has only generated a major perturbation of the local granular fluxes, a "wave" that propagates radially with the speed of light.

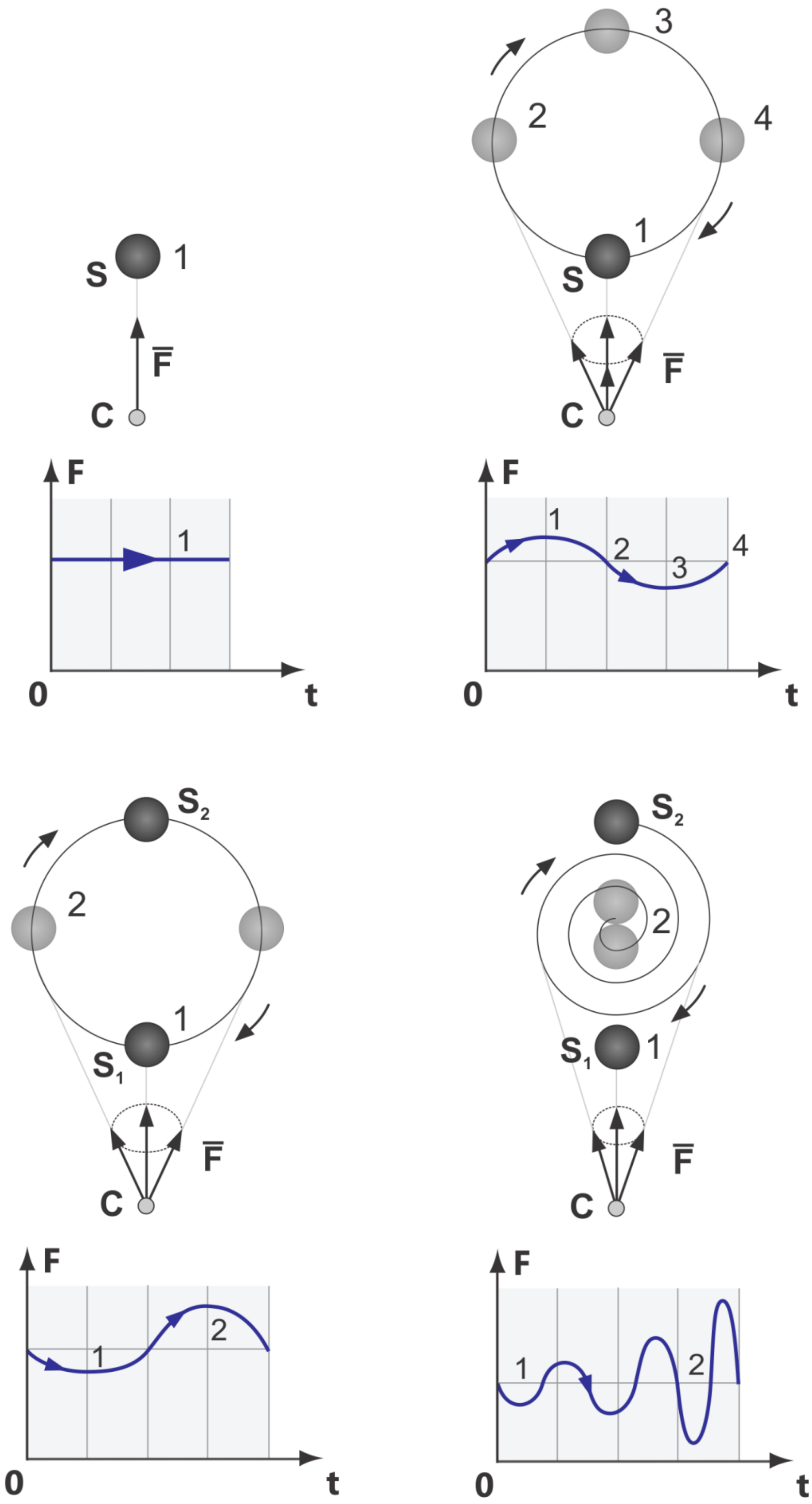


Figure 18 - *The merger of two black holes*

2.5. Conclusion

This article tried to formulate fundamental explanations for fields and for their interactions with matter, my goal being to clarify the granular structure and the working mechanisms of nature at the lowest possible scale. The materiality of this world and its mechanics, the determinism and causation that govern everything are fully explained in my new vision over the land of physics; and there are still no scientific experiments to contradict any of the hypotheses described in my *Prime Theory* and *The Universe* books. Neither the new astronomical observations of the distant galaxies nor the observation of the so-called gravitational waves contradict my model of the Universe, in which the granular spatial fluid virtually imposes all the laws of physics simply and predictably. The gravitational field has proved to be in fact the macroscopic reflection of the mechanics of this medium; the way we will globally define it, as meaning and as formalism, would therefore be very important in explaining all the other laws of nature. And every law should include the rules of relativity (as all material structures are moving) and another essential thing: the absolute character of our Universe's genesis and the energy this process gave to the granular level of reality.

3. The formation of elementary particles

A software simulation of the granular collisions

3.1. Granular characteristics

The assumptions and postulates stated by the Primary Theory [1], along with all characteristics of the spatial granules and of the special fluid they form, are considered all valid in this article. Everything here is based on the particular granular dynamics, being analyzed in an absolute framework (an absolute system of reference, natural to our Universe); all these things may be seen as an extension of the corresponding chapters of my first books ([1] and [2]).

Here is a summary of the fundamental granular characteristics:

- One free granule has a perfect spherical shape and its constant diameter is denoted by **D** (which is possible to be very close to the Planck length).

- All granules have the *absolute and constant velocity* ***C*** (estimated at minimum 140% of the current value of **c**), regardless they are free or if they belong to certain structures.

- Implicitly, all granules have the same value of mechanical impulse and kinetic energy (elementary).

- All granules are made of the so-called *essence* - the primordial, *perfectly elastic* substance.

- Consequently, the intergranular collisions are all perfectly elastic granular collisions and the total granular momentum will be conserved.

- There is no other form of mutual influence or interaction between the distinct granules, besides the one of pure mechanical nature - the perfectly elastic collision.

- Any free granule can move in any direction inside the three-dimensional space and its trajectory will be further considered an *absolutely* straight line. The physical space is practically *discrete* as constitution (being composed of distinct granules), but it is *analog* from the point of view of the possible directions of travel, a continuous medium.

We must mention here a special feature of the intergranular collisions: the value of the absolute speed does not change after a collision - only the velocity vector's direction will be different. In addition, it should be noted that the terms *impulse, momentum, mass, energy* used in regard to specific granular characteristics are reflecting physical quantities that are similar to those we currently employ at quantum and macroscopic scales. The granular quantities have in fact a different nature, as they directly inherited the way our Universe (the space and matter) was born; the analogy with the regular mechanics (classical) and its principles is quite perfect, and this thing can be further used to formulate all the theories related to the granular medium.

If we restrict the analysis to the granular scale and to free granules only, the theory of relativity may no longer be necessary; we still have a maximal, constant and unique speed (whether we are taking into account the granular collisions or not), but we cannot discriminate between various systems of reference and we cannot have a variable rate of time. We may only work with the granular speed ***C*** (as space does not normally contain multi-granular structures) and, for short periods of time (while the granular density has not varied significantly), we may use the speed of light at those moments, **c** (the variation of this speed over time is described quantitatively in Chapter 1).

At the beginning of the universe, this amorphous fluid of space generated countless stable granular structures, the well-known elementary particles. How was it possible? To answer this important question, two additional hypotheses will be used in the current context, namely the continuous decrease of the granular density in time (about 13.8 billion years, see Chapter 1.3) and the *constancy* of all fundamental granular characteristics over the ages. In order to figure out all the aspects of this complex phenomenon, the granular collisions will be thoroughly analyzed now in an attempt to discover their fundamental working "mechanisms", by using some concrete examples and simulations.

It is obvious that space, regarded in this context as a medium that contains (hypothetically) a quasi-infinite number of identical components (all having the same characteristics) could be treated as a particular type of automaton whose evolution would therefore become predictable by simple mathematical methods. However, a few things forbid us to further use this simple model:

- The finite (but extra-large) or infinite size of the system and its initial density distribution (the hazard involved there and the non-uniformity).

- The impossibility to determine the absolute values of the physical quantities related to granules, also the discrete time that could flow at this level.

- The intrinsic uncertainty of all space/time coordinates in this quasi-uniform granular medium.

Despite all these, we may virtually isolate a *significant part* of this system, large enough to allow us to make statistical analyses and to identify any possible evolution in time. We are expecting to see, for example, how the self-organization process begins and then creates new and complex structures - as the elementary particles and their associated fields. However, this distinct spatial zone will not be completely separated; it will inherit and propagate all the local granular fluxes.

3.2. Granular collisions

The special medium presented above can be theoretically described only if we relativize the majority of its physical quantities (of the individual granules and of their system), keeping as a fundamental thing the *absolute granular speed.* However, we have to initially identify a geometric parameter that could be considered an *absolute constant*, the **granular diameter** for example, and then we can build a uniform scale for dimensions and distances in a linear metrics. The granular time flows uniformly, being a quantity that derives from the existence of the absolute granular speed and from the existence of the linear, uniform and isotropic empty space. The movement of any granule is therefore uniform, continuous, and it occupies all the intermediate positions on its absolutely straight trajectory. As this system contains a really huge - but finite - number of granules, we may simply assume that the granules travel in random directions (their spatial distribution practically becomes continuous) and they form some granular fluxes (there are groups of granules moving exactly in the same direction). Regardless of the presumed decrease of the granular density over time and of the unknown value of the granular diameter, one thing is certain: all granules are continuously colliding with each other. These collisions have the following important characteristics:

- Collisions are most likely to happen between only two free granules (collisions involving three or more granules at a time are very rare).

- The existence or the natural occurrence of two or more free adjacent granules moving in the same direction is extremely unlikely.

- All collisions are perfectly elastic; the granular energy and impulse remain unchanged.

- Regardless of their direction, the collision of two granules is frontal, in that direction connecting symmetrically their centers (see Figure 19, where three individual cases are shown). Any other type of collision, let's say a tangential one, does not produce any changes in the movement and trajectory of the granules (due to their special elasticity property).

- The collision of two granules is not instantaneous, it takes a certain amount of time; this time interval will significantly depend on the angle formed by their trajectories (see Figure 21, A).

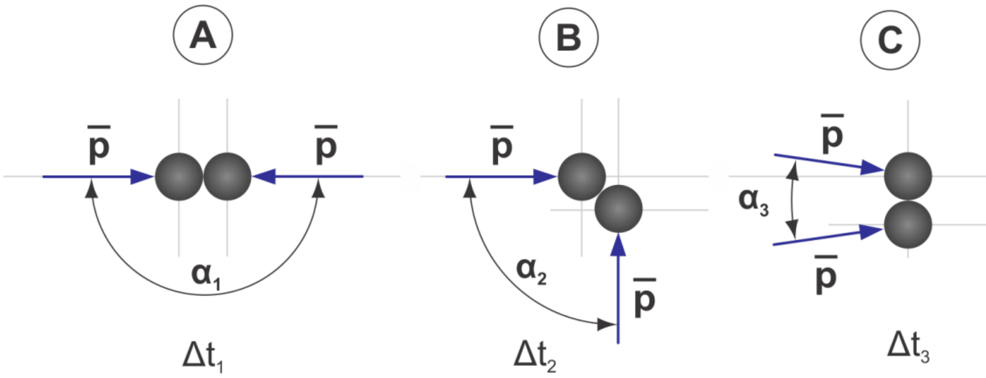


Figure 19 - *General types of granular collisions*

- The colliding granules are in perfect contact during this period of time (Figure 20, B), creating a temporary "supergranule" that has a shorter or longer lifespan. A new hypothesis may be formulated now, namely the granules do not merge in this process; the supergranule will contain both deformed granules, but they remain separated the whole time. Regardless of the fusion type, the granules will eventually split up and each of them will take over the impulse of the other.

- The supergranules may have any absolute velocity during their lifespan, from zero up to the maximum value ***C***, and a higher speed means a longer lifetime. The existence of *free supergranules* having a speed close to ***C*** is very unlikely.

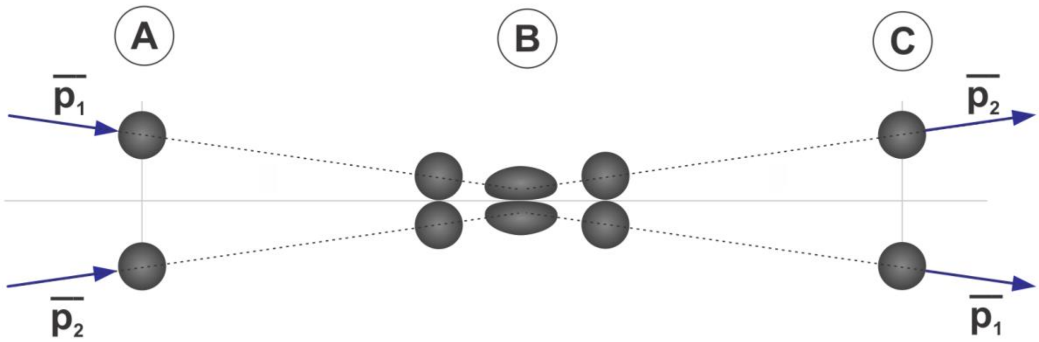


Figure 20 - *Slow granular collision*

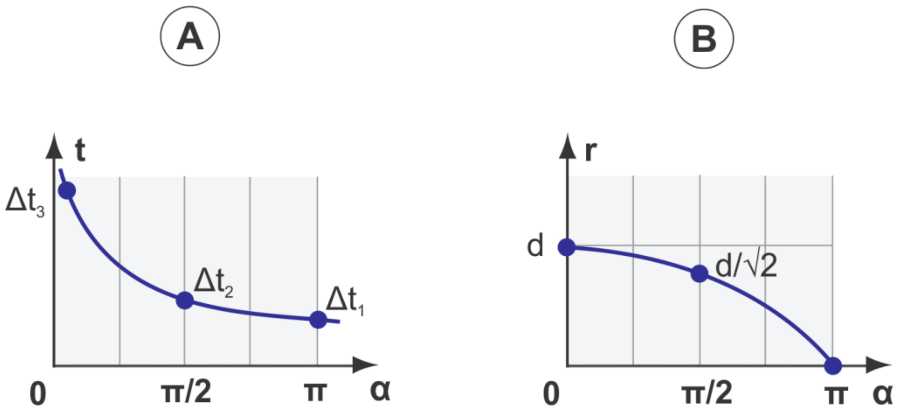


Figure 21 - *The duration and spatial displacement*

All of the granular collisions are governed by the **Law of conservation of global momentum**, but a few more things have to be mentioned now**:**

- The total impulse is conserved at any time during the whole transition process.

- This law shall apply regardless of the concrete elements involved in a collision: granule-granule, supergranule-granule or supergranule-supergranule.

- Collisions that involve at least one supergranule may produce total or partial separation of its component granules.

- In case two granules are colliding, one of the granules takes the impulse of the other and continues its movement in the same absolute direction, becoming an equivalent granule. In other words, the direction of any granule is preserved after a normal collision (involving only two granules). However, new phenomena may occur in this simple process:

a) a variable delay, which will decrease the average speed of the granules.

b) one granular diameter is the maximum displacement in the granule's trajectory (see the case shown in Figure 21, B).

The effects of these phenomena are time-averaged after a large number of collisions and their final result will be an actual lower granular speed $\mathbf{c} \ll \mathbf{C}$ and a *null* average trajectory displacement (in an ideal, uniform space).

Statistically, the most frequent collisions will be the granule-granule ones, followed by the granule-supergranule type (with those supergranules that have a longer lifespan, which existed in the early universe). These kinds of supergranules, regardless of their form - filament, cylinder, tube, sphere, torus, irregular groups - will eventually disintegrate after multiple collisions with the free spatial granules. We will describe now these ordinary collision types, as they are representative for a functional model of the granular space and of its evolution over time.

Figure 22 shows a general case (the collision between a granule and a long lifespan supergranule) where you may observe the conservation of total impulse $\boldsymbol{p}$ (which is the sum of the initial ones, a multiple of the elementary impulse). The final impulses are, in principle, of the same values, but their new direction is symmetrical relative to the total impulse vector.

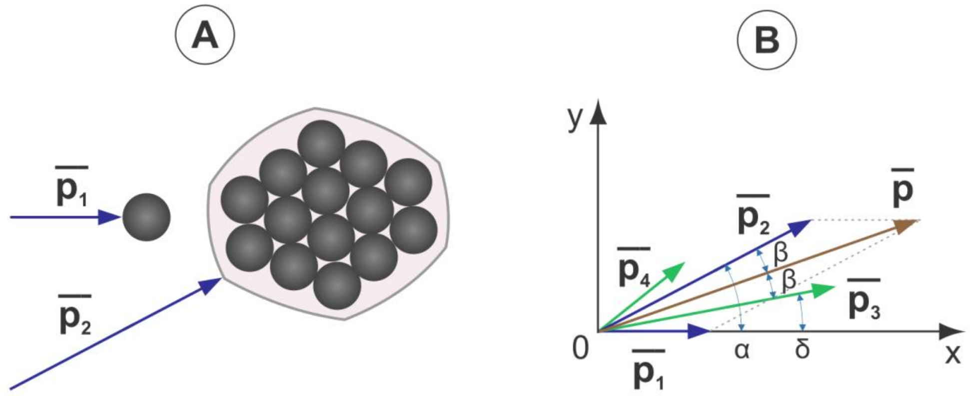


Figure 22 - *Granule-supergranule collision*

During the transition interval, that supergranule might either break apart or it may include the free granule and eject another - things that depend on the initial impulse directions. Whichever situation would be, the final impulses are multiples of the elementary impulse and their vector sum will always be equal to the total impulse. In our concrete case, the impulse $\mathbf{p_1}$ changes to $\mathbf{p_4}$**,** while $\mathbf{p_2}$ changes to $\mathbf{p_3}$.

$$\bar{\mathrm{p}} = \overline{\mathbf{p_1}} + \overline{\mathbf{p_2}} = \overline{\mathbf{p_3}} + \overline{\mathbf{p_4}}$$

Figure 23, the upper part, shows a frontal (head-on) collision between two granules (A), the moment when they become "flattened" (B) and the final moment when they have finished the impulse exchange (C), continuing to move in the same directions as equivalent granules. In the lower part of the figure, we may see what happens in case of a tangential collision: the granules are flattened in the longitudinal direction (B), *slipping* past each other and continuing to move in the same initial directions.

Knowing these specifics of the granular collisions, we may now try to make a global picture of how various fluxes behave when they are crossing other flows, uniform or not (considering the granular nonuniformity and the variable density of the early universe).

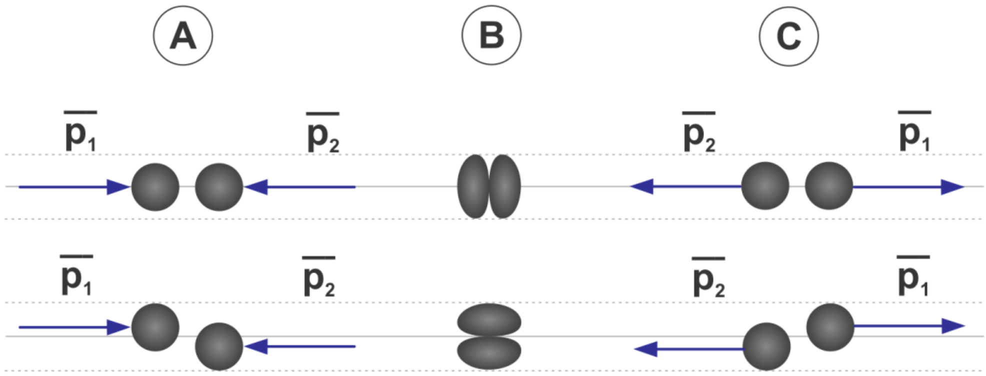


Figure 23 - *The frontal and tangential collisions*

Let's now consider a short flux that passes through a certain area - where an intense flux is already flowing in a particular direction; depending on the exact density this short flux has, two distinct cases may exist:

a) if the short flux is less dense (a few tens of granular diameters being the average distance between its granules), it will move toward the source of the strong flux (due to granular displacements), *in the reverse direction*.

b) if the flux is compact (its granules being very close to each other - oscillating in fact on the average distance of about one granular diameter), it will be pushed (and possibly curved) *in the strong flux direction*.

The latter case may apply to all photons that pass through an intense gravitational field (near a star), this phenomenon being known as the *gravitational lensing effect*. The photon's successive granular layers are compact on radial directions, and this kind of structure undergoes a change in trajectory toward the source of the strong flux. The first case applies to the photons that move along the gradient of a gravitational field, when they are "seen" as low-density fluxes and therefore they will undergo only a change in frequency (redshift or blueshift, depending on the gravitational gradient).

3.3. The formation of elementary particles

The early universe had all the necessary conditions to form and then combine the elementary particles, namely:

- High initial granular density, which rapidly decreases over time.

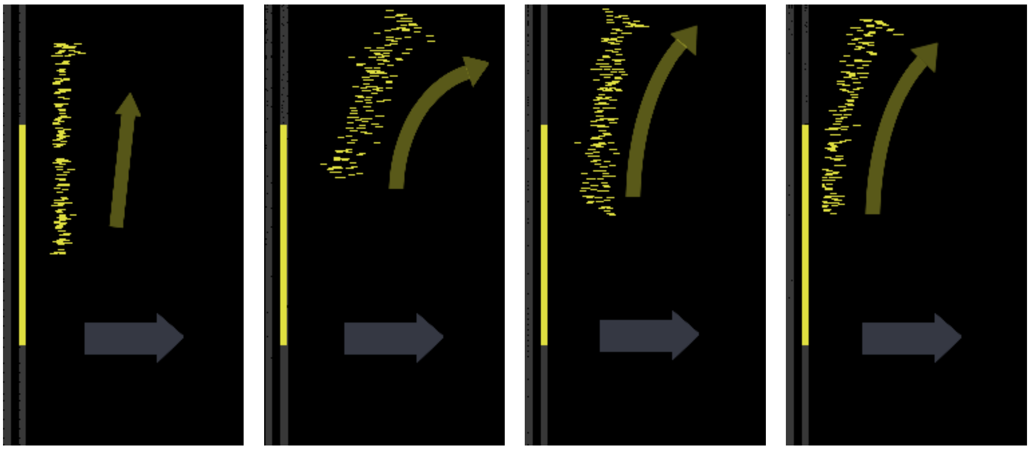
- Omnidirectional, uniform and nonuniform granular fluxes.

- A high number of supergranules, of both temporary and stable kinds.

All granular structures formed in this medium have crossed many areas of variable fluxes; the geometry of these structures has been therefore modified and they eventually became curved-type, concentrated flows. The "Elementary Particles" application tries to simulate the behavior of a compact granular structure (group, filament, supergranule) while it crosses through a nonuniform additional flux (of variable density). To reduce the number of mathematical calculations, this simulation will be confined to a two-dimensional "box" of 10x10 units, a place where the omnidirectional local flux is no longer included. This thing does not distort the results, the compact structures and their combinations will just lose the internal cohesion. All of the functional aspects of this software are widely described on its web page (the download links are also there): **http://www.1theory.com/software.htm#2**

Four images (screen captures) generated by this program are available at their original resolution (you may click on the pictures A...D); they correspond to a constant flow and to three different vertical gradients.

It can be easily noticed that the compact flux (the yellow one) bends under the uneven granular "pressure" exerted by the horizontal fluxes (which have a certain density gradient). Each filament (which contains ***n*** granules and simulates a supergranule moving at speed ***C***) is bumped at a given time by a granule from the horizontal flux, changing its direction slightly to the right - according to the formula of conservation of global impulse.



A B C D

Figure 24 - *Granular structures moving within nonuniform fluxes*

Figure 22 shows us a simple way to write a formula for the angle of the granular impulse (**p_2** -> **p_3**); the initial angle **α** will turn into angle **δ**, whose formula is:

$$\delta = 2 * \arctan(n \sin(\alpha) / (1 + n \cos(\alpha))) - \alpha$$

meaning that the final impulse of the supergranule has a symmetrical position to the initial one in regard to the global impulse of the system.

The compact structure will lose the internal cohesion and the elasticity of its granular filaments (as the local flux is not simulated) - which will thus have slightly different impulse directions. However, the pictures above illustrate a clear tendency; any compact flux will be *bent* if passes through nonuniform fluxes.

At the beginning of the universe, nonuniform granular fluxes were generated in all possible directions (as it is stated in Chapter 1). Any area of primordial space has been crossed by such flows and thus emerged (according to this simulation) a huge number of curved embryonic formations. These clusters remained in compact form, lasting long enough to join each other in larger formations; in this way, they created small granular vortexes that keep rotating in random, but unique directions. These discoidal formations proved to be stable structures (concave or convex in equal measure) that can freely move (having linear and *precession* movements) through the spatial fluid. The geometric shape of these elementary particles (either free or bound in larger structures by different fields) also remained very stable over time. We may notice here the huge number of granules contained in such particles, a number that decreased significantly once the granular pressure dropped over time. During this process of creation (a ***self-organizing*** process that has generated heavy electron and positron-type particles), the curvature of one particle's side surfaces (so its electrical charge type) was determined only by chance. Their mass, seen as the number of constitutive granules, has been *dynamically* set when the pressure of the granular flows (gravity) balanced out the sum of their internal granular momenta. At the end of this process of *generic particle* creation*,* once the granular density dropped significantly, two distinct phenomena happened (they practically determined the future configuration of matter in the universe):

1. Stable groups of three generic particles were shortly formed (as being heavy particles, they could not accelerate enough in their electric fields of opposite signs and annihilate this way).

2. The mass of the remaining particles (the *free* ones) decreased significantly in a short cosmic time and their annihilation process became possible (the matter-antimatter reaction, which has generated photons and has led to the success of matter, i.e. of the electrons - they were in greater number).

We have to mention, in addition to the first point, that the three-particle groups have been held together by the gluonic fields and they proved to be very stable in time; these formations are in fact the protons and neutrons we all know about - the composite particles included in the actual baryonic matter. The quarks of these particles held a bigger mass due to their strong gluonic connections - which also provided them perfect stability.

The *spontaneous* formation of generic particles in the early universe took place due to the very high granular density of space at that moment and due to the nonuniformity of the granular fluxes. It was in fact more like a "chain reaction", the newly formed particles causing other variations in the local fluxes, which in turn maintained the whole process running. This phenomenon led to a fast decrease in density of the granular space; when this density reached a certain threshold value, the spontaneous particle generation came to an end.

3.4. Conclusion

The elementary particles have been formed in a *natural and complex* process in which the important role was played by the variable granular density and nonuniform fluxes of the early universe (as direct consequences of its birth mechanism), along with the implicit randomness of these initial conditions. Granules, as building blocks of space and matter, were able to build in this primordial medium a near-infinite number of rotational structures that proved to be extremely stable over time. It is quite remarkable the way this granular fluid made possible the existence of the self-generating, self-organizing and self-balancing mechanisms of those material structures. Moreover, the granular fields appeared shortly, connecting in several modes all these elementary particles; these fields continued the construction "work", generating more complex matter structures - atoms and molecules, the raw material necessary to build even larger structures in our universe.

This fundamental process has structured the granular matter (the essence) and has automatically induced a global dimensional relativization, of intrinsic nature, to the entire architecture of our Universe. All the physical quantities characterizing the newly formed matter and its evolution are not of absolute kind; their values will vary more or less over time. Therefore, any comparative analysis will be made on the data coming from various cosmic epochs must be preceded by a normalization process that might compensate for their variation in time, very likely of nonlinear type.

4. The shape of elementary particles

Fluidity and stability

4.1. The shape and stability of elementary particles

As it was previously shown in *"The formation of elementary particles" (Chapter 3)*, the elementary particles are granular structures that have, in a uniform space, well-defined and stable shapes. Their size and the number of component granules are only depending on the granular density of space. Figure 25 (the upper part) shows a few sections through generic elementary particles (already described), simple pictures in which no precise scale factor was used. The shapes of these generic discoidal and toroidal structures ensure their perfect stability in time, whether we consider the free particles or those belonging to composite formations (the bottom part of the figure, where a meson and a proton are represented).

Any interaction that may exist between these particles is caused by the local granular flux. This flux generates all the known fields and creates, as a final result, the forces that are exerted between adjacent particles. It should be noted that all these particles, composite or not, are executing their own precession movement - and this is due to the internal granular motion and to its special features.

Two elementary particles, the electron (top, blue) and the positron (bottom, red), are represented (a section and a side view) in Figure 26. The concavity of their side areas determines the type of their electric charge, as previously stated in my theory [1], establishing the direction of the electric fields they will emit continuously (Figure 27).

4.2. Characteristics

1. The form of all free elementary particles that are lying within a uniform flux is perfectly *symmetrical.*

2. Their geometric shape is given by a particular surface of revolution, in fact by a *regular closed* surface that has been rotated around an axis.

3. The particle's surfaces are *smooth*, their radius of curvature being always bigger than a threshold value.

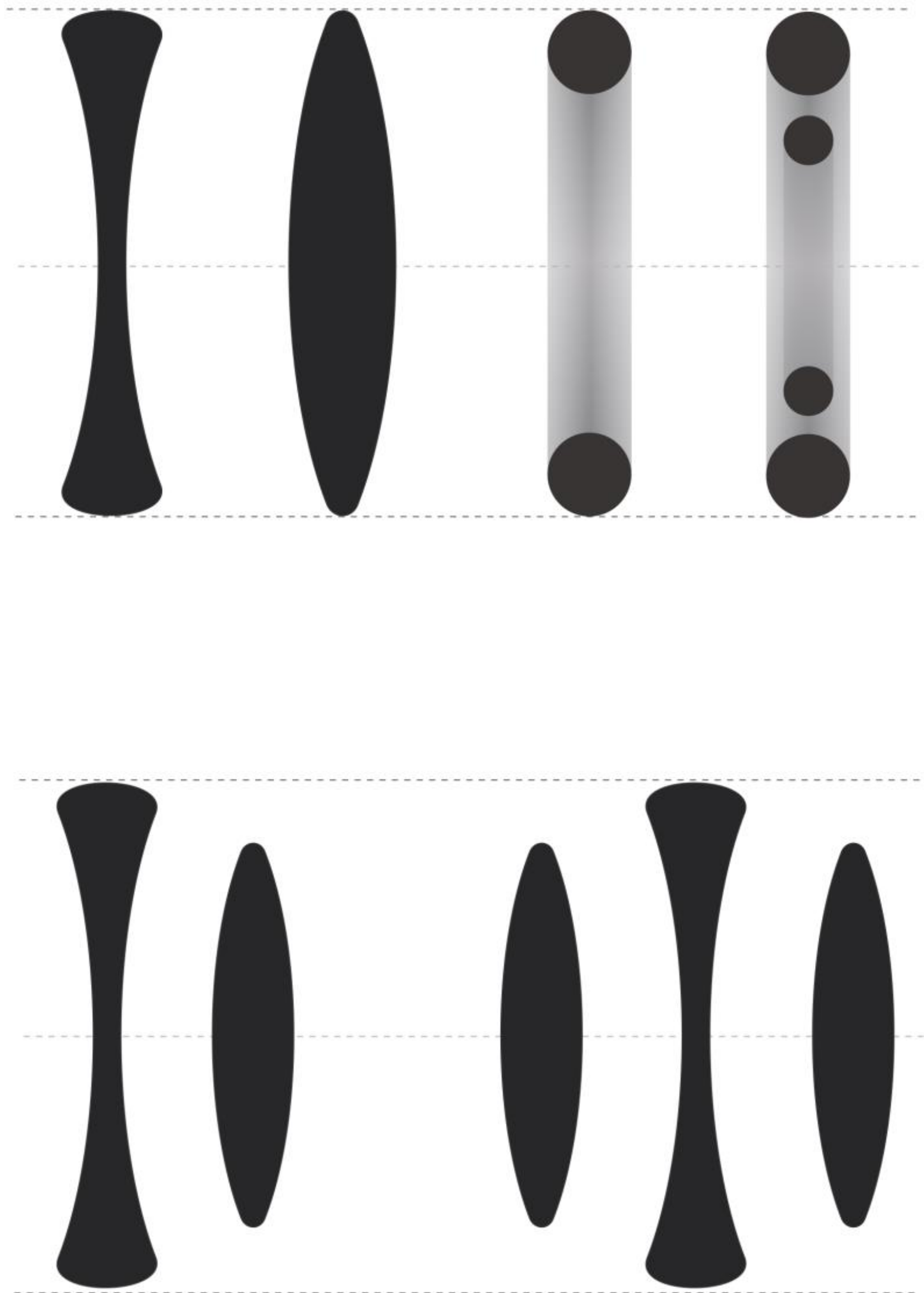


Figure 25 - *Generic types of elementary and composite particles*

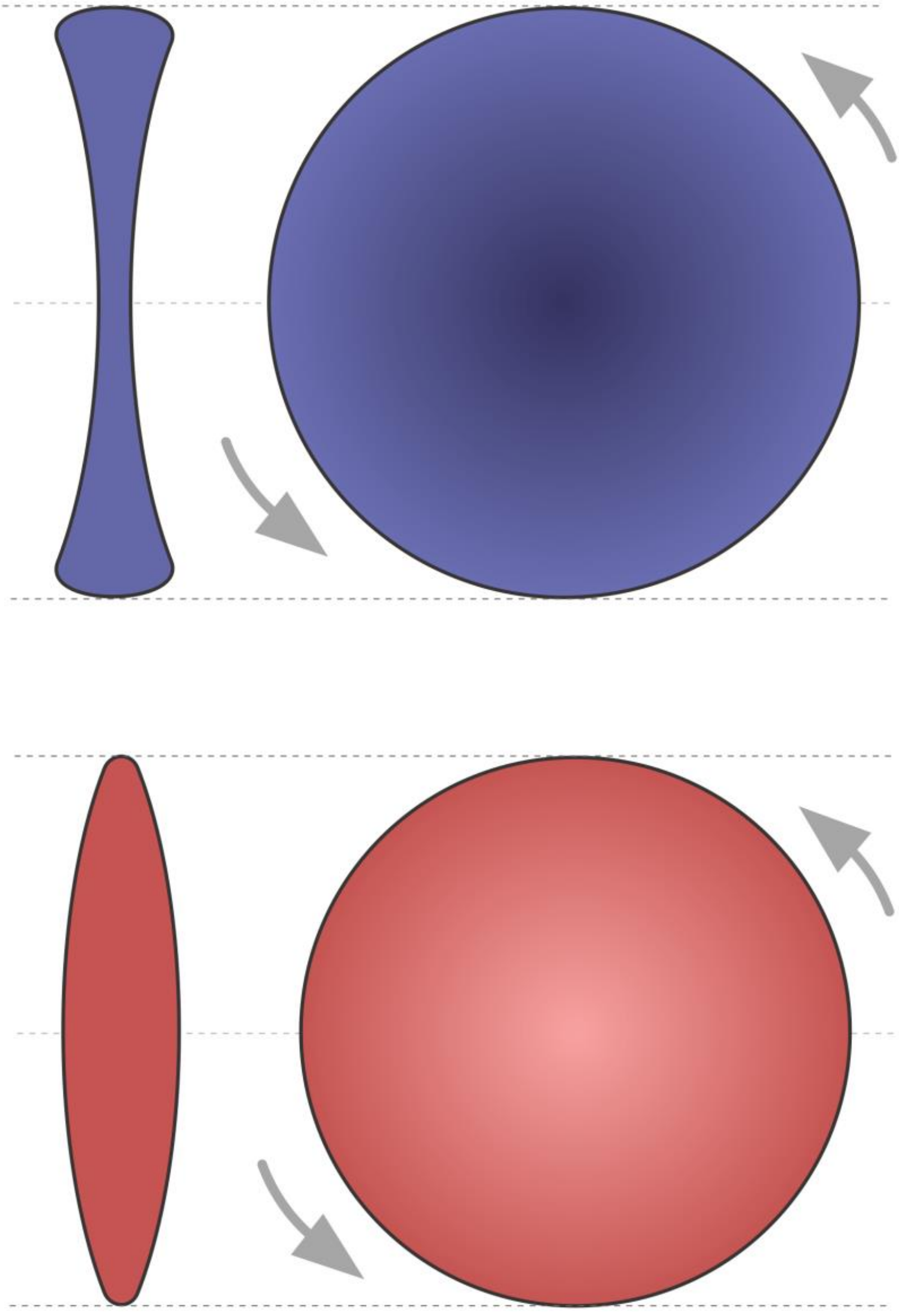


Figure 26 - *The electron and the positron*

4. Considering their internal structure - granular layers that are practically bonded together and that may slip past each other without "friction" - all

particles will act as a *viscous fluid* with certain surface tension (if we are using some terms of fluid mechanics). This thing will lead to several interesting properties, especially in the case of composite particles:

- Distinct granular layers can "store" the direction of their motion, imposing in this way different global directions during the two revolutions any particle makes for a complete rotation in its precession movement.

- The elasticity given by the internal granular structure may allow different temporary deformations to elementary particles, within certain limits, under the action of powerful fluxes. Just as a speculation, the electrically charged particle's surface may flatten (and increase in diameter) at high, relativistic speeds. This important effect could occur during the time interval a photon is generated and emitted.

- A significant deformation is produced by the gluonic field (colored in dark gray) to the side quarks of a neutron (see Figure 28, the particle from the bottom). This deformation, which is also called "color charge" in the quantum chromodynamics language, changes, practically cancels the electrical charge of those two quarks. The electrophotons they are continuously emitting will also be deformed, producing no field effects for this reason.

- In some special cases (intense fluxes or collisions between particles), a particle may transform into another one; the total momentum, electric charge and granular mass are all conserved in the process. The elasticity property allows a particle to split up into smaller pieces if the disruptive force is acting symmetrically in a central zone (this is the case of a free neutron, one of its side quarks eventually decays into an electron and an antineutrino).

We have to describe now the pushing forces that are generated by the local flux on its contact with particles, e.g. with an electron (Figure 29). As multiples of the gravitational unitary force, these forces create a dynamic balance with the internal "pressure" generated by the granular impulses, all over the particle's surface.

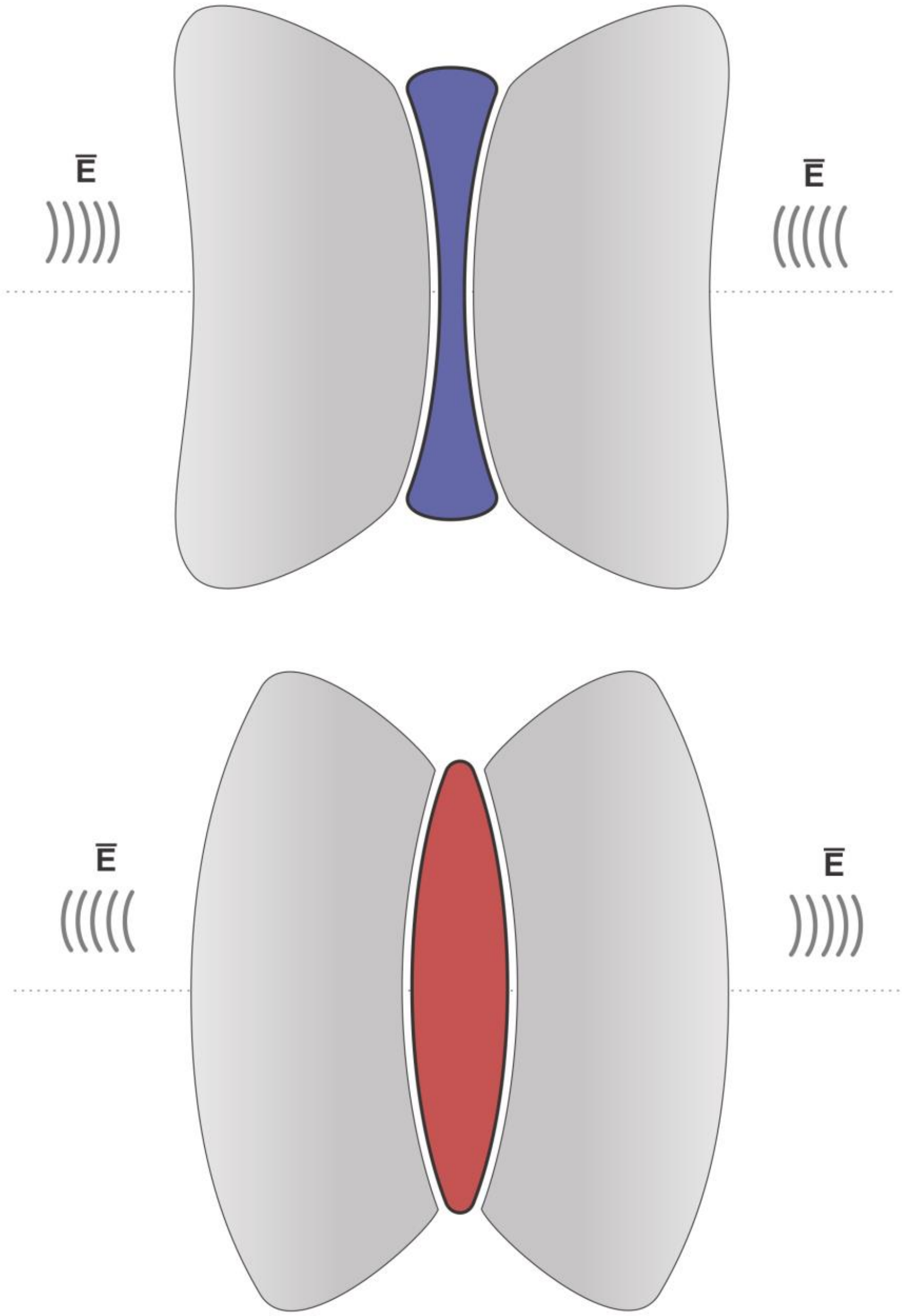


Figure 27 - *The electric fields of electrons and positrons*

Their scalar expressions are of this form (k_1 and k_2 are two constants and all surfaces are considered plane):

$$\mathbf{F_1 = k_1 * d_1 * F_u}$$

$$\mathbf{F_2 = k_2 * (d_2)^2 * F_u}$$

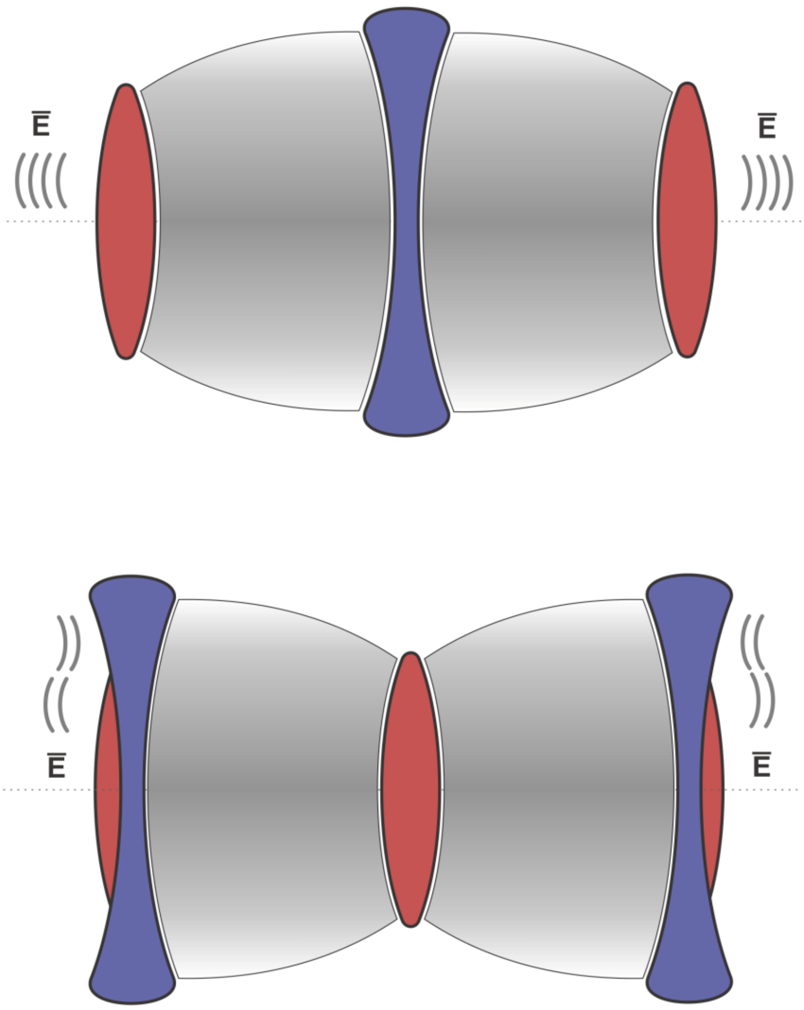


Figure 28 - *The internal structure of protons and neutrons*

The force $\mathbf{F_1}$ equilibrates an internal force of centrifugal kind, which is generated by the granular impulses that have to be modified in order to maintain the quasi-circular trajectories for all internal granules - from the axial region up to the edges. $\mathbf{F_2}$ balances an elastic force produced by those compressed granular layers (of larger areas) which tend to move away from each other and to increase the thickness of the particle. A more detailed analysis can only be performed on a complete model, on a three-dimensional simulation, specially designed for the generic particles that are subjected to a constant external "pressure".

The electric charge of the elementary particles - meaning the concavity of their side surfaces - has to be analyzed in the same manner. If the granular medium is uniform, both sides of the particles have identical concavities and these curvatures are maintained for an indefinite period of time. But how is determined the exact type of concavity at the moment a particle (or an antiparticle) emerged, which is the mechanism behind its biconcave or biconvex shape? The answer should contain at least two parts, considering the way in which particles have formed: one by one, as in the first moments of the universe, or in pairs, as a gamma photon generates now, for example. However, both cases involve the same "mechanics": one granular vortex is increasingly compressing and eventually reaches a compact discoidal form.

In the first case, we can speak of randomness. The discoidal structure, which may start as a squashed cylinder with flat side surfaces, is pressed on the narrow edge ($\mathbf{F_1}$) and, consequently, its side surfaces are curving until a dynamic balance is reached. The final inward or outward curvature is a random outcome, the probability of each type of surface to appear seems to be 50% (we can make a mechanical analogy: the embryonic particle is like a drum; if this musical instrument is evenly pressed on the rigid body, its membranes will either curve upward or downward).

In the second case, we can speak of a certain degree of determinism. For a simple mechanical reason, the two particles will have different concavities (polarities, and this leads to the conservation of charge). The granular medium is very dense, as in the previous case. However, there is one different thing, which eventually determines the positive (for example) particle from the pair: the source that generated the gamma photon, i.e. its intrinsic polarity. As we already know, all layers composing a photon body naturally inherit and transport the concavity of the emitting particle's surface.

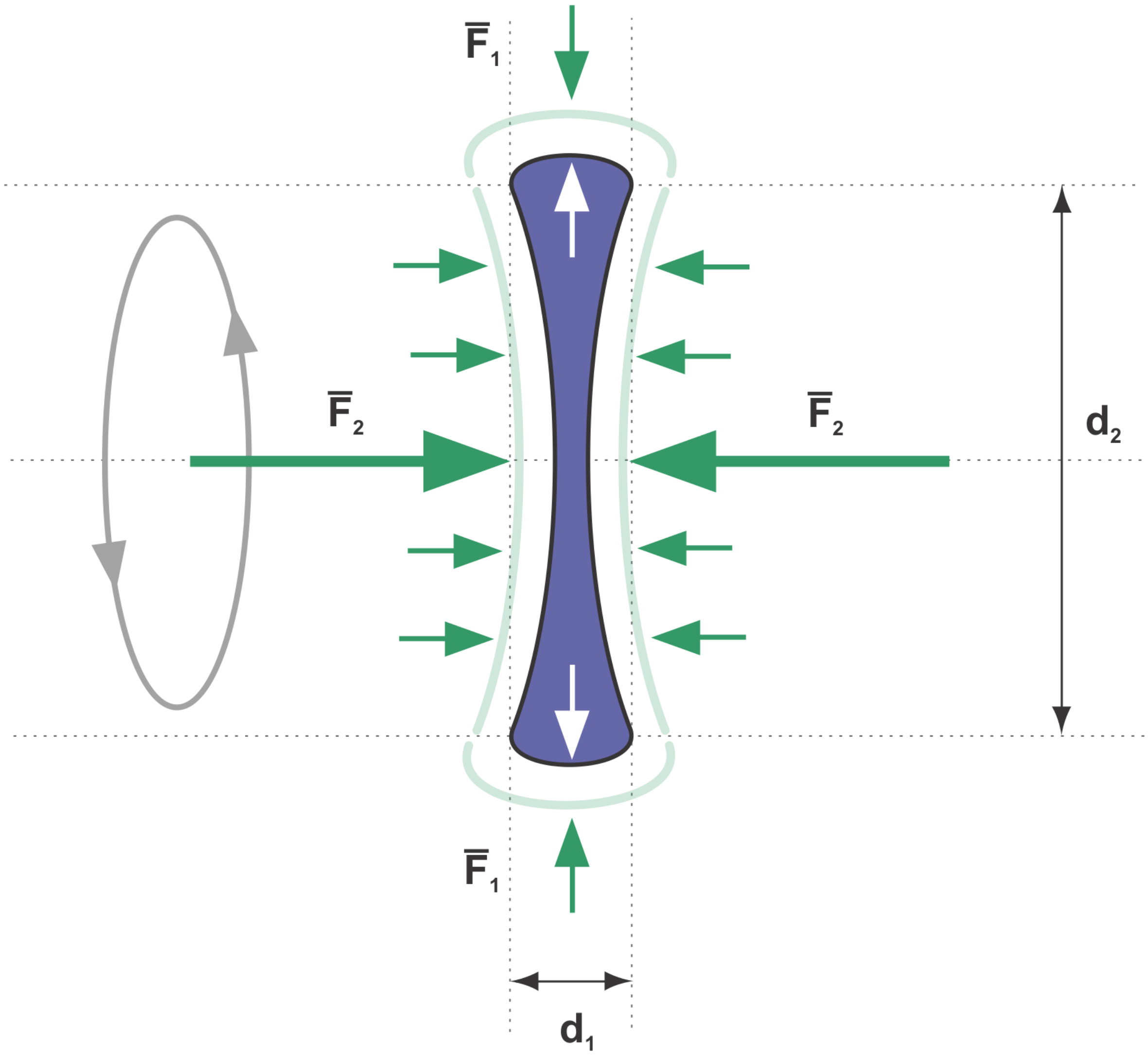


Figure 29 - *Internal and external granular forces*

5. Mass - Energy equivalence

The dynamic directional mass

This article tries to clarify several theoretical concepts related to some physical quantities, such as mass and energy, starting from their definitions stated in my first book (Prime Theory [1]). All explanations will be placed within the framework generated by the granular mechanics - a given of our current universe, which actually determines all the laws of physics, at any possible scale.

5.1. The Mass

What is mass in fact? Is mass a well-defined concept in modern physics?

If we look back at the manner in which the mass was firstly defined in my theory ([1], Chapter 6.2) and if we take into consideration the postulate stating that any granule is moving all the time (if seen from the AFR), it seems quite natural to connect the mass of all granular structures to their movement and to suspect a variation of its value under certain conditions. However, all the parameters of the spatial granules (either free or in a structure), including the elementary impulse and energy, remain constant over time!

The symbolic, the rest and dynamic mass

As the granules are elementary quantities of essence that have a certain volume and a shape stable in time, we may attach them a symbolic mass denoted by **μ**, of constant value (it does not depend on the granular motion), which has a classical meaning of amount of substance.

In order to ensure a unitary perspective on the mass of granular structures (regardless of their concrete shape), a new and complete definition is needed to be used in granular mechanics:

Any granular structure, defined as a finite group of granules whose granular density exceeds the local one and that acts as a distinct entity (simple or composite), possesses the following mass-like characteristics:

*- A **symbolic mass**, given only by the number of granules - a scalar, constant quantity, invariant in all frames of reference.*

*- A **rest mass**, given by the symbolic one and by the value of the granular impulse.*

*- A **dynamic mass**, given by the spatial distribution of the internal granular impulses, which may now be considered a direction-dependent quantity (tensor) and whose values will vary with the absolute velocity of the structure.*

Note 1: The granules in a structure can be bonded to each other or separated; this aspect was not considered here, yet it has certain significance in some quantum interactions.

Note 2: Mass, especially the dynamic one, no longer seems to be one fundamental physical quantity, as the generic mass does in a classical sense. The elementary granular impulse (energy) gives a clear meaning to the new mass and preserves the role it plays as a fundamental quantity. In all granular structures, the dynamic feature of mass is a characteristic that only appears during their interactions through different fields.

Note 3: The total mass of the bigger structures (atoms or molecules, in which some elementary particles are bound together by various fields) may be obtained by the temporal averaging of the component masses, the result being different from a normal mathematical summation; the movements of the component particles are "confined", they all have a lower number of degrees of freedom and thus their dynamic masses are changing. The distribution of mass of the local fields (different forms of energy) also contributes to this, in a smaller extent.

Note 4: The total mass of a macroscopic body (which is made up of atoms) is also an averaged value.

Note 5: The rest mass is a particular case of the dynamic mass, the absolute speed being considered zero.

Let's consider an elementary particle that is made up of **N** granules; it may thus have a symbolic total mass **N μ**, total energy (of kinetic nature, the granular energy being denoted by **ε**) **N ε** and a total impulse **N p**. Observation: the last two quantities depend on the frame of reference; also, these formulas are valid in the particular case when that particle is observed from the AFR and if, virtually, all the granules would have the same direction.

The first type of mass, the absolute *symbolic mass*, was introduced in order to maintain the classical perspective on the particle's mass; therefore, this kind of mass will only depend on the amount of substance (on the number of constituent granules, the speed is not involved here).

If this particle would be at rest in the AFR and all its constituent granules would rotate on parallel layers (all velocity vectors are parallel with the side surfaces), we could introduce an absolute *rest mass*, a quantity correlated with the amount of substance and with the external impulse necessary to cause a global movement with the speed **v**. This rest mass would be a constant which only depends, in principle, on the number of particle's constituent granules and on their elementary granular impulse.

The *dynamic mass* could be introduced in the same way, as a quantity that depends on the number of granules and on the *distribution* of the impulse vectors inside the considered structure (therefore on its global speed, which may be relativistic). As all structures in question are not spherical, there will be a certain dependence of the dynamic mass on the spatial orientation (on the global direction), as shown in Figure 32 for electrons and protons. This mass will therefore be expressed as a function of direction (the direction of an ideal flux, uniform and very thin, that acts upon the particle), but in practice we will use some **mean** values, averaged for the duration of the intrinsic motion of precession. *Note*: at small global speeds, the directional dynamic mass tends to get uniform due to the intrinsic precession, its average value becoming constant.

If we are to analyze the dynamic mass on a single direction, there will be a minimum value for the particle being at absolute rest (equal to the rest mass); in this case, we may assume, *in a simplified manner,* that all its internal vectors have the same orientation, perpendicular on the future direction of travel. Therefore, the variation of an external impulse that would cause the same acceleration to the particle within a certain period of time would have a *minimum value* (this is the natural way in which the mass must be regarded, or as the value of an external impulse that would produce a certain speed - see Annex 1). The dynamic mass manifests similarly if a particle speeds up or slows down (during short intervals and under infinitesimal impulses), generating in this way certain spatial symmetry. If the particle has reached speed **c** on a certain direction, it may only be slowed down, and on this opposite direction, its mass is *finite*. Note: No inertial/gravitational mass differentiation is involved here, as this distinction is only valid in the case of very large and dense cosmic bodies.

5.2. The Energy

Kinetic energy, the type of energy that will be discussed now, is always associated with an entity, i.e. with a granular structure in motion. If we look at the particle above from the AFR and then analyze the directivity of its granular movement versus the global one, we may discern three possible distributions (as shown in Figure 30) of the elementary kinetic energies:

- Only rotational motion at the absolute speed **c**.
- Rotational and translational motions.
- Only translational motion at the absolute speed **c**.

These cases (they are similar to the previous ones, from Chapter 1) involve an ideal, simplified particle, which does not execute the precession movement (anyway, Prime Theory [1] assumed that the global velocity vector can be neither parallel nor perpendicular to the surface of a particle). An external force (produced by charged particles and their electric/magnetic fields or by gravitational fields) that acts a certain time upon this ideal particle will transfer it certain amount of impulse, and this thing will cause a change in direction to all its internal granular impulses. The energy is "transferred" through the fluxes of the respective field to the particle and produces a change in its energy distribution, a change of the ratio between its rotational and translational energy, while the total energy remains in fact unchanged.

By its translational motion, the particle "exhibits" more or less from its internal, total energy, as much as it has received from the external granular impulses (of the electric and magnetic fields). Once it has reached the speed of light, this particle can no longer receive more impulses from the outside on its current direction (because its speed became equal to that of the external source of impulses or because the frontal granular collisions prevent any speed increase).

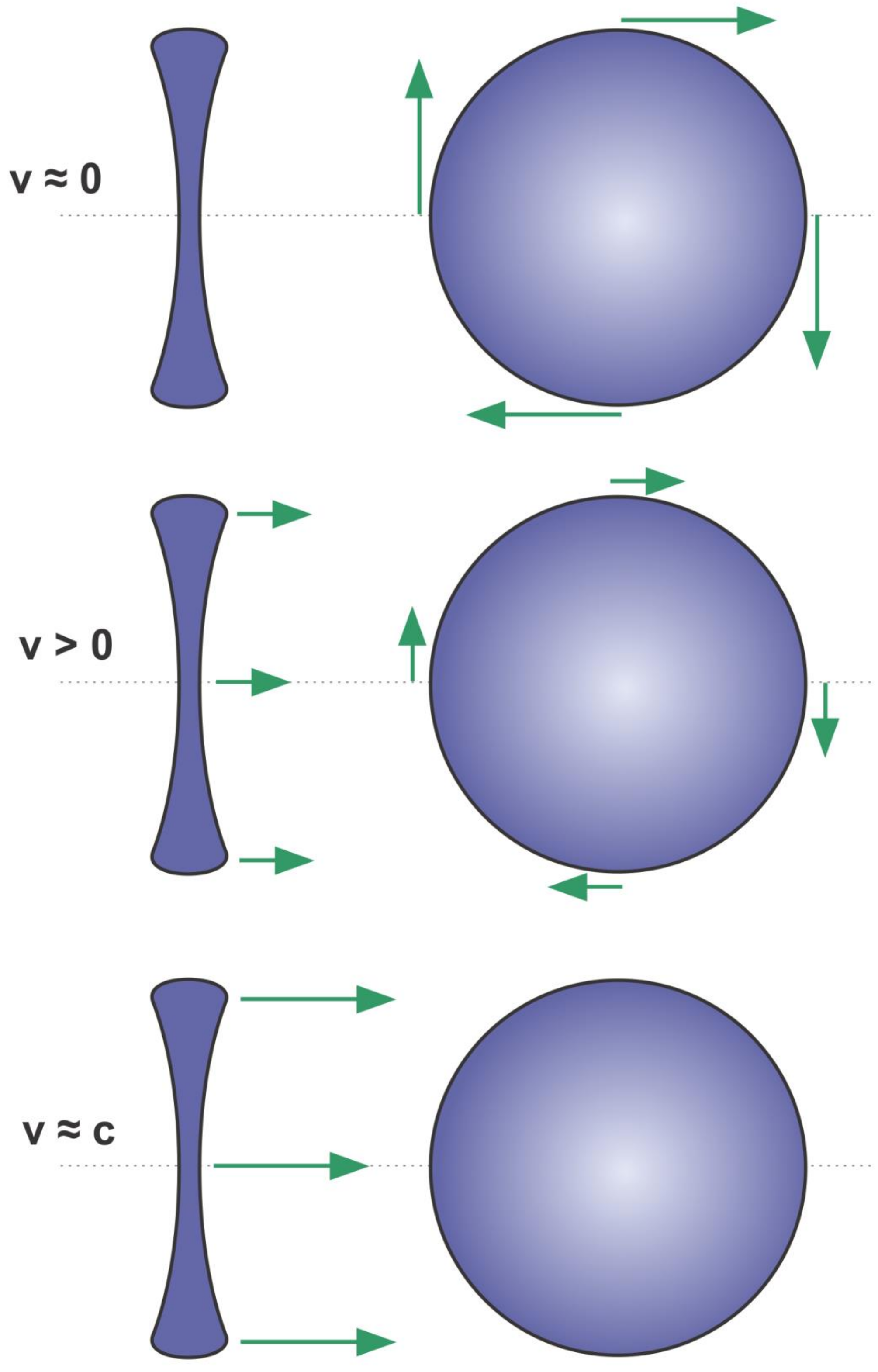


Figure 30 - *The distribution of rotational and translational speeds of an electron*

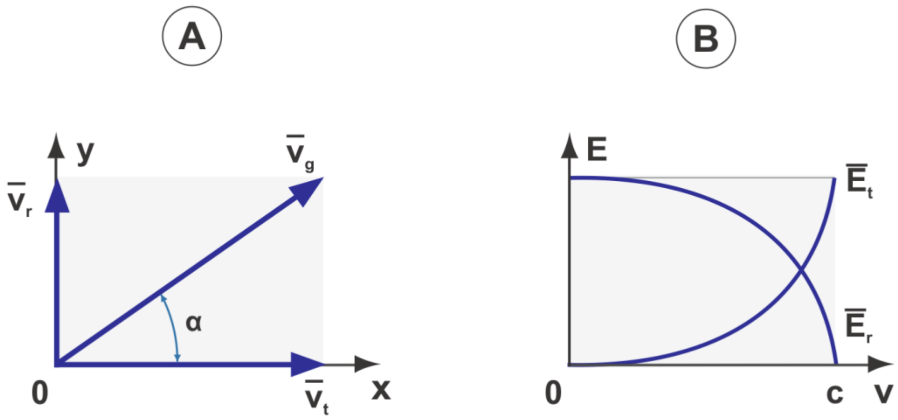


Figure 31 - *The distribution of speed and kinetic energy*

Figure 31 shows (on the left) the (normal) decomposition of the particle's global velocity $\mathbf{v_g}$ into its rotational and translational components, $\mathbf{v_t}$ and respectively $\mathbf{v_r}$, their values being included in this formula:

$$\mathbf{v_g^2 = v_r^2 + v_t^2} \quad \text{(where } \mathbf{v_g = c = constant}\text{)}$$

The total kinetic energy in the closed flux/particle system is *conserved*; the flow will change its direction and the particle will change its both absolute speeds (global and rotational).

In this context, it seems natural to redefine the kinetic energy (ignoring, for now, the mechanical work done by the forces in the system and the mass in a classical sense). The kinetic energy $\mathbf{E_k}$ will therefore be seen as a derived parameter that characterizes the proper state of a particle moving at a certain absolute global speed; this energy of the absolute movement (it was described in my book [2], Chapter 3.4) is a scalar quantity proportional to the square of the absolute speed, to the number of internal granules and to the elementary energy.

That particle has a rotational kinetic energy $\mathbf{E_r}$ and a translational one $\mathbf{E_t}$; they can be summed in this way:

$$\mathbf{E_k = E_r + E_t} \quad \text{(where } \mathbf{E_k = N\,\varepsilon = constant}\text{)}$$

The formula expressing the energy $\mathbf{E_t}$ may be easily obtained from the previous equations:

$$\mathbf{E_t = k\, v_t^2 = N\, \varepsilon\, v_t^2 / c^2} \quad \text{(where } \mathbf{k = constant}\text{)}$$

This function is graphically represented in Figure 31, on the right side.

5.3. The Time

At the granular level, things are simpler: time is a just reflection of the consistency of space. The granular medium is made up of granules and they all move with the constant speed ***C***; therefore, time has a constant rate in any AFR and this rate may be set arbitrarily. There is no reason to consider other frames of reference in this environment of constant granular density (on short intervals).

At the quantum level and above, we have to deal with structures. The granular structures, regarded as distinct entities, may have different absolute speeds in AFR (less or equal to **c**) and thus different relative speeds. They all vibrate, oscillate and interact with each other through fields; these things happen at a certain rate if particles move slowly and at a lower rate if their speed gets close to the speed of light, **c**. As it was specified above, all structures "transfer" a part of their internal speed, energy and impulse into their *external* translational movement when they interact through various fields (or vice-versa, "absorb"). However, their total energy is a constant value, which means that this amount of energy is actually split into different parts and this phenomenon depends on the absolute motion of particles.

Time may be associated, at this level, with the proper, internal movement of particles, the one which reflects itself in their precession and which imposes a certain rate to all possible interactions. Therefore, from the components of the granular speed, the one that determines the internal rotation of particles could be a perfect reference for their local time (see Annex 2). We may simply say that, at low global speeds (absolute speeds of translation), the local time is flowing uniformly and its rate is maximum; however, this rate drops significantly at relativistic speeds, close to the value **c**. The simultaneous "movements" through time and space are therefore limited to a global maximum speed, as it was described by the principles of relativity, and this happens because a certain entity (here, a particle) may move through space and also fix the rate of its local time *by the same internal granular motion*.

5.4. Photons

The photon structure is created when an electrically charged particle has relativistic absolute speed and, at the same time, it slows down or speeds up in a certain field. Photons are spiral structures with a variable pitch that are made up of compact granular layers moving simultaneously at speed **c** in a unique direction. The symbolic mass of a photon is given by the number of granules contained in these granular layers, **N μ** (N differs in various photons). The impulse of each component granule is perfectly aligned with the direction of travel; therefore, the total impulse is pointing in the same direction and its value is **N p**. The kinetic energy is due to the translational movement and its value, **N ε**, is constant. However, the dynamic mass of a photon is variable:

- It is infinite on the photon's direction of travel, because this structure may no longer receive an extra impulse to accelerate and increase its speed.

- Photons cannot be slowed down when they travel through uniform, free space; only their direction may be changed under the action of some lateral fluxes. These fluxes will "see" a mass of minimum value if they flow perpendicularly on the photon's direction of travel, a mass that will increase toward a maximum value as the angle of incidence decreases (this is the curvature of the photon's trajectory in a strong gravitational field).

Note: The mass of electrophotons could have a similar description, regardless of their variable and unstable structures (see Chapter 2.4.2).

The envelope of the granular layers has a certain frequency, and this is what gives a measure of the photon energy in quantum physics, not the total kinetic energy described above, **N ε**. This difference appears because one photon transfers only a part of its energy during the special interaction with an atomic electron, when it is synchronized through the impulse transferred by the photon's granular layers. Normally, the values of these energies are proportional; moreover, the photon's total energy, **N ε**, is always conserved.

Let's analyze a simple case to support this statement, the redshift of a photon passing through a gravitational field, for example. At the granular level, this phenomenon is caused by the decreasing gradient of gravity; this gradient increases the distance between the photon's layers, as their speed changes at different moments when it crosses the gravitational field. As a result of this process, the number of component granules in photons remains unchanged and therefore their total energy will be conserved. However, the eventual transfer of energy toward an orbiting electron will differ; it will have a slower "rate", and this corresponds to a possible jump of less energy. In other words, out of the total energy a photon contains, only a fraction is transferred to the orbiting electrons, the remainder being practically lost in the granular space.

5.5. Composite particles

The composite particles are made up of two or more elementary particles (quarks) that are held together by the gluonic field (via the strong interaction). The constituent particles perform their precession movement in a special way, synchronous or not, being elastically bound together by the gluons of a very high granular density (which are reducing the number of degrees of freedom). The distribution of mass in the composite particles is mainly determined by the gluonic field, which adds the most amount of mass (as a number of granules) to the total mass. We may approximate the direction of granular fluxes in gluons with the line connecting the center of the particles, one-half of the granules moving in each direction at any moment. Therefore, the dynamic mass of the gluonic field has a maximum value in that direction and it is lower on the perpendicular ones. Anyway, these values will be averaged over the period of one rotation (precession) and we may practically work with a single value of mass (which will still be dependent on the absolute speed involved).

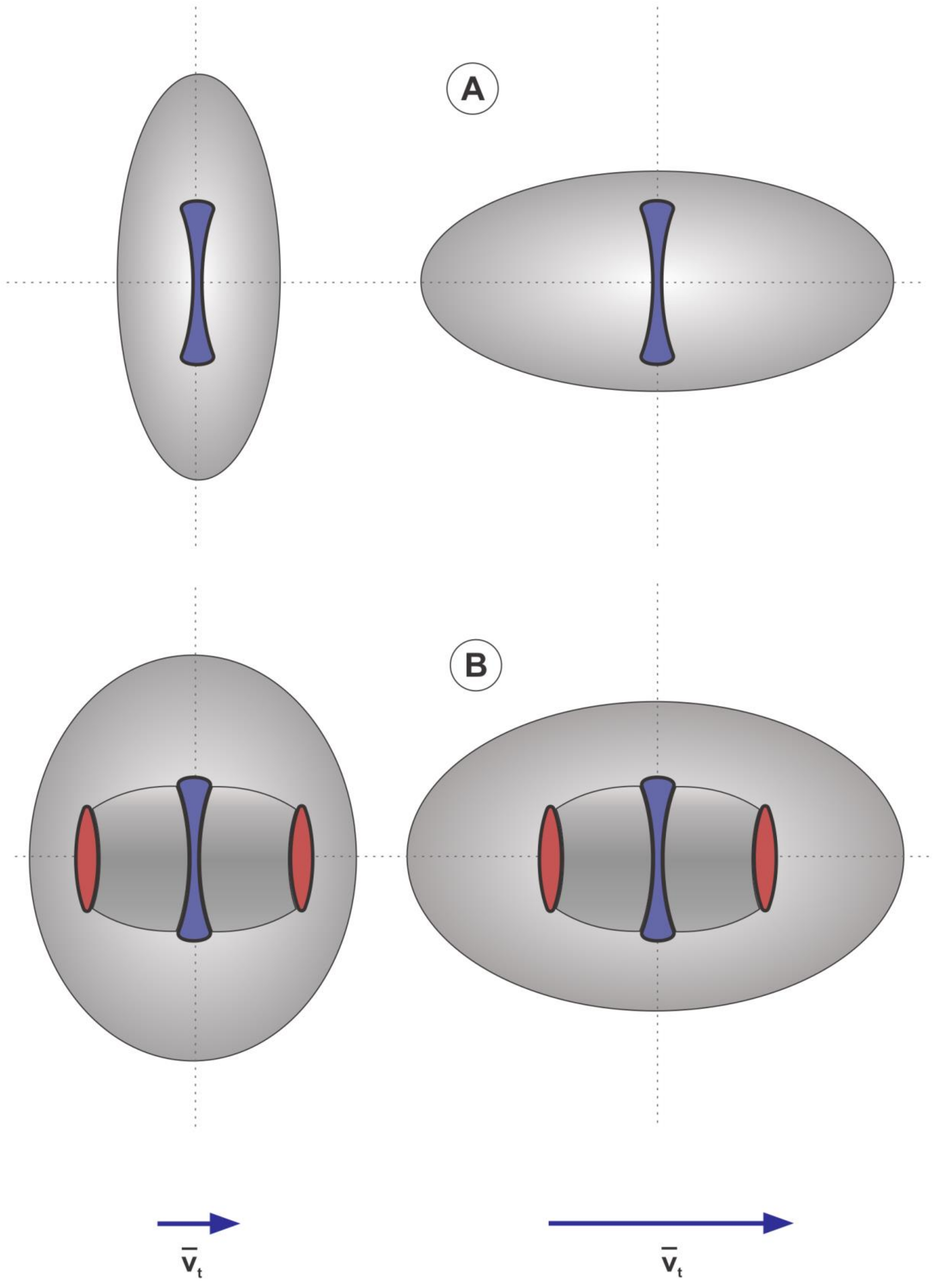


Figure 32 - *The distribution of the dynamic mass in electrons and protons*

5.6. Conclusion

The mass-energy equivalence is an implicit relation, it could have been observed since the moment we have first stated the granular properties. This article just added some details to the concept of dynamic mass of the usual granular structures and tried a new definition for their kinetic energy. Moreover, this new perspective explains why the relativistic phenomena occur at the quantum level, shedding more light upon the concepts of mass, time, impulse and some other physical quantities.

Mass, seen as substance, cannot be converted into energy or vice versa. The mass contains energy since the granular matter was created. Therefore, the structured formations existing in the amorphous spatial fluid will contain significant amounts of localized energy (kinetic energy). Consequently, it simply results that the mass and energy cannot be created or destroyed; they only may be grouped in certain compact formations, stable or not in time.

The dynamic mass of a particle shows the amount of kinetic energy (elementary impulse) that must be grouped and oriented to interact with that particle in order to change its internal impulses and thus allow a global movement with a certain absolute speed. Things are similar for macroscopic objects: as they are in fact smaller or bigger collections of elementary particles - bonded and organized as atoms and molecules, we have to work with averaged values of mass.

This duality related to the motion of particles helps us explain their *inertia*. All the free particles keep the ratio between their rotational and translational speeds during the global motion, and this means they are holding their previous state (they maintain the kinetic energy they reached after the last interaction caused by a field). One particle, being either at rest or in motion, requires a certain impulse transfer from a directional granular flux in order to change its current state, to overcome its inertia. This is similar to the concept (kind of classic) of some force that acts on a particle and changes its current state of motion.

The concentration and dispersion of granular kinetic energy are representing in fact the mechanism of any kind of field, allowing the energy exchange between all quantum and macroscopic entities. The gravitational field, which is generated by the granular consistency of space, provides through its fluxes the primary support for all the other fields. In certain systems, both micro and macro objects can have another type of energy - potential energy - due to their relative position in the gravitational field. However, regardless of the form or the name it would have, the energy always means an aggregation of those granular, elementary energies of kinetic nature.

The elementary energy, regardless of the mode it is concentrated at a moment, is always conserved in all quantum interactions. This seems perfectly natural, as these interactions and transformations conserve the *symbolic mass*, i.e. the number of granules. The granular fluxes, any kind of field they would constitute at a given moment, are mediating (by their moving granular mass) all transfers of energy/ impulse between particles.

The dynamic mass, as well the energy, cannot have infinite values because they are in fact configurations of the internal energies and impulses (finite in number and magnitude) of particles. If a particle reached the absolute speed **c**, its impulse along the direction of travel can no longer be changed and this is the reason why there is an apparent dynamic mass of infinite value in that direction.

5.7. Annex 1

Let's now consider an *ideal* elementary particle whose internal granular impulses (or velocity vectors) form the angle $\boldsymbol{\alpha}$ with the global direction of travel. As the granular speed can be assumed to be **c**, the particle's global speed will be $\mathbf{v = c \cos (\alpha)}$. The internal impulse is denoted by $\mathbf{p_1}$ and the value of an external impulse that acts at a given time is $\mathbf{p_2}$, $\mathbf{p_2 <= p_1}$. As a result of this event, the angle $\boldsymbol{\alpha}$ will become $\boldsymbol{\alpha'}$; this is equivalent to a new global speed $\mathbf{v' = c \cos (\alpha')}$. The final angle has been already calculated (Chapter 3.3) and it has this formula:

$$\alpha' = 2 * \arctan (p_1 \sin (\alpha) / (p_2 + p_1 \cos (\alpha))) - \alpha$$

If we represent **v'** as a function of the external impulse, it may be easily noticed the nonlinear dependence; this means that an increasingly higher impulse is required for the same increase in speed of the particle (and vice versa, when the particle is slowed down). The speed limit **c** could be reached by particles (starting from rest) if they receive a total impulse of value $\mathbf{p_2}$. As for the dynamic mass, you may easily notice this thing: if one particle is accelerated by a certain flux, it will "exhibit" a variable dynamic mass that has a minimum value at rest and a maximum value (but finite) just before the absolute speed **c** is reached. However, the value of mass gets "infinite" due to the blockage created by the granular fluid once the speed limit is reached.

Figure 33 shows on the horizontal axis the normalized external impulse (to the internal one) and, on the vertical axis, the absolute velocity (of values in the range 0...c), both being linearly represented.

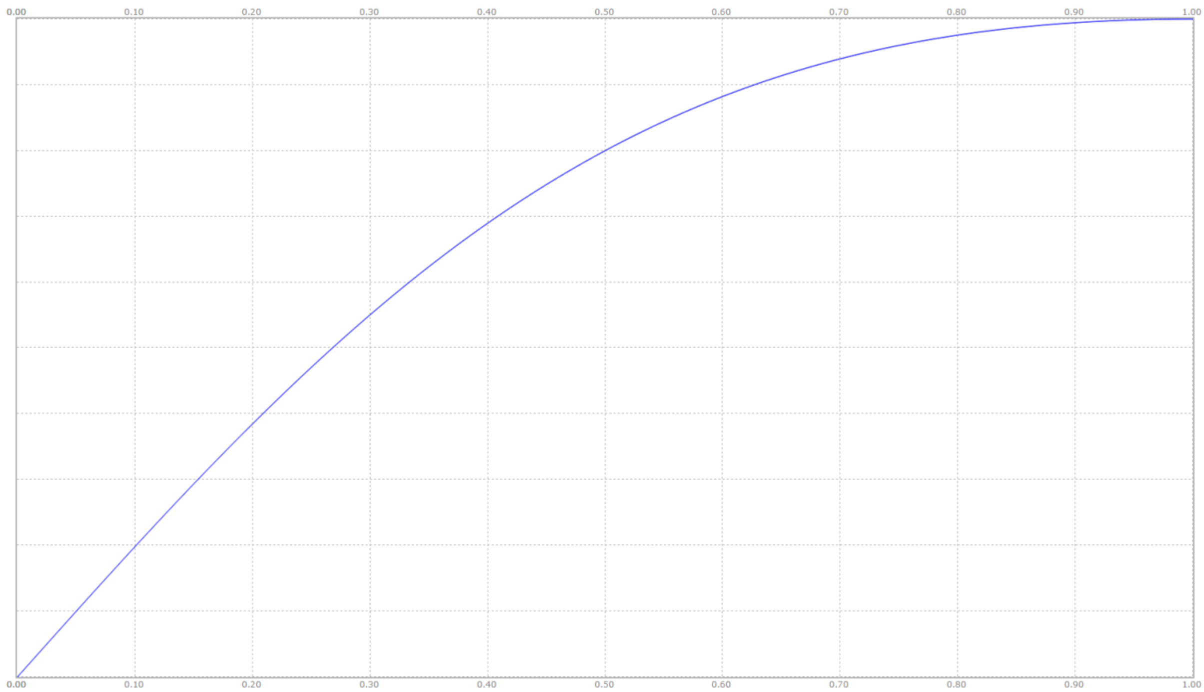


Figure 33 - *The dependence of translational speed on impulse*

5.8. Annex 2

Let be this distribution of particle's speed (as in Figure 31, on the left), where the speed of rotation $\mathbf{v_r}$ is assumed to fix the rate of interaction through the precession motion and through the value it induced to the dynamic mass. The time is therefore inversely proportional to $\mathbf{v_r}$:

$$\Delta t = k / v_r \quad \text{where} \quad k = \text{constant}$$

For a particle at rest, its local time is the AFR's time; its rotation speed is exactly **c**:

$$\Delta t = k / c$$

While the particle is in motion, its local time is **Δt'**:

$$\Delta t' = k / v_r = k / (c \sin(\alpha)) = k / c / (1 - \cos^2(\alpha))^{1/2} = k / c / (1 - v^2/c^2)^{1/2}$$

Finally, it simply results that the time is given by this equation:

$$\Delta t' = \Delta t / (1 - v^2/c^2)^{1/2}$$

which is the well-known formula of relativistic time dilation.

6. Granular collisions

Uniformity and variation

6.1. Introduction

All the assumptions and postulates made in my first books ([1] and [2]) about the granular medium and about its evolution over time did not give a precise answer and neither formulated a complete scenario for its emergence, regardless of the various cosmogonic theories that were presented until now. Therefore, this is an attempt to compensate for this lack of information and to give some plausible explanations for most of the fundamental characteristics of the spatial fluid:

- The huge, but constant number of granules and their identical size/form
- Their uniform distribution throughout the empty space (considered closed and which is continuously expanding)
- All granular characteristics are not changing over time
- The granular kinetic energy, a finite and constant granular speed ***C***
- The decrease of local granular entropy during the formation of elementary particles
- The variation in time of the granular density and the modeling of intergranular collisions

It has to be mentioned here that all physical quantities associated with these granules will further have only absolute values, even for the simple reason that relativization makes it impossible to observe and measure all things in a closed system. Anyway, all these values are neither too big nor too small, and therefore the granular properties are within a kind of Goldilocks zone; this fact is very important, as it will allow the future evolution of the large system made up of granules.

6.2. The theory of the large systems

Regardless of the way it came into existence, as being a given of infinite size that represents the absolute nothingness or as a finite void that resulted from the spread of the primordial essence, the three-dimensional space will be further considered a passive framework where our granular Universe simply "floats". Obviously, as it was stated in my first book [1], these things could also be seen inversely, i.e. to consider space as the "full" component and the essence as the "empty" one. However, as the full/empty ratio would have been too high, it seemed natural to consider the essence as being the material part, i.e. the part full of something.

Here are a few of the fundamental features of space (when it is seen as a three-dimensional framework):

- Absolute uniformity and isotropy of any region of space
- The lack of any interactions between space and the granular essence
- In case the space is finite, its presumed expansion is just a geometric increase in volume

Let's consider the moment when essence came into existence, which may also be the moment when space appeared as an empty frame, as a volume. My favorite scenario was described in the chapter named The First Bangs: the essence already existed (or it appeared as stationary and contiguous substance) and multiple bangs occurred at a certain moment inside its body. There is an additional assumption, this elastic substance occupies a limited, finite volume and is subjected to external pressure, thus being in a compressed state. The distributed process that soon begins is of mechanical nature and it looks more like an extended implosion; it is even possible that it would not have been violent and to have lasted a very long time (at cosmic scale). Anyway, this dynamic process has eventually led (through division, internal friction or other mechanical transformation) to a granularized substance (of a certain size) and to the transformation of the elastic energy into kinetic energy. A huge number of infinitesimal granules appeared this way, and each of those granules is moving in a random direction at a constant speed. Their number and size were determined by the quantity of essence and by its degree of elasticity, while their speed was given by the initial elastic energy. A simple representation of the essence is shown in Figure 34A; 34B shows its granular state at a later moment (it is not drawn to scale).

Note 1: The granularization process is irreversible, the kinetic energy is now distributed at the granular level and it can no longer be restored (the granules cannot join together back).

Note 2: What is the source of this initial elastic energy? If we consider the law of conservation of energy as supreme and universal, we will need to find out where this energy came from or what other forms of energy compensate for it! Anyway, for the time being, this is a deep mystery and it is possible to remain so if we continue to think only "inside" our Universe...

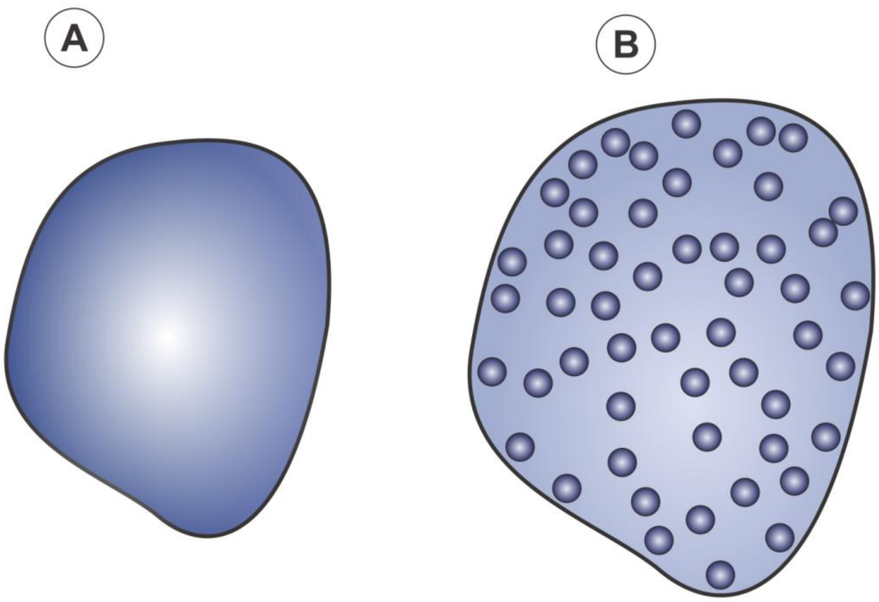


Figure 34 - *The essence and its granular state*

All of the granules are moving freely inside that framework we described above. As their initial density was huge, most of the granules were bonded together in large groups, for large time intervals; all collisions between individual granules and those groups were chaotic, but they allowed a fast leveling of the granular speed. A collision between two identical granules only means an exchange of speeds, but there was a very high probability (due to the huge density) of simultaneous collisions between three or more granules (grouped or not). This latter process, infinitely repeated, could have averaged the speed of all granules to the final value ***C***. Anyway, a special granular fluid was made in this way, similar to gases; it can exert pressure on the external membrane (via the transfer of granular impulses) and thus trigger the geometric expansion of the frame described above.

This is the moment since we may speak of the normal space, stable and functional, space that may be further considered by the laws of physics in his duality of geometric frame and granular matter.

What are the special features of this new construction, space? The large system this space has formed, is it stable?

a) If we only look at its geometric component, there is nothing we may say about the size of the space (no marks for measurements or estimates, nothing that might be compared). The same thing can be said about the periods when its material component had a quasi-uniform granular distribution.

b) *The really huge number of identical components*, i.e. granules, which may be simply estimated to several googols (10^{100}) - due to the new number of galaxies [6] and due to my assumption that there is a minimum number of 10^{15} granules inside an electron (a ratio of about one-to-one was considered between the number of free granules and those contained in the material structures of any kind).

c) Seen at the granular level, space seems to be amorphous and dynamic; all granules continuously move and collide chaotically. However, if we change the perspective and extend the angle of observation, space is gradually turning into a *fluid with special properties, uniform and isotropic*, which has a certain granular density.

d) The components of this system are mobile, they all move at a constant speed and collide perfectly elastic. Their really huge number makes possible the existence, any direction and any moment of time we would consider, of *a flux of granules that have parallel trajectories*. Taking into consideration the way all material parts of space emerged, out of a unique chunk of essence, a postulate was issued in [1] telling that an equal number of granules moves on each possible direction in space (their total impulse is quasi-null).

e) If we admit that this system is closed and its volume is continuously expanding, then the density of the granular fluid will decrease over time. It seems normal to assume that there were many initial irregularities in the local granular distributions, as of directions and density, but they all have diminished and space became uniform in time.

f) The fluid made of free granules (those generating in fact the directional granular fluxes, constituting the intrinsic gravitational field of this large system) underwent significant changes in density during the initial stages of the universe (fractions of a second, as in the Big Bang theory), for example at the time when the majority of the elementary (quarks) and composite particles were formed. Once the density got low enough, the formation of electrons and positrons and their immediate annihilation have also led to rapid oscillations of the granular density.

g) The granular spatial system cannot be divided and analyzed as separate regions; both the nature and the dynamics of its granular fluxes show us that any area we would consider, it would be "connected" with all the adjacent and more distant ones, mutually influencing each other in a continuous manner. However, this influence is transmitted at a limited speed, the speed of light at that time and place.

h) The granular space seems to be a stable automatic system, behaving linearly and predictably; this means it could remain in a steady-state for ever, just its density will be decreasing over time... Therefore, all its physical quantities could be described by equations and statistics similar to those of the ideal gas. We may even introduce the concepts of *granular time* and *granular entropy* (seen as a measure of the chaos at this level), which both could be included in a law where the value of global entropy will only increase in time.

By analyzing this entire system, we may emit a general theory of space that is similar to the second law of thermodynamics (the properties of the constituent granules are all known [1]):

A closed system, which consists of a fixed number of identical material components and which undergoes a continuous expansion process, has a *constant or an increasing value of the global entropy. However, there may be some spontaneous transitions of the local states - when the local entropy will decrease - only if the number of components exceeds a critical value and if their density lies within a critical range.*

6.3. Linearity and evolution

When it is observed, the objective reality shows us that things did not evolve linearly and the granular space has actually passed through a stage that fully complies with all conditions of the theory above! Even if the perfectly elastic collisions maintain the rectilinearity of the granular trajectories, even if the distribution of the granular impulses is not perfectly symmetric, even if the granular kinetic energy is conserved in this closed system...

There was some nonuniformity in the granular distribution of space during its initial stages and, consequently, all the granular fluxes were warped in the regions with high-density gradients. Everything has happened because these primary fluxes were very dense and therefore they behaved as larger granular groups (as bigger granules, see Chapter 3 and the *Elementary Particles* application). Once a flux gets curved and turns into a vortex of the right size, its regular discoidal shape is maintained due to the uniform pressure exerted by the omnidirectional fluxes that flow in any spatial region. The presence of denser granular fluxes and their aggregation in stable formations practically represents the nonlinearity that is superposed over the granular uniformity of space and which changes all dynamics of the system... In addition, this process has triggered important drops in the local entropy, as the above theory of space described. This self-organized system now contains larger components, granular structures of several types. The omnidirectional fluxes, i.e. the gravitational ones, will provide support for the fields that allow these granular formations to interact. The charged particles will speed up or slow down in these fields, creating in this way other granular structures, *the photons*.

Therefore, the huge number of granules and their perfect elasticity, the directional fluxes, all of them have allowed the natural emergence of some big structures with stable shapes, which will further act as new entities - the elementary particles. Quarks have immediately grouped into protons (positive charge) and neutrons, attracting the free, slow electrons; even bigger structures were formed in this way, *the atoms*.

In conclusion, we may say that the initial nonuniformity of space, corroborated with the nonlinearity of the granular dynamics, started a vast process (and likely irreversible) of creation and organization of elementary particles and atoms; these new formations may freely move through the granular fluid and interact with each other through various fields, therefore they may evolve and build more and more complex structures in time. The matter created in this way will indirectly reflect the internal structure and mechanics of the spatial fluid; it will continue to move and transform, grouping and regrouping in fact the primordial energy of space. The gravitational fluxes and the granular collisions will impose dimensional and speed limitations, but their uniform distribution of impulses will allow the inertial movement in any direction with no kinetic energy loss. Moreover, we may say:

- The current density of space is lower than the initial density, and this changes the absolute values of all constants of physics; however, we cannot observe this phenomenon at a local scale.
- The actual level of density no longer allows the spontaneous production of particles and antiparticles.
- Photons and fields are granular structures that are temporarily increasing the local granular density.
- The space is crossed, especially in the vicinity of cosmic bodies, by numerous fragments of particles and photons, and this causes a permanent fluctuation of its local density.

7. The relativity

General remarks on relativity from a granular perspective

Premises, features, causes and effects of relativity

1. As it has already been postulated, an Absolute Frame of Reference may be introduced at the cosmic level and all things will be further regarded to this frame (or observed from there) if it is not specified otherwise.

2. The relativistic effects are produced only in *material systems* (collections of elementary and composite particles - free or organized in atoms and molecules), starting from the quantum scale.

3. The relativistic phenomena are due to the following characteristics of the constitutive elements of the material systems (all granular characteristics were described in my first book, Prime Theory [1]):

a) their absolute speed limit, the speed of light in vacuum, **c**.

b) their granular consistency and this granularity will impose:

- by the absolute granular speed ***C***, this limit of the effective speed, **c**.

- as all the particles are in fact granular aggregations, the uniqueness and simultaneity of their global movement (translation through the three-dimensional space and rotation) - see *Mass-Energy Equivalence* (Chapter 5).

c) an absolute speed limit **c** to the propagation of their interactions.

4. The consequences of relativity (dilations or contractions of various physical quantities, proper ones or observed) are present only in the material systems, starting from the quantum level - we may thus consider all granular structures to which we can assign a dynamic mass. This dynamic mass, as it was already explained in the *Mass-energy equivalence* chapter, changes with the absolute velocity of that structure, and, consequently, all its interactions that might be reflected in the local time will also change. This phenomenon is mainly due to the spatial redistribution of all granular impulses within particles, and these changes actually generate and allow the global translational movement of all

particles. As things are interrelated, any increase of the *translational* speed leads to a decrease of the *rotational* one and to a mass increase; therefore, the frequency of all local interactions - i.e. the rate of the local time - also changes.

5. Gravity causes the same effect, the increase of the dynamic mass in a single direction, similarly producing the dilation of the local time.

6. In order to compare these effects in two different material systems (or two inertial Frames of Reference - FR) we need to know their absolute speeds, not only the relative one (according to the *Theory of the Absolute* [2]). These speeds (if they are getting close to relativistic values) determine the averaged values of the dynamic masses for all particles, and thus they establish the rates of time in those systems (and all the consequences resulting from that). Moreover, on the direction of movement, the relative speeds of the interactions are getting smaller, despite all fields are propagating with the maximum absolute velocity (the value **c**).

7. There are no structures present at the granular level, and the absolute granular speed is constant; consequently, the rate of the granular time is also constant.

8. Photons have no regular dynamic mass (there is no internal granular movement) and therefore they do not satisfy the above premises of relativity. Their changes in frequency - redshift or blueshift - (seen in different FRs) are caused by the Doppler Effect:

- In case the sources and receivers are moving, the effect is caused in fact by the absolute velocity of photons (**c**) and by the nonzero time interval they are produced or absorbed. These things change their wavelength (effectively on emission and apparently on reception) and the shift is depending on the speed at which these transmission and reception apparatuses are moving. At relativistic speeds, this phenomenon may also be explained as a variation of the rate of the local time with the absolute speeds of those devices.

- In the case of variable *gravitational fields*, the effective wavelength of photons changes (and their frequency) when they pass through areas with a granular gradient (variations of the granular density of space or of the fluxes in certain directions). If these gravitational fields are static, the shifting phenomenon can also be explained (within the General Theory of Relativity) as a variation of the rate of the local time with the field strength.

9. As all the particles from a body are continuously moving, the absolute velocity of each of them will vary continuously; when the body's global speed reaches relativistic values, its components will have, alternately, relativistic and non-relativistic instantaneous speeds. The dynamic mass of these components, and hence their local time in relation with the nearby components, will vary in the same way. This body, seen as a whole, will therefore have averaged values (temporal and spatial) for both its mass and local time.

We can easily realize that relativity and its effects are intimately linked to matter and its motion, having as the main cause the granular consistency of all material components and of all the fields that are mediating their interactions. The uniqueness and the absoluteness of the granular energy/impulse, as well as the specific granular mode of binding structures together, are all being reflected in this way at the quantum level and beyond.

8. Time and relativity

The mystery of time, explanation and conclusion

Introduction

This article is a short analysis of the methods used to measure time, of the principles of physics involved and of the various types of equipment specially designed for this purpose. It will also highlight the behavior of these devices while moving at relativistic speed in inertial frames of reference.

What is the basis of time measurement?

Normally, a periodical phenomenon is required to measure time, a cyclic event that repeats at a constant interval; this period should be adjustable, a fine-tuning being required to compensate for the action of various environmental factors. As each period T passes, a certain impulse (may be of mechanical, electrical or optical nature) is sent to a special "counting" device, which will turn it into a human-readable format, into a numerical value. Most of these time measuring devices (clocks) feature some restart or synchronization mechanisms; they allow a clock to start at certain moments or to show the same time as another, distant clock.

Note: Although the term "relativistic mass" is no longer used by current physics, the variation of a mass-like physical quantity (see Chapter 5) with speed is still certain.

8.1. The hourglass

This device can operate with either water or sand, and the measured time interval starts when the bulbs are inverted - the upper bulb being full - and stops once it becomes empty. This interval is proportional, in principle, to the volume of the flowing "fluid" and inversely proportional to the neck width (there are more parameters):

$$\mathbf{T \sim V / D^n}$$

Remark 1: We may presume that the weight of the fluid increases if the hourglass used for tests moves at relativistic speeds (while being in a uniform gravitational field); however, this type of clock is not able to reflect the time dilation stated by the TR.

Remark 2: Similarly, it is not able to reveal any gravitational time dilation (as stated by the GTR).

8.2. The gravity pendulum

This is probably the first mechanical device used to measure time. Obviously, it was not a very accurate timekeeper and, even worse, it is affected by the global movement. In brief, the potential energy of a certain weight is periodically transformed into kinetic energy and vice versa, and the whole process takes a certain amount of time, one second for example. Its period of oscillation does not depend on mass:

$$\mathbf{T \sim 2\,\pi\,\sqrt{L/g}}$$

Remark 1: This clock indicates a time that passes at a constant rate, regardless of the relativistic speed the whole device might have (in a uniform gravitational field), and therefore it cannot show the relativistic dilation of time (TR).
Remark 2: As the gravitational acceleration gets higher, the period of this clock becomes smaller, and this behavior *does not comply* with the predictions made by the GTR.

8.3. The mechanical watch

Its central system is an assembly consisting of a balance spring and a balance wheel. Such a simple mechanism oscillates at a certain resonant frequency, and that period is:

$$\mathbf{T \sim 2\,\pi\,\sqrt{I/k}}$$

where by **I** is denoted the moment of inertia of the balance wheel, directly dependent on its mass.

Remark 1: Although the period obviously depends on mass, the dependency is not linear and therefore the displayed time cannot be accurate in the case of relativistic speeds.

Remark 2: Its period does not depend on the gravitational acceleration, so it is not consistent with the GTR.

8.4. The electronic clock

Despite the *electronic* part in its name, this type of clock is based on the mechanical oscillation produced by a quartz crystal. This oscillator has the period of oscillation given by this formula:

$$\mathbf{T \sim 2\,\pi\, l^2/a \sqrt{12\,\rho/\,E}}$$

where **ρ** is the density of the material, whose value depends on mass. The remarks are thus identical to those of the above-mentioned case (3).

8.5. The atomic clock

This type of clock uses as a reference the electron transition frequency from certain atoms (Hydrogen, Cesium, Rubidium), which may be in the microwave, optical or UV region of the electromagnetic spectrum. SI has defined the second as the duration of 9,192,631,770 oscillations produced of the element Cesium-133, which thus becomes the standard in time measurement. But a frequency standard can also be obtained from the atom of hydrogen (the 21 cm line, given by the spin of the electron), about 1420 GHz, using masers. Anyway, the formula for this frequency is (Rydberg):

$$\mathbf{f = \pi^2\, m_0\, e^4/h^3\, (1/n^2 - 1/m^2)}$$

It may be easily seen that the period is inversely proportional to the rest mass of the electron; if we were to speculate, a relativistic increase of this mass would lead to a "contracted" time (assuming that the other physical quantities involved remain constant).

Remark 1: All cesium-based clocks that were used in kinetic tests have shown correct deviations, almost identical with those resulting from the TR formulas. We may come now to a general conclusion regarding the quantum phenomena that occur at global relativistic speeds: they are influencing the transitions of the orbiting electrons in more complex ways, and many other physical quantities are also varying.

Remark 2: This formula does not depend on the gravitational acceleration; however, the emitted photons will exhibit a gravitational redshift. Therefore, this atomic clock may measure the time in accordance with GTR calculations.

8.6. The light clock

Considering the TR and its postulates, a clock based on a light pulse that reflects on a mirror and then comes back on the same path might show the passage of time in a certain inertial FR - as the speed of light is constant (this is a common example). If this frame is considered fixed, we may measure the value of that period of time, **Δt** for example. If the same light clock is put in a mobile frame (speed **v**), it should measure a larger time interval, **Δt'**, as the light rays have to travel a greater distance until they reach the mirror and come back (the well-known formula of time dilation).

This perspective on things is wrong, as it was previously stated in [2]; a correct view has to be based on the new definition of space, on the new structure of elementary particles and of the absolute nature of motion. Therefore, considering all the TA premises [2], we will consider next an AFR called A (Figure 34) and an inertial frame called B that moves with the absolute velocity **v** along the OX axis. The light rays are represented by blue arrows, vectors symbolizing the relative velocity of the light in regard to the O points. We may easily write down the formulas for all relative speeds in those frames of reference:

$$\mathbf{u = c}$$

$$\mathbf{u_1 = c - v}$$

$$\mathbf{u_2 = \sqrt{c^2 - v^2}}$$

$$\mathbf{u_3 = c + v}$$

If $\boldsymbol{\alpha}$ would be the angle of the light pulses (relative to the OX axis), the general formula would be:

$$\mathbf{u = \sqrt{c^2 - 2cv\cos\alpha + v^2}}$$

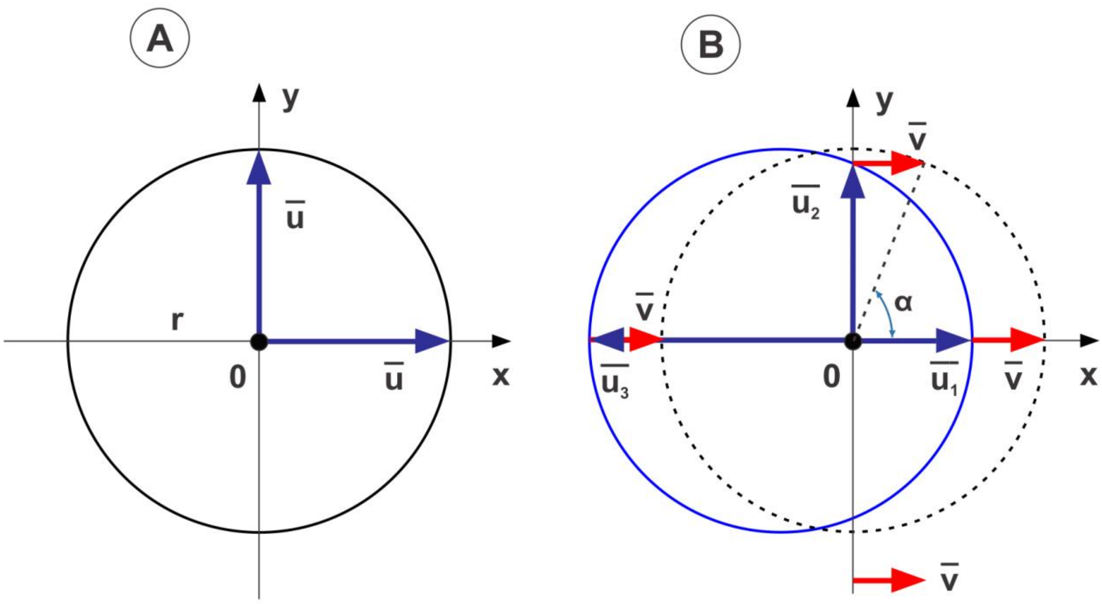


Figure 35 - *Inertial frames of reference*

Even if the light ray (reflected by a mirror) would be used in both directions, the time indicated by this device (of radius **r**) would have a significant dependence on the angle **α**. We may write:

On OX and OY: $\mathbf{\Delta t = 2\ r\ /\ c}$

On OX: $\mathbf{\Delta t' = 2\ r\ /\ (c - v)}$

On OY: $\mathbf{\Delta t' = 2\ r\ /\ \sqrt{c^2 - v^2}}$

Taking into consideration only the OY axis, we will find the classic formula of the time dilation:

$$\mathbf{\Delta t' = \Delta t\ /\ \sqrt{1 - v^2/c^2}}$$

Remark 1: This clock (operating in a vacuum) can measure the time in accordance with the TR.

Remark 2: It can measure the time in accordance with the GTR if we would use the Doppler Effect.

8.7. Conclusion

A general conclusion may be simply drawn at this point: the time cannot be accurately measured at the macroscopic level - as its rate of passage is set at a different scale, namely at the quantum level (this was explained in my article *Mass-energy equivalence* - Chapter 5, where all started with the granular time). Therefore, only the quantum processes should be used to measure time; at the macroscopic level, time is just a reflection, a sum of the relativistic changes that are happening at the atomic level and below. The clocks of types 1 to 4 do not actually measure the real time; they just use some physical characteristics of the macroscopic objects to obtain different delays or oscillations that are not directly linked with the "source" of time.

The primary time emerges from the first level of matter, being connected with the granular kinetical and dimensional constants; it embeds itself in any elementary structure (particle or field) that acts, moves or propagates at the quantum level and beyond.

9. Fundamental physical constants

9.1. Categorization

My previous books and articles have all shown the true nature of reality that surrounds us - confirming the granular model of a closed universe; they have also shown a profound relativization imposed to all physical quantities that describe it. As observers located inside this universe, we are using tools and measuring devices that have the same consistency and granularity as the observed matter; therefore, we will obviously face an objective limitation analyzing and probing the microcosmos. The observational uncertainty will affect any measurement performed under a certain dimensional scale, altering its value. At the quantum level, i.e. the realm where the elementary particles lie, it is all about movement, its particularities, and about its associated laws and quantities. However, as it has already been pointed out, all the rules and physical quantities from this dimensional level are in fact consequences of the motion existing at a lower, sub-quantum level. Here, at the granular level, lies in fact the whole mechanics that allows our Universe to function at any higher scale. We may find there the absoluteness of the motion, but also its inner relativization - if all things are regarded in their complex dynamics and since the beginning. The absoluteness originates from that unique source of matter we mentioned, the primordial essence. At *time zero*, the compact matter has turned into granular matter; this cosmic event has eventually imposed a directional equivalence and an almost perfect uniformity of the three-dimensional space, along with a constant value of the granular impulse/energy. That *intrinsic relativization* comes from the absence, after *time zero*, of any other marks that may still represent the stillness of the unique source of matter. On the other hand, we are also dealing with a subsequent *dimensional relativization*, characteristic to any material structure, which comes from the intrinsic one and from the closeness of our Universe. Therefore, it seems normal to look for a set of true fundamental physical quantities that may completely and absolutely describe the universe and the movement of its structured matter.

1. Considering the previously stated conditions [1], we could now assume the existence of a fixed initial amount of granular material, and therefore the granular number **N** will become an absolute constant of our Universe. To

support this idea, we have to additionally presume that the granular division has definitively ceased after *time zero* and that this phenomenon is irreversible (we can either include or not the division process into that initial moment, depending on the model we choose; however, we will consider here the most recent moment). This really big number **N** has been estimated in a previous article to at least a few googols, thus making our Universe a special large system, where many important data will only have statistical components.

2. As all the granules are identical in shape and size, we can associate them the constant diameter **d**, which, in the absence of any other fixed marks, could be considered as the basic unit of measure for length. If we assume that the initial shape of the essence was also spherical, its diameter **D** simply results as:

$$D = d\,\sqrt[3]{N}$$

3. Once the division process ended, all the granules have reached a constant, absolute speed, which will be further denoted by ***C***. This value of speed holds indefinitely, it is not affected at all by the number of granular collisions (all collisions are perfectly elastic).

4. As being a certain amount of matter in motion at a constant speed, a granule will implicitly possess granular impulse (momentum) and granular energy (kinetic). These are fundamental, constant, absolute quantities that will be further denoted by $\overline{\boldsymbol{p}}$ (vector quantity) and respectively **e**. Note: in any isolated system of a fixed number of granules, these two physical quantities are subjected to the laws of conservation.

5. After that first cosmic event, the isolated system called the universe has undergone a continuous process of expansion, starting from a sphere of an initial diameter **D**. We may assume that the absolute speed of its edge is lower than the speed ***C*** (the model of a closed universe), and therefore there were granular collisions that changed the granular impulses toward the inside of the sphere. It is equally possible that the wall of this sphere "dissolves" itself, sending the granules toward the inside of the bubble. Any model we would take into consideration, these three statements are certain:

- At a global scale, there are no privileged granular directions; this declaration will simply lead to a basic granular postulate related to the quasi-null vector sum of all granular impulses.

- The granular density had a maximum value in the beginning (granules were very close to each other), then decreases with the geometrical expansion of space.

- There were small nonuniformities in this granular system; anyway, the entire system tends, at any scale would be regarded, to automatically increase in uniformity.

6. We could also define a granular time, a quantity derived from the granular speed and diameter, which would have a constant rate of passage. However, it would be a kind of virtual quantity, neither fundamental nor very helpful to this set of constants.

7. The granular density, as well as the average intergranular distance, is not a constant quantity (as it was already described in [1]). Instead, both of them are very useful in some calculations (as of the pressure exerted by the granular fluid on compact structures) and they will be included in this basic set as $\boldsymbol{\rho}$ and respectively $\tilde{\boldsymbol{r}}$.

8. Certain granular gradients have appeared in space just after the bang moment (Chapter 1). The granular collisions and the high density allow us to give a simple explanation on how the omnidirectional fluxes crossed these areas and formed many rotational, compact structures (Chapter 3). All these new structures got stable shapes and sizes shortly, adapting continuously to the decrease of the granular density (to the pressure exerted by the spatial fluid). This decrease in density had two main causes:

- The formation of compact granular structures - the elementary particles - representing a significant percentage of all granular material, about 5...30%.

- The volumetric expansion of space, which automatically produces a "dilution" of the granular fluid.

The omnidirectional granular fluxes generate a well-known phenomenon called gravity and maintain the shape, size and stability of all elementary particles that spontaneously emerged during the period of high granular density. Considering their origin and the huge spatial volume where they were generated, these fluxes will be almost uniform at any scale.

We presumed only two stable shapes for the elementary particles (and their antiparticles), the flat disk (electrons, positrons and quarks) and the torus (neutrinos). However, there are some other stable formations, such as the gluons that bind a composite particle (two or three quarks) together, and some unstable ones. The side surfaces of the discoidal-type particles have a certain concavity; this geometric feature gives them the important "electric charge" property. Furthermore, all these particles execute an internal, continuous motion of precession characterized by the parameter called *spin.* These latter features lead to the emergence of some force fields around particles, namely the electric and magnetic fields. They can (all these fields are constituted of *electrophotons*) cause interactions at a distance, i.e. they may exert certain forces on other particles.

The regular photons, as well as the electrophotons, are granular structures of a specific shape (fixed or dynamic) that results from concentrated granular fluxes, but they are not compact formations. Therefore, they can only propagate through space at the maximum possible speed (which is influenced by the local granular density). The maximum speed of photons will be denoted by **c**; this derived quantity results from the granular speed ***C,*** the local granular density ***ρ*** (which also includes a certain probability) and the duration of a granular collision. The formula of the maximum speed through the empty space is (speed of light):

$$\mathbf{c = \mathit{C} / (1 + \rho\, \tau\, \mathit{C})}$$

where **τ** is the average duration of the granular collision (it depends on the granular diameter and on the elasticity constant of the primordial material).

Any change of the granular density affects the intensity of the granular fluxes, i.e. the pressure exerted by space on all compact granular structures. The balance between the momentum transferred by the granular space and the internal, rotational one, determines the shape and size of any elementary particle. These dimensions will modify some other quantities, such as the electric charges and therefore the strength of their electric fields. However, all these things are included in the global *relativization* that every physical quantity is always facing, one particular phenomenon that induces in turn certain *constancy* to all the values we can measure. It will be very difficult to work with the absolute values of the fundamental physical quantities, but this thing could bring us much closer to their physical significance.

9. As it has already been described in my first book [1], the quantity named *mass* can be interpreted as the amount of external impulse required to change the state of motion (in fact the internal impulse) of a certain particle. Obviously, the mass of a particle primarily depends on the number of constitutive granules and on the value of the granular impulse. However, the movement of a particle is quite complex, being in fact a combination of internal precession and external translation/rotation (produced by the nearby fields). This re-orientation of all internal impulses will change, in the local frame of reference, the ratio between the rotational movement and the translational one (global, averaged, absolute). The "speed" at which this particle will interact with the other ones (through various fields) will change in this way, and this is equivalent to a decrease in the rate of local time. This relativistic phenomenon also involves the increase of the particle's mass (through the mechanism described above), which will be cumulatively reflected at the macroscopic level. We may actually redefine relativity (the one coming from the movement of any material structure) as a change of the internal balance between the *absolute* (internal movement) and *relative* (external one).

10. In principle, the *mass* may only characterize a structured granular formation whose density is higher than the local one; therefore, it is natural to see the *energy* associated with this mass as a structured formation of granular energies. Any particle has a certain amount of mechanical energy (kinetic energy) and its movement through the granular fluid changes the ratio in which this energy divides into rotational (internal) and translational (external) kinds. The eventual acceleration caused by a field to a particle means the action of a certain force whose magnitude is given by the amount of momentum transferred in the unit of time. The energy is neither created nor destroyed at the granular level, it only changes its structural configuration at a given moment, concentrating in various particles or fields.

9.2. Conclusion

We have identified eight fundamental physical quantities that fully characterize our Universe at the granular level: **N**, **d**, $\boldsymbol{C}$, $\overline{\boldsymbol{p}}$, **e**, **τ**, $\boldsymbol{\rho}$ and $\tilde{\boldsymbol{r}}$; first six quantities are fundamental physical constants, while the last two are correlated and both are depending on the expansion of space. The granular diameter **d** could constitute itself a distinct unit of measure which could characterize the global relativization within this universe. We may imagine some complex models that would include all these constants; any type of particle, atom, field and photon may be completely described by these models and we may deduce all their derived quantum properties. Normally, any other physical quantity should be somehow connected via certain mathematical formulas with these defining constants, at any scale. These eight constants are therefore completely giving our granular Universe and its actual dynamics.

10. The size of our Universe

10.1. The current vision

Let's assume that the current theories regarding the Universe's birth (the Big Bang theory and the related inflation), as well the calculations of the age of various stars/galaxies, are all true; therefore, we have to deal now with a very large material system, which appeared about **13.7** billion years ago (current years) and which suffers a continuous process of expansion. What exactly is this scenario hypothesizing? A "singularity", i.e. an infinitely dense point of matter and energy, undergoes a sort of explosive process and generates the tridimensional frame named space; this not very well defined void is full of energy and it will be immediately populated by the first elementary particles and their formations. Very interestingly, the initial expansion process of this newly born space had a superluminal speed - several orders of magnitude above the current speed of light. However, in order to comply with the actual laws of physics, scientists considered it an inflationary process, an intrinsic increase of space in itself - and not a real transport of matter, whose speed should have been lower than the actual speed of light in a vacuum. The particles and atoms were uniformly distributed within this empty space, and here comes a small question. How space did "stretch" differently at the initial and later moments, carrying and, at the same time, not carrying the matter along with it? Anyway, after a few hundreds of millions of years, the stars formed the first galaxies; space is still expanding but at a much lower rate. Many scientists are considering that only the space between galaxies continues to expand, while these huge stellar formations will keep their structure and size due to gravity. Space, regardless of its mysterious internal consistency, does not actually drag the matter along with it. The current cosmology claims that the galaxies are not taking part in the global expansion of the universe, a process in which some of them should have already reached superluminal speeds. No, they are traveling in fact at a few **hundreds** or **thousands** km/s relative to the **CMB**, in their galactic clusters. What is actually "moving" out there, justifying the size of the cosmological redshift **z** for distant sources, is only the space itself. The Doppler Effect, mostly relativistic, produces a significant redshift to the light of these sources. However, the distant sources do not move with those computed speeds for real; that shift of the color spectrum (seen by a presumed stationary observer) is only due to the expansion of space. All the other contributions (gravitational effects, rotational movements, stellar dust and cosmic gases) have been practically ignored in these calculations of the redshift.

One particular case is the quasar **ULAS J1342+0928** (a black hole); it has a measured redshift of **7.54**, which means its light has been emitted about 690 million years after the Big Bang (13.1 billion years ago). This quasar is therefore located at a distance (the expansion of space was taken into consideration) of 29.36 billion light-years from Earth. Similarly, it may be mentioned here the oldest and most distant astronomical object, the Galaxy **GN-Z11**, which has a redshift z = 11.09 and its age is about 13.4 billion years. Its proper distance is also very big, 32 billion light-years.

10.2. The granular vision

As many of my previous documents have stated, the space is only extending in a geometric manner (by addition), while its granular component automatically fills any empty zone that appears in the process. Therefore, if we consider only this granular component of space (it has a constant number of granules and dictates, in fact, all the properties), we may realize that space undergoes a continuous process of *dilution*, not one of *dilation*. In conclusion, at the time the first galaxies were formed, the average granular density of space was higher than today (but lower than that existing at the time of CMB emission). For this reason, some of the so-called constants of physics changed their values over time, while others remained unchanged. In the same way, due to the complete relativization of our Universe, some of the derived physical quantities remained relatively constant over very long periods of time.

10.2.1. The rate of time

Here is a short description of those types of time that were previously defined at each dimensional level of reality and which are connected to the movement of matter and to the propagation of some fields.

a. *The granular time* (virtual) is determined by the existence of the granular movement and by its constant speed. Therefore, this time features a constant, absolute rate of passage, being regarded as a source of time for any higher dimensional level (see The Universe [2]).

b. *The local time* is associated with elementary particles. As their internal movement (the intrinsic precession, determined by their granular structure), may be partly distributed into an external translational movement - the granular time may be similarly distributed into particle's local time, whose variable rate is dictated solely by the particle's absolute speed. Additionally, we may presume that the local time is not significantly affected by the changes of the granular density of space.

c. *The quantum time* is associated with structures, i.e. with the composite particles and their formations - atoms and molecules bonded in various systems. This kind of time has a variable rate of passage, as all the movements and oscillations of the system components are having variable frequencies (which depend on their interactions through fields). It is also relevant in this context how the gravitational field, its nonuniformity in fact, causes a slower rate to the local time. The source of quantum time is the particle's local time, which is exactly the time described in the preceding paragraph. The local granular density changes the intensity of all gravitational fluxes (we presume that their nonuniformity remains almost constant as ratio); however, the quantum time is not significantly affected by this due to the intercorrelations imposed by the global relativization. Even if the rate of this kind of time would change with the granular density, this will be indirectly reflected only in the shift of atomic spectra (which are assumed unchanged here).

d. *The normal time* is associated with a particular macroscopic system and represents the average rate of the quantum time experienced by its component particles. This kind of time is therefore dependent on the absolute speed of that system and on the local gravitational field (more precisely, on its nonuniformity caused by the nearby masses).

In conclusion, all these definitions of time are leading to this idea: a unique rate of time may be used globally, for our entire universe (presumed quasi-stationary); this includes the moments when the first galaxies were formed - and when a higher value of the spatial granular density must be considered. Moreover, a certain mathematical formula may be used, in which the *absolute* distance traveled by light could be expressed as a product between the speed of light (lower than the current one) and time (of constant rate). Estimating a "flat" geometry of space (seen as an isotropic continuum) and ignoring its variable granular density, we may have perfectly straight trajectories for all photons; therefore, the total distance they have traveled could be mathematically expressed as a sum of the distances covered at different speeds. As a special particle that consists of concentrated granular fluxes, a photon may only move at the maximum speed allowed by the density of the local space. For now, the gravitational fields that could curve its path or any other abnormalities and gradients of the granular density of space will not be taken into consideration.

10.2.2. The photon energy

Here are a few considerations on those photons that have originated from distant galaxies (sources). These "old" photons have traveled for several billion years to an Earth-based observer and most of them show a significant redshift. We are not including in this analysis the photons emitted by closer sources (let's say less than a billion light-years away); the majority of them underwent a normal, not relativistic Doppler Effect (at source and destination) that produces either redshifts or blueshifts, according to the recession velocity. Their variation in energy is directly determined by this phenomenon and it is fully explained by the current laws of physics. As we already know, all photons coming from very distant sources have a significant redshift, i.e. an increase in their final wavelength; this frequency decrease implies an energy decrease, which is not coherently explained by the current theories of astrophysics. For example, with all the presumed expansion of the empty space, the loss in photon energy could not be simply transferred to space, "heating" it in some way as a direct result!

However, the granular perspective allows us to give a simple explanation for this phenomenon. Let's consider, as shown in Figure 36, a photon denoted by **ν** (which was emitted when the first galaxies were formed, about 13 billion years ago, and which is observed today on Earth). The precise manner in which the absolute speed of photons depends on the granular density and how this density has continuously decreased over time were previously described in Chapter 1.3. Thus, the formula for speed is:

$$v = C / (1 + \rho \tau C)$$

At the time that photon was emitted, the granular density was $\boldsymbol{\rho_0}$ and the speed was $\mathbf{v_0}$, while now the density is $\boldsymbol{\rho}$ and the speed is $\mathbf{v = c}$ (the current speed of light in a vacuum). How exactly the granular density evolved over time is not known yet, but for this logical argumentation is not even necessary; we will further consider that the speed of light has increased linearly in the past 13 billion years, from about 30,000 km/s up to 300,000 km/s today (it varied more abruptly before this period, and from significantly lower values).

Using this formula $\mathbf{1 + z = \lambda_{obsv} / \lambda_{emit}}$, values greater than one were obtained for **z**; for example, the CMB photons (they have been emitted 379,000 years after Big Bang) have a very big value, z = 1089). These extreme values helped scientists to calculate the "distance" to the source: a mind-blowing value of 46 billion light-years for the radius of the observable universe. In other words, they say we can actually see the early galaxies (which are located at proper distances much larger than 13 billion light-years) despite the continuous dilation of space during that period. As a remark, this thing may give the false impression that those galaxies moved at superluminal speeds.

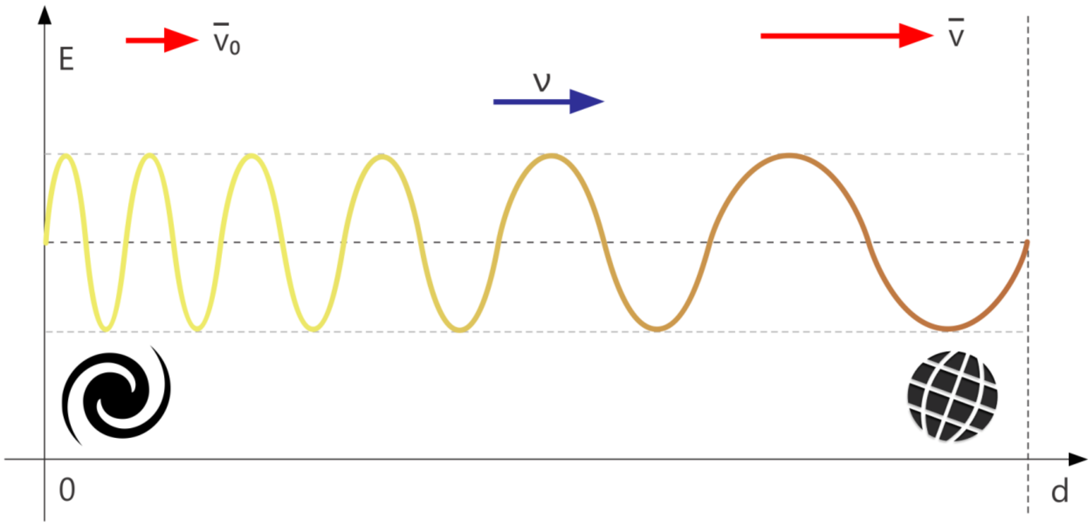


Figure 36 - *The redshift of light*

Returning to the granular perspective, we have to remember the specific granular structure of photons, which is a multilayer double spiral of a certain length and whose average density is greater than the local one. A photon emitted by a distant galaxy has traveled for billions of years, crossing regions of space with decreasing density. During this journey, its form gradually changed (the length in fact) and its speed became higher and higher (a quasi-linear increase is considered for now). If we presume an *absolute geometry* of space and we relate these things to the actual physical constants (lengths and speeds), we can realize that the redshift of photons has been only caused by the increase of their absolute propagation speed. Moreover, if we assume that the duration of one photon's journey through space is 13 billion years, the traveled distance can be simply calculated and we can make an estimation of about *8-9 billion light-years* (this kind of reduction is also valid to the closer sources - under one billion years - but in a smaller proportion). In other words, the sphere of the observable universe has to have a similar radius value, *much smaller* than the official one. Even so, as these very old galaxies are observed in all cosmic directions (assuming no relativistic speeds for all of them), we may still picture an observable universe (in the beginning) of very large dimensions - which could be only formed in a superluminal expansionistic process. In order to explain this in granular context (where the granular speed shall not exceed the value ***C*** and the geometric space is not deformable), another model of the universe's birth (a distributed one) was imagined in Chapter 1.1. Anyway, even if this new radius value is correctly estimated, our Universe will always be bigger than the observable one and it will likely continue its expansion.

As the redshift is a certain phenomenon, we have to find out now what exactly is happening to the photon energy and whether this energy is always conserved within the cosmic system. Simplifying all these things, let's now make a thought experiment and focus only on the points of departure and arrival of the photon above, as shown in Figure 37. These are two separate points that are very distant in space and in time. Metaphorically speaking, they even belong to different universes (whose short names could be $\mathbf{U_1}$ and $\mathbf{U_2}$, for example). Although both U_2 and U_1 are included in the same big universe, some of their fundamental physical constants are quite different. The whole universe is in fact a dynamic system that changes over time and extends spatially, regardless of its "open" or "closed" attribute. We can see all these things in an absolute manner and relate them to the current metric, but we must not forget about global relativization. In particular, as time goes by, some physical "constants" - such as the granular density or the average granular distance - are changing. The universe U_1 had a greater granular density in the beginning, and therefore its absolute speed of light was significantly lower in comparison with that of today (in U_2). Similarly, the mass of the elementary particles and their electric charge were different; seen in the context of the global relativization and without precise modeling, we cannot say, for example, if the light emitted by the first hydrogen atoms had *exactly* the same frequency as of today. However, for the sake of simplification, let us consider that the structured matter's "physics" was the same in both universes and only the absolute speed of light differs significantly.

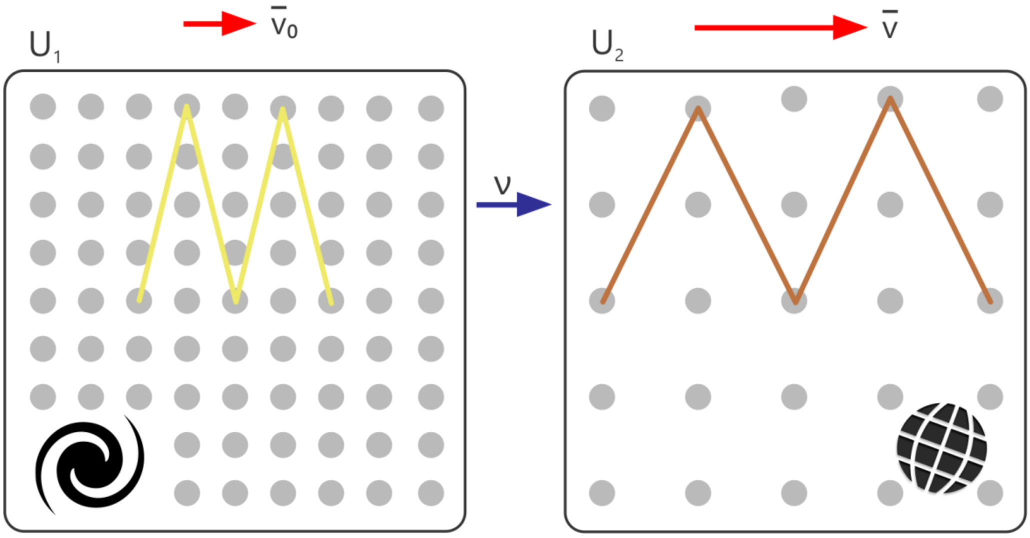


Figure 37 - *A photon in different "universes"*

Once these additional assumptions were made, what can we say now about the photon energy? A simple conclusion may be drawn at this point: if we were local observers in those two universes and we would relativize all the measurements to the local physics, we might practically obtain as a result the *same* amount of energy for that photon. This amount of energy would only change if the photon crosses the "barrier" between the two universes and if we make an *absolute* comparison, considering that these universes are identical. In other words, the energy of our photon (and its proportionality with the frequency - the Planck "constant") does not change in fact; only the physics of the universe is changing. The difference in energy is actually zero and the law of energy conservation can be perfectly applied in this case - if it is adapted to the local physics (constants) of certain space-time regions. No energy is taken or given to space by photons; space is only changing its characteristics over time due to the decrease in granular density. It is also relevant in our case the way this transition between different universes is made, gradually and slowly, over billions of years.

11. A unique reality

Relative vs. Absolute - the end of the battle

11.1. Introduction

The reality that surrounds us is based on a very simple mechanism, as it was already described in my first book, 'Prime Theory'. A few exact rules may describe exhaustively its intrinsic mechanics, up to the largest cosmological scales. Among them, causation occupies a very important place and gives humans, as rational beings, the special possibility to fully understand everything. Precise theoretical models allow us to cover the whole story of the Universe, from the very beginning, to understand its evolution and to make predictions for the near and distant future.

A lot of theories and models of modern physics, even the strange ones, often give extraordinary results in limited areas, such as the Standard Model for quantum physics or the GTR for macroscopic physics. However, a "theory of everything" is missing in this picture; this kind of theory is definitely required to harmonize the current models of reality - as we are dealing, obviously, with a *unique reality* and a set of *unique rules,* no matter the scale.

Thus, 'Prime Theory' was intended to be a complete model of reality: it formulates the rules governing our Universe at any scale, reveals the initial absoluteness and its reflection in all material structures, and shows the common denominator of gravity and fields. Moreover, the 'Theory of the Absolute' even allows the integration of the well-known 'Theory of Relativity' into this new paradigm.

All these visions on a unique reality should lead to a unique descriptive framework, both physically and mathematically. We cannot apply TR in any context, ignoring the absolute that characterizes the movements of matter. It is impossible to have, at the same time, a functional framework for relative movements, where any IFR is perfectly equivalent to another - describing in this way a kind of self-closed, limited universe (however elegant would be this concept), and a framework based on absolute at any scale, where the granular movements determine the state and functionality of all material structures, generating a global spatial nonuniformity. Definitely, there is a limitation for speed in our Universe; and it is not directly related to the speed of light in a vacuum, but to the absolute granular speed. Similarly, an object cannot move at any "speed" through the so-called space-time continuum, and this limitation also originates at the granular level, being of absolute nature.

11.2. The basic assumptions of TR

Let's consider this big laboratory named Earth, a place where we can make almost any type of scientific experiments. Here are the general conditions of this lab, seen now as a frame of reference:

- The rotation of our planet around its own axis (0.46 km/s) plus the revolution around the Sun (at about 30 km/s). Moreover, our solar system rotates around the galactic center while it also moves, along with the entire galaxy, with a constant speed (relative to the CMB); overall, we might consider that Earth has an absolute movement, uniform and linear, at about 400 km/s. This velocity will vary slowly in time, as both direction and value, and these changes can easily be measured. However, the whole system can be regarded as being inertial over short periods of time.

- Dense atmosphere (but transparent), made up especially of oxygen and nitrogen; the atmospheric pressure is approximately 760 mm Hg, and the refractive index is 1.000293 for light (λ = 589 nm).

- Weak gravitational field, a relatively constant gravitational acceleration (9.81 m/s^2) on the surface.

This local "universe" allowed physicists to measure the speed of light, more and more precisely, and to eventually declare it a constant. Therefore, an exact value was established for the speed of light in a vacuum, 299 792 458 m/s. Having regard of the refractive index above, the speed of light in the air reaches the value of 299 702 547 m/s - about 90 km/s slower than **c**.

There have been many measurements (performed in the open air and ultra-high vacuum systems) in which scientists like Michelson and Morley tried to detect the slightest variation of the speed of light. In essence, all these measurements have generated almost constant values for this speed, which are not depending on the direction of propagation; this observation quickly forced physicists to reject the concept of a special "ether" that may serve as a medium of propagation and speed limitation factor. To postulate that the speed of light is a universal physical constant, being identical in any inertial frame of reference, was the logical conclusion of all these trials. Furthermore, the ideas that all reference systems are equivalent and the laws of physics are the same in all inertial reference frames (are invariant) were widely accepted. In other words, the speed of light does not depend on the speed of the source and any observer will measure the same value for this speed.

All these things seem to be correct in a profound relative world, where everything moves and an absolute reference point, to which we could relate the motion, cannot be pinpointed. From a certain inertial frame of reference, an observer will therefore see a "limited", "uniform" world, where nothing can have relative superluminal speeds. Based on these equivalence hypotheses, the Theory of Relativity (the special one) has automatically concluded that you can move through space and time at any speed - less or equal to the speed of light, but not simultaneously; therefore, space and time may be regarded as a single entity - called spacetime. Also, the local time becomes relative; it slows down once your speed approaches the speed of light.

Unfortunately, TR is not based on the fundamental mechanism of things; it builds, yet starting from concrete and correct observations and measurements, a mathematical model that is an imperfect reflection of the objective physical reality. The basic assumptions of TR were shaped in accordance with the measurements made in the "earthy universe"; then, the TR was simply extrapolated to the cosmic scale. All these adjustments and generalizations have created a partially accurate framework, distorting the natural perspective we should have on concepts like spacetime and matter.

Paradoxically, the concrete results we can obtain by applying TR are quite accurate. We can find several reasons leading to this, and among them are the *low speeds* of the planets in the solar system and the *low speeds* of the man-made vehicles and rockets (most observations being performed on Earth or inside the solar system). All tests and analyses should be extended, in principle, to more distant regions and to higher speeds.

11.3. The basic assumptions of TA

Obviously, it is very difficult to disprove all these assumptions that are backed up with a multitude of experimental data and all the good results that follow the TR calculations. However, could we imagine a wider framework that may allow better explanations of reality and where TR could be just a particular case? A new framework, complex enough to allow us to absolutize the movement and eliminate, conceptually, the quasi-total relativization observed in all experiments made on Earth?

Einstein might have said once that relativity is sufficient to fully explain the world and its physical laws, and to introduce an absolute frame of reference is an "unnecessary complication." In my humble opinion, this affirmation oversimplifies things, eluding some essential features of matter and of its dynamics.

A more complex framework, based on the granular model of space, was introduced in my first book [1]; it can better describe the movement of matter, at any scale, and redefines most of the fundamental physical quantities. This framework was later extended (see the book [2]) in order to include an essential element - the intrinsic absoluteness of our Universe, and this automatically led to some important changes in all TR's postulates.

This new theoretical construct started from a simple postulate about the constancy and absoluteness of the granular speed; this speed, denoted by ***C***, has been further considered a universal constant (as in [2] and Chapter 9], where AFR means the absolute frame of reference). Consequently, the speed of photons in a uniform granular medium is also constant and absolute (its value is only depending on the density of the spatial fluid).

Therefore, the postulate of TR that states the constancy of the speed of light in any IFR is not a universal truth, being in fact a particularization with old observational roots on Earth; it must be adapted and extended to the entire universe (see my new version in TA [2]). Moreover, the laws of physics are the same in any IFR, but the proper states of all objects are changing with absolute speed. These two postulates of TA are (in a simplified form):

- The speed of light is an *absolute speed* in this universe and, at the same time, an upper limit for the actual speed of any granular structure;

- The laws of physics are *the same* in all inertial frames of reference, but their parameters depend on the system's absolute speed and direction (in regard to an AFR).

The Theory of the Absolute [2] involves material objects in motion and specifies the way their absolute movement affects their internal states:

The proper state of a body in uniform motion can be fully and accurately determined only if its absolute velocity is known (as both magnitude and direction).

For example, the local time of an object will only depend on its absolute speed; obviously, it will differ from the local time of the other objects that travel at different speeds, but the difference between their rates of passage does not depend directly and exclusively on the relative speed.

11.4. TR and TA, explanations and implications

These two theories are apparently irreconcilable, although they both claim a constant speed of light in a vacuum; TR claims that the relative movement is sufficient to fully describe the local "physics" of a moving object, while TA says that we must know the absolute speed for a complete description. TR is thus limiting the perspective we may have on the surrounding "world" from an IFR, while TA enlarges and globalizes it. However, as the surrounding reality is something unique, we, therefore, may fully describe it by a single, global and accurate model. The particular case in which these theories become mathematically compatible was previously shown in [2]; briefly, this case presumes that one of those two IFRs to move "relatively" with respect to an AFR and then to apply TR only on it. Thus, we may measure and obtain the same speed of value **c** for the light emitted in any direction. Considering this, could we embed TR into TA and continue to use the good results yielded by relativity, just changing the context where it applies? Anyway, we have to explain the real physical phenomena and to give some concrete examples before answering this question and drawing a well-informed conclusion.

Firstly, let's go back to our earthy lab and to its granular characteristics. Ever since my first model [1] was conceived, the granular fluid (the medium in which all material bodies, particles and photons are immersed) is thought to be a special fluid made of countless spatial granules that move with the absolute speed ***C*** (estimated to be at least **1.4 c**). At this level, the rules of simple mechanics allowed us to identify the gravitational fluxes and to describe the movement of matter of any kind (with respect to the AFR - that universal, privileged, fixed frame of reference). But what happens on the Earth's surface? Is there something changed in this granular framework? If our laboratory has this absolute speed (about 400 km/s in AFR), then why don't we get different values for the speed of light in different directions (the measuring accuracy of 1:1000 now being accessible)? The short answer is yes, there is a change in this framework and it simply explains the identical values for speed.

As it was shown in Chapter 2, the granular fluxes that flow near the surface and in the vicinity of big cosmic bodies undergo some substantial changes. These fluxes, no matter if they were reflected or if they have crossed a body, are "modulated" by the particles from inside that structure (we saw how the granules are reflected by particles - which are completely opaque to fluxes). As the constituent particles are continuously moving, vibrating and rotating, the quantum-scale modulation will vary accordingly. Certain regions of space around the cosmic body are thus crossed by fluctuating granular fluxes; the intensity of these continuous *fluctuations* is very low, much smaller than the global gravitational nonuniformity caused by the "opacity" of that body (as shown in Figure 38, where the flux fluctuations have different shades of gray in a two-dimensional representation). The intensity of the granular fluxes inside those squares varies in time, but its value oscillates around the local average level (which only changes with the distance to that body). The surface area of those shifting squares is comparable to the size of elementary and composite particles; this dimensional approximation is a simple deduction, as the particles themselves and their movements are the sources of this phenomenon. All these changes of the granular fluxes (which also mean changes in the local granular density) allow us to state the general existence of random and continuous fluctuations at quantum scale in any area around a massive cosmic body, overlapping with the nonuniformity of the local gravitational field.

In other words, the spatial fluid of any region inside and around a cosmic body (planet, moon, star) undergoes a new kind of "granularization", now at the quantum scale. The intensity of this phenomenon, which will be named

Quantum Gravitational Fluctuations - QGF, decreases with the square of the distance to that body. This new concept is similar to the *quantum fluctuation* of modern physics (defined as a variation of the amount of energy in a "point in space"), but it does not involve the creation of pairs of virtual particles and does have a concrete dimensional attribute.

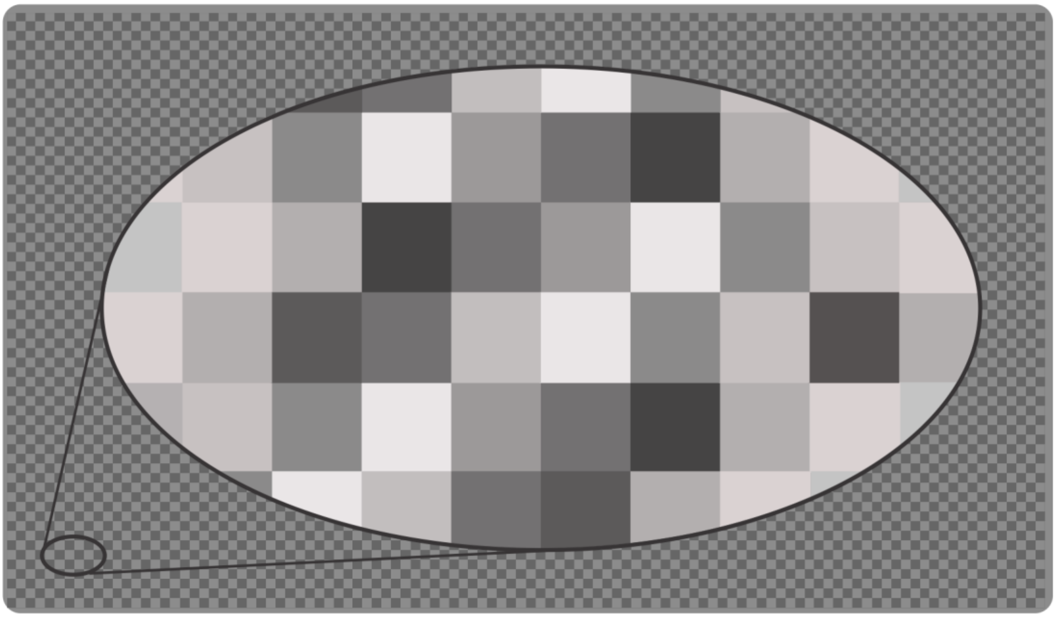


Figure 38 - *A two-dimensional detail of the granular fluctuations*

This new quantum granularization has another interesting feature, it accurately reproduces the global movement of the particles (and thus of the entire body) that generated it. For example, an observer from a space station orbiting the Earth may see how such fluctuations move synchronously with the rotation of the planet around its own axis, in the same direction. The effects of this new spatial granularization are very important, and they all are listed here.

Explanations

A) Let's imagine now a laboratory placed on an alien planet (an Earth-like one); this planet does not rotate around its axis, it just stands still in space (in regard to an AFR). Figure 39, the upper picture, shows the possible quantum granularity of a horizontal surface, a simplified picture that would be displayed by a hypothetical measuring instrument (in vacuum). Two photons, $\boldsymbol{\gamma_1}$ and $\boldsymbol{\gamma_2}$, are emitted by a light source in opposite directions and travel through this quantum granular medium (drawn with equal-size, black and white squares) at the same speed **c**. The granular density of this medium is considered uniform in any horizontal direction (we will further ignore the negligible effects of gravity on light).

B) Going back to our laboratory on Earth, we remember that it rotates along with the planet - its angular speed being **ω** and the peripheral one **v**; the measuring instrument should show the same distribution on a horizontal surface, as it moves simultaneously with the laboratory and the planet's gravitational field (we currently ignore the revolution and the global motion). Two photons emitted by a light source should have an absolute movement through space, traveling with speed **c** in opposite directions); each of them will practically "see" a different medium, a different quantum granularization. Figure 39, the middle picture, shows the structure of this new medium crossed by the two photons; the right side reveals a larger granularity, the photon and the medium having the same direction of travel and their relative speed being **c - v**. Things are reversed on the left side, where the relative speed should be **c + v**. Taking into consideration the formula of the speed of light in a granular medium (Chapter 1.3), i.e. its variation with the granular density:

$$\mathbf{v_{light} = C \,/\, (\,1 + \rho\,\tau\,C\,)}$$

in conjunction with the apparent decrease and increase of density to the right and respectively to the left, we may easily realize why photons have undergone a real variation of speed and how they practically "changed" their absolute point "zero" in synchronicity with the global motion of their medium. Photons move in fact with the normal speed **c** in both directions, but with respect to a new AFR, namely the lab's IFR.

What if those two photons were emitted on the OY axis, upwards and respectively downwards? Obviously, they will follow the new "straight path"; while moving along the axis at the normal speed **c**, both photons will be "dragged" to the right with the speed **v**. Their initial directions, presumed to be of an absolute kind, are changed and adapted to the local IFR's velocity.

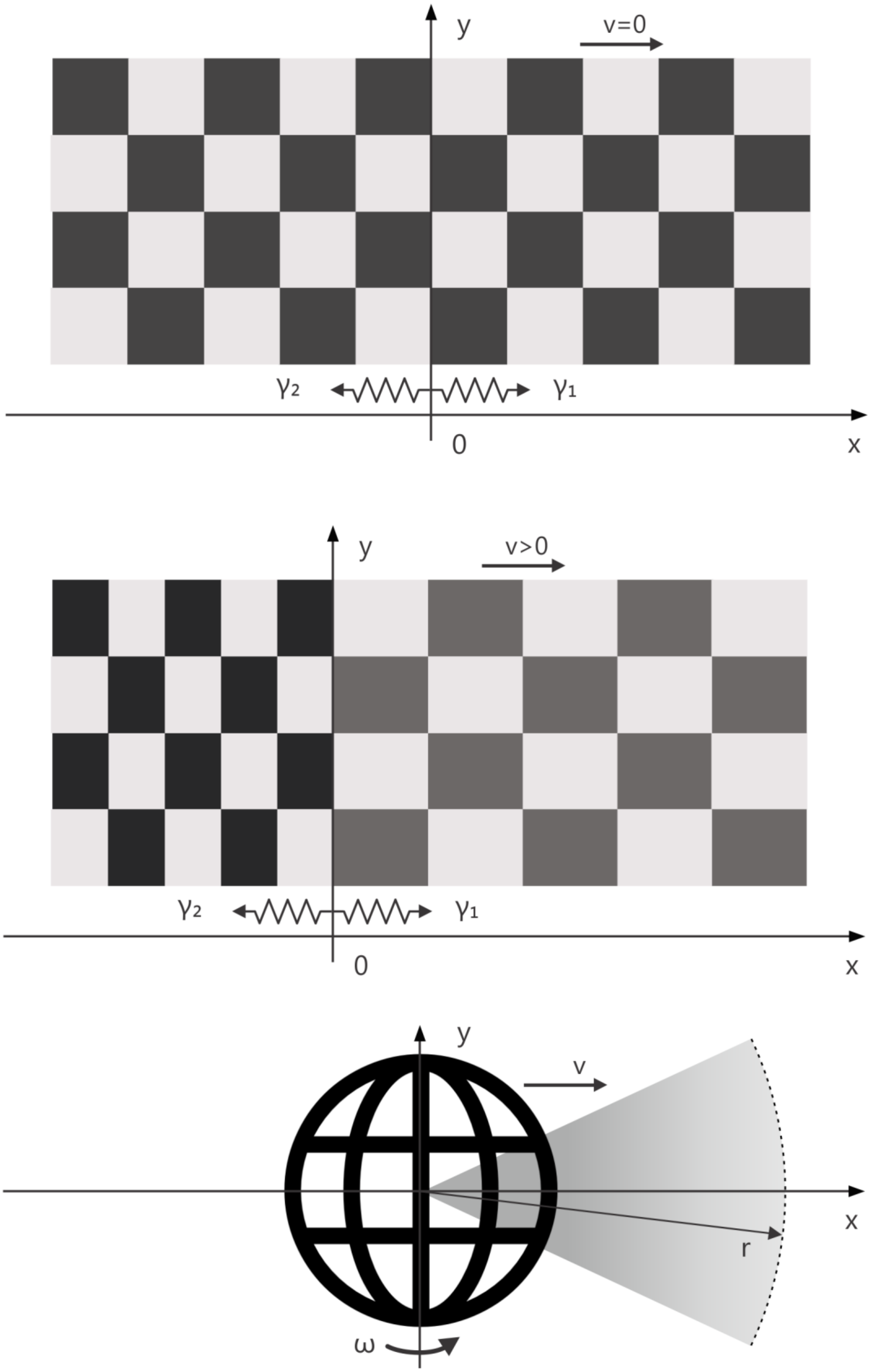


Figure 39 - *Quantum gravitational fluctuations in AFR and IFR*

We are facing a significant change in the entire local physics, caused by the inherent "absolutization" produced in any IFR that moves synchronously (the same speed and direction) with the source of the gravitational field. The QGF phenomenon (which is in fact determined by gravity, i.e. by the presence of a massive body in space) becomes dominant in all regions where the gravitational field has significant strength - inside a sphere of maximum radius **r**, as in Figure 39, the lower picture. At this distance, the amplitude of these quantum fluctuations gets very small, reaching the normal level of the empty space. However, the gravitational fields and their fluctuations superpose in a point in space; thus, the most intense source will impose the physics in that place.

Implications

A) Experimental detection of that "ether", made by measuring the speed of light in various directions (Michelson-Morley type experiments), cannot have a positive outcome, even in a perfect vacuum. The QGF phenomenon occurs at the granular level, changing the fundamental structure of space; it will affect any measurement, in any direction (inside that sphere of maximum radius). In order to succeed, this kind of experiment must be carried out in a distant place (far away from the gravitational fields). As an alternative, the light sources should move at significantly higher speeds with respect to the "local absolute".

B) This change of the local physics involves changes in the physical movements of particles and atoms; the entire dynamics of the quantum "world" is practically affected by the new "local absolute".

C) If we leave the Earth's sphere of influence, Sun would be the next major player in our solar system; farther away, the galaxy and its central black hole are also counting in this picture. However, the intergalactic space is in fact that cosmic region with no such quantum fluctuations.

D) It is obvious now that TR may be applied successfully in this local absolute frame. All postulates of special relativity are therefore valid in these systems with local gravitational fields and low absolute speeds, and the adjacent constructs (Lorenz transformations, Minkowski space, GTR and its formalism) are now making perfect sense.

E) What is the absolute speed one massive body may have so that the QGF phenomenon would still cause the absolutization of the local physics as described? The answer depends on the exact value of granular speed ***C;***

if we consider $\boldsymbol{C} \cong \mathbf{1.4\ c}$ (as in [1]), we can estimate the value of that maximum speed to $\boldsymbol{C}$ - $\mathbf{c} = \mathbf{0.4\ c}$. This quantum phenomenon is thus present in most cosmic systems (including Earth, with its absolute speed of about 400 km/s).

F) Does the local time of these systems differ from the Universe's absolute one, of maximum rate? Yes, time is dilating in these systems, all their components move at a certain global speed that produces changes to the granular impulses of particles. Therefore, the temporal comparisons made in [2], Chapter 3.4, are all valid; we have to pay more attention when we leave the relative zone of a gravitational field and apply TA instead. The rates of time must be compared by using TR inside of a system and by using TA between different systems or places.

G) Let's now consider an ideal system, free of gravity (for example a spaceship crossing the intergalactic space), where we would like to measure the local time. A light clock will be used for that purpose (like the one described in Chapter 8.6); all TA conditions are fulfilled and the absolute speed of the ship, **v**, is known. With respect to the local IFR, the absolute speed of light (denoted by **u**) may have different values, as in this formula:

$$\mathbf{u} = \sqrt{\mathbf{c}^2 - 2\,\mathbf{c}\,\mathbf{v}\cos\alpha + \mathbf{v}^2}$$

(**α** being the angle made by photons with the ship's direction of travel).

If this clock would use omnidirectional light pulses, the time dilation factor is slightly smaller than the TR's one, according to this formula (numerically tested):

$$\Delta t' / \Delta t = 1/\pi \int_0^{\pi} \frac{c}{\sqrt{c^2 - 2\,c\,v\,\cos x + v^2}}\,dx$$

The definite integral was made over a semicircle interval due to the obvious spatial symmetry. Replacing v/c = β, it yields:

$$\Delta t' / \Delta t = 1/\pi \int_0^{\pi} \frac{1}{\sqrt{1 - 2\,\beta\,\cos x + \beta^2}}\,dx$$

11.5. Conclusion

In my opinion, this article might help solve the most important incompatibility or inconsistency of modern physics: on one hand, the absolute spatial medium and its special mechanics (described in [1] and [2]); on the other hand, the Theory of Relativity. My explanation is based on the particular change caused to the granular space by the presence of massive bodies, i.e. of gravity. This new phenomenon has been named QGF and it is in fact the consequence of an additional granularization of space, one that is imposed by the presence of a structure with numerous particles (atoms and molecules). Consequently, all of the local granular fluxes are affected, being modulated and combined at quantum scale by the interactions with the dense matter; in fact, a matrix with the instantaneous distribution of that matter is superimposed over the uniformity of the local fluxes. A significant cosmic mass will thus "mark its territory", changing the very fabric of the surrounding space and leaving a trace of its global movement. We may say now that gravity influences the entity called local spacetime on two planes; moreover, it has a direct action on all matter and absolutizes its dynamics. *Theory of Relativity* may thus be applicable in any local context, but only if we identify the local absolute system. In the case of global situations or of zero gravity, we should use the *Theory of the Absolute* instead. Consequently, our Universe proves to be a large collection of local absolutes, of small universes that are more or less overlapped. Each significant cosmic body and formation disturbs the uniformity of the granular fluxes, also their pattern; this affects the movement of matter around these bodies, starting from the quantum level.

12. The flow of time

A new perspective on the passage of time

12.1. Definition

Understanding what time really means is equivalent to understanding the mechanism that runs the whole Universe and all those processes that move, change and transform its matter. Equally important are, in this perspective, the changes of the space itself (i.e. that particular medium in which all these things are happening). We could never talk about time if there hadn't been a structured matter or if this matter would have been in a state of perfect stillness. The global model created by the current physics to explain the nature of reality has a certain degree of compatibility with the experimental observations, but it is at least incomplete; this model is fragmented on several dimensional intervals and, more important, it does not define the fundamental elements that made up the space and ordinary matter. The laws of transformation and conservation of various quantities that characterize the physical phenomena, from quantum level up to the cosmic scale, try to theoretically reflect more and more aspects of an extremely complex and dynamic reality. Most of the latest theories do not provide a full and rational explanation for the underlying mechanisms behind space and matter, although these two fundamental components of the surrounding reality should be very *simple* and easy to define. We have to better use our imagination in order to develop an abstract model of nature, to fill in all the blanks if the experiments can no longer give us significant data. We may observe and analyze the whole reality around, but there are *objective* limitations in reaching its biggest and lowest dimensions. Two big parts are therefore missing from any global model of reality, namely the extremes of the dimensional spectrum; consequently, they both should be completed by using logic and the scientific argument.

Regardless of this universal model that remains to be formulated, one thing is certain: the matter of our universe is transforming continuously, being driven by various fields. Their energy is transferred to matter, and more and more complex structures are created all the time. The interactions between these structures change their states and hold them together, allowing some big cosmic objects to be formed and to start moving through space. These sequences of changes (of the state, position and energy) would be better described mathematically if we introduce a special physical quantity named *time*. It will help us to correctly describe the movement of matter and the speed of its transformation processes. We may therefore identify in these changes a particular moment when a certain event takes place and accurately quantify it. An equation that describes the state of a physical system may help us identify the exact moment of an event, showing its "position" in time. Relative to the current moment called "now", there is something new we may declare about that event: it has happened in the past, it is happening now or it will happen in the future. Thus, it became very easy to associate the quantity *time* with a certain dimensional axis that is oriented from the past toward the future. We've practically created a new physical dimension (besides the other three of the three-dimensional space), a quantity that may help us to better describe the movements of matter.

Modern physics still uses a dual definition of *time*, a classical one (the Newtonian time) and one of relativistic nature (as described in Einstein's Theory of General Relativity):

- Time is a fundamental physical quantity (scalar, absolute and linear) that characterizes the duration of movements, phenomena or a succession of events; time flows uniformly in any physical system, regardless of the external phenomena.
- Time is also a fundamental physical quantity (scalar) that characterizes durations - but which depends on the concrete system of reference (on its speed actually) and on the *intensity* of the local *gravitational field* (or, in accordance with the equivalence principle, on the *acceleration* of a system); the time dimension represents one coordinate in the four-dimensional continuum known as *spacetime*.

In my opinion, however, time is no longer a fundamental physical quantity! It is in fact a derived scalar quantity, of a variable rate, which results directly from the inherent nature of reality: matter, in any form, may freely move through the three-dimensional space. This special quantity, therefore, depends on the absolute granular motion (which is considered absolute at the scale of our universe or locally, where is determined by the nonuniformity of gravitational fluxes and by their quantum gravitational fluctuations). The motion of granular matter, from elementary particles and photons up to the complex cosmic structures, has an absolute speed limit; this restriction reflects itself in the proper movements of matter, and this determines in fact the rate of the local time. Generally speaking, all matter is subjected to a speed limitation when it moves simultaneously through space and time (Chapter 5.3: "The simultaneous movements of particles through space and time are therefore limited to the global maximum speed, as it was described by the principles of relativity, and this happens because the *same* entity may travel through space and may also fix the rate of its local time *by the same internal granular motion*"). Although space is granular, the movement of any material body through it may be considered continuous - any intermediate positions on the trajectory being occupied at a moment; therefore, the movement through time may also be considered continuous, regardless of its variable rate of passage.

Seen globally, time actually becomes a more complex quantity; it is no longer an abstract concept, which may describe - for example - a virtual reference frame, but a physical quantity that has to be always associated with *concrete* matter (structures) *and* with its movement (as there is the real origin of time). Therefore, time may have different meanings at different scales (as shown in detail in Chapter 10.2.1). Its rate of passage can be either constant or variable, depending on the scale and on the actual physical system we analyze.

12.2. My vision

There were several kinds of time introduced in my previous works, but only three of them (the most important ones) will be shown here:

A. *The primary (granular) time* derives from the granular motion, as all the granules in the spatial fluid are moving at the absolute speed ***C****.* It is therefore associated with the speed of this uniform motion and, consequently, has a constant rate of passage; this kind of time is in fact a virtual quantity that comes directly from the fundamental constants we have used to describe the granular level (Chapter 9).

B. *The quantum time* flows in the quantum realm and is associated with the movement of all granular structures. This kind of time cannot be seen just as the proper time of a specific particle, but also as a descriptive element of its interactions with other particles through various fields. As local time, it derives from the fundamental constants of space and thus, indirectly, from the primary time. The source of this time is the specific, dual-type movement of elementary particles: their intrinsic precession and the global translation (which has the speed limit **c**). It should be noted that the entire dynamics of a particle depends on its absolute mass, which depends in turn on the absolute speed and on the concrete distribution of granular fluxes (known as the intensity of gravity). If this type of time is associated with a single (isolated) elementary particle, then it cannot describe the actual mechanics of the quantum level and it would have only a theoretical, abstract nature; this mechanics implies in principle several particles to interact, a system of particles.

C. *The macroscopic time* can be assigned to any structure made of elementary particles, to atoms and to the physical bodies they form. The quantum time, as well as the macroscopic one, shows an *absolute character* (they are directly linked to the real nature of our universe) - when a stationary structure is considered - or a *relative character* - when that structure is in motion. All of the atoms and molecules that are making up a physical body have their own movements (besides the global one); we may therefore see the macroscopic time of a particular body as a resultant, as the arithmetic mean of all its internal quantum times.

Both quantum and macroscopic times are considered by modern physics as a unitary, continuous quantity of relativistic nature; they will be simply called *time*. As we have already seen, the local time of a particle or a more complex material structure depends on the absolute speed, its rate of passage being slower close to the speed **c**; therefore, if that particle travels at this exact speed, the local time becomes infinitely slow - it practically comes to a full stop. Inversely, if that particle or all the particles of a system would be in a state of absolute rest, their local time would reach the maximum possible rate of passage.

Considering this absolute component of time, we might introduce a global temporal quantity, of a maximum rate, to use for the entire universe. Even if the granular density is not the same in all regions of space, even if we would ignore the massive stars and all the galaxies, this kind of time cannot have a constant rate of passage. Paradoxically, even the rate of time changes over time! These changes are due to the variable granular density of the universe - which varied significantly since the Big Bang and which continues to decrease. Although the fundamental constants we previously postulated (Chapter 9) are truly *absolute constants,* this phenomenon induces a global relativism in our universe. As the granular density varies over time, some other quantities, such as the mass of elementary particles and their maximum speed (the speed of light) will also change. This entails different variations of the internal parameters of all our time-measuring devices. What can we do to ensure that our observations directed to distant cosmic objects are uniform? As previously proposed, we can agree on a unique rate of time - resulted from a repetitive, actual quantum phenomenon - which could be used for all observations of the cosmic objects, and to extrapolate the absolute values of all the other quantities in accordance with the estimated variation of the granular density.

Two more c*onclusions* (Chapter 8) have to be mentioned here, as they both are related to the time measurement (with atomic clocks and light clocks) in relativistic conditions:

- "... only the quantum processes should be used to measure time; at the macroscopic level, time it just a reflection, a sum of the relativistic changes that are happening at the atomic level and below."

- "The primary time emerges from the first level of matter, being connected with its granular constants (kinetical and dimensional); it embeds itself in all granular structures (elementary and composite particles, atoms, etc.) and their quantum interactions."

12.3. Entropy and time

Why does disorder have to always win in our Universe? Why entropy always tends to increase, is this really a universal law?

First of all, let's take a look at the granular level: here, space may be assimilated to a perfect fluid, evenly distributed, whose entropy-like property does not vary on short intervals (the volume of space increases continuously, but we choose to ignore this change now).

The structured matter lies at the quantum level (elementary particles and atoms are bound together by different fields); there, space loses its uniformity and may directly interact with the granular structures. Let be a spatial region in the proximity of a star, a place where the gravitational field is very strong. In addition to the *quantum gravitational fluctuations* (see Chapter 11), that area is continuously crossed by the radiations and particles originating from that star; we may also consider the incomplete photons and the granular remains produced when some particles annihilate. Any material structure that would exist in this fluctuating medium will be subjected to *random transfers of energy*. We may therefore conclude that space itself, over time, could increase the entropy of all quantum structures - no matter how isolated they would seem to be.

However, we cannot declare that any transformation of matter, as compact or granular essence, has always increased the degree of disorder (if this concept can be applied in that place and time) - giving in this way a direction to the *arrow of time*. For example, there were two special moments in the early universe when the matter has spontaneously organized itself; first, the emergence of the simplest granular formations and, later on, the moment when these formations have joined together in composite structures. The continuous action of the granular fluxes and of those fluctuations on the structured matter, over billions of years, have had two seemingly opposed effects:

- Large amounts of energy were transferred to matter by the granular fluxes, allowing the creation of all sorts of heavier atoms (the fusion reaction inside the stars was maintained in this way).
- The same granular fluxes increased the entropy of some complex structures these atoms have built eventually, then broke and recombine them in other forms; this is in fact the natural process behind the very complex, highly organized structures (see the living cells and life in general) - apparently dominated by order.

The space itself, by using its own granular energy, has shaped and built complex material things, proving to be very creative over time! Two important factors, the emergence of a *huge* number of granular structures in the early universe and their *stability* over time, have allowed this simple mechanics to work continuously and to generate a great diversity of particles, atoms and molecules. The first building blocks of matter, the Hydrogen and Helium atoms, have clumped together and formed distinct systems - the stars and their formations - which continued to concentrate the primordial energies in billions of cosmic laboratories named galaxies. This process may repeat itself: a star is born, burn for a while and then has a destiny that depends on its mass and composition; for example, it could explode (went nova), become a red dwarf, a neutron star, or a black hole. The matter that is spread around in case of explosions may constitute the fuel for new stars, and thus the whole process may be restarted.

At any scale, all material systems are evolving continuously, changing and passing through different states. As it was specified in my previous work (Prime Theory [1], Chapter 10), the mechanics involved here is always causal and deterministic: *"Clearly, the current state of a system determines in a causal way its future states; this happens at any level, as it is the true nature of things, setting up the direction of the arrow of time".* The perpetual motion of the spatial granules at a constant speed (***C***) allows in fact the movement of any material structure at an absolute speed ranging between **0** and **c**. Time, as a physical quantity of variable rate, reflects how all of these structures travel through space and, simultaneously, interact.

12.4. Temporal symmetry

We know all about the symmetry of physical laws under the simultaneous change of electric charge and parity, also about the time reversal symmetry. However, if we consider the previous description of the "arrow" of time, it would seem unreasonable for all the laws of physics to remain the same if the sign of time changes. The universe, i.e. all forms of structured and unstructured matter, is continuously transforming; if we speak of a closed system and fixed dimensions, we may have large-scale conservation of *all* quantities related to motion. But this system is not fixed; space undergoes a continuous expansion process, which automatically imposes a certain asymmetry to the movement of matter. This thing has determined a few big changes of the granular entropy over time and has led to the emergence of the structured matter - which is another significant asymmetry seen at the cosmic scale (The Universe [2], Chapter 2). The entropy of the normal matter remains constant or increases over time, according to the second law of thermodynamics; however, this is just a consequence of the special consistency of matter. In other words, our universe came out of its initial "frozen" state of stability and order at a certain moment (known as Big Bang), then it built a virtually infinite number of small stable "islands" - the elementary particles and their structures. Without going into detail, we may notice how matter keeps forming structures in an irreversible process that is powered by the force of the granular fluxes (now in a mature and quasi-stable universe). The dynamics of this process is based on a fundamental asymmetric phenomenon (which is also reflected by the arrow of time): the spatial fluxes have only a *constructive effect*, compressing and condensing the matter. If our closed universe is expanding and if the intensity of the spatial fluxes is proportional to the granular density, the global constructive effect of these fluxes will decrease continuously over time. *This is where the real source of the arrow of time hides in fact, as fundamental asymmetry; it is the global ratio between the granular material and the structured matter, which in our universe is constantly growing* (this can be seen in the growing number of black holes and in their increasing mass). If the future will hold a state of equilibrium between the expansion of space and the concentration of matter, it is difficult to say now. Considering the currently available data, a never-ending expansion and an oscillating universe seem to be now two equiprobable speculations...

12.5. Time and relativity

The local time, as a quantity that depends on the local absolute speed (if there are gravitational fluctuations) and on the local gravitational field, passes at different rates for different bodies, even if we take into account only the averaged values. A very accurate clock that would be placed near a certain body does not measure, in fact, its local time... There are some small differences caused by several phenomena, mainly by their different positions within the gravitational field. And things differ even more for individual atoms and molecules, as their current time changes with the thermal agitation and with the random directions of their movement. However, we may use a standard clock and assume a constant rate of time for all of the macroscopic objects around (those with nonrelativistic speeds). Important adjustments should be made only if the gravitational field has significant variations (as in the case of the global positioning system GPS) or if the speed of that object is in the relativistic speed range. Two important conclusions were formulated in The Universe [2], Chapter 3.2:

1. The local time of a body depends on absolute speed; its rate of passage decreases when that body accelerates in regard to the AFR and reaches a relativistic speed, according to the TR formula we may apply in this context.
2. The local time also depends on the absolute direction of travel; a regular clock that would be using oscillations in opposite directions will therefore compensate for these intrinsic deviations. However, the quantum scale particles will experience bigger time variations if their direction of travel changes.

The well-known formulas of time dilation are:

$$t_0 = t_f \sqrt{1 - v^2/c^2}$$

$$t_0 = t_f \sqrt{1 - 2GM/rc^2}$$

where
t_0 is the proper time between events A and B for a slow-ticking observer
t_f is the coordinate time between events A and B for a fast-ticking observer (at rest or respectively, at a large distance from the massive object)
G is the Gravitational constant
M is the mass of the object creating the gravitational field
r is the radial coordinate of the observer
c is the speed of light
v is the velocity

12.6. The mechanics of time

We should assign some special attributes to the local time in order to describe "how fast" a body moves or if its internal state has changed significantly. As we previously postulated that matter has a *continuous* movement, at any scale, the flow of time must have the same characteristic. Therefore, if we "look" beyond the units of measurement and the actual measurements, several concepts connected to the "dynamics" of time may be identified:

- *Time interval* represents a finite time duration that is measured between two distinct events, or between the physical changes (for example the state, position) of a generic body.
- *Time rate* is the rate at which the local time actually flows; it may be established in relation to a fixed rate that is measured in another system, considered as reference. The measure of the passage of time could be given by a repetitive phenomenon of constant frequency that takes place in both systems. Its unit of measurement may be arbitrarily chosen (anyway, it is linked with some fundamental constants), but the value will always tend to zero in systems traveling very fast, close to the speed of light.
- *Moment of time* - is an exact position in the time continuum, an infinitely short period of time during which a certain event does happen. We may also use the term "now" for a specific point in this infinite chain.
- *Time*, regarded as a physical quantity related to our universe, can only exist if there is structured matter and this matter interacts. The *time* "passes" because all matter from our universe is dynamic, moves, transforms and its state changes continuously. If these processes would stop, or if the matter would be destructured to its granular state (or condensed into amorphous forms like black holes) in the distant future, then this macroscopic time will no longer have any meaning, it will also come to a stop.
- As time is an "elastic" quantity, we may simply compare it with a rubber band that extends itself under certain conditions of speed and gravity; however, this band can revert back to its normal form and size if those special conditions cease to exist.

Granular mechanics describes the perpetual motion of those spatial granules (and their collisions), being centered on the idea that these phenomena conserve the granular kinetic energy; therefore, this spatial fluid will automatically induce all the other conservation laws of the mechanical quantities from the higher scales. All these laws will have a logical and causal connection with the quantity named *time*, which is in fact another image of the elementary kinetic energy. In conclusion, we can say that the properties of time depend on the fundamental constants of motion; moreover, if this mechanical energy would not have existed - as a continuous movement of matter through space - we could not talk now about the concept of time! The causal link described here is extremely important, as it actually reveals the true nature of time. We have presumed that the granular movement conserves the total granular energy (the state of motion at granular scale); therefore, the granular time - as an indirect source of quantum time - should conserve its "flowing" state. Consequently, the absolute macroscopic time *can never be stopped*, and, moreover, *its rate of passage cannot be changed* (it is determined by the fundamental constants). The inner relativism of the local time flowing in any physical system is also caused by the granular movement (whose amount of elementary energy is also conserved in structures, no matter their size).

12.7. Time travel

As time is not something reversible, we cannot act directly on it; also, we cannot consider it *an independent entity* that exists apart from the organized matter. The local time of a body moving at relativistic speed or of a body lying in a strong gravitational field slows down in comparison with the absolute time. Let's say now that the structured components - meaning the matter and fields from all over the universe - have a certain global state S1 at a certain moment T1, a state that includes all characteristics of their movement. As matter moves and interacts, at a later moment, T2, there will be a different global state, S2. The distribution of energy (in any form) has changed between the two moments, whatever close they might be. However, the total amount of energy did not change; the energy has just been *redistributed*. Locally, a certain amount of energy might have been consumed, but this exact quantity was absorbed somewhere else, in another form. The global process that took place between T1 and T2 is irreversible and continuous; the transformations of matter, starting at a granular scale, may be neither stopped, nor reversed - they simply happen, and this is a kind of "mechanical given" of our universe.

At the quantum scale, however, there could be atoms having the same state and position between two moments of time; this does not mean that a certain atom could "freeze" time or could travel back in time! It surely had some interactions within this period of time, and its electrons continuously moved inside their orbitals - so the local time has passed in a normal manner. Extrapolating these things, we may reach the same conclusion for the macroscopic realm. A certain body continuously changes its internal state and its local time may only slow down under those special conditions. In extremis, at the speed of light or in a gravitational field of infinite intensity, time would simply stop - and the whole body would turn into an amorphous granular mass, for which time itself no longer has any meaning!

As movement is the cause for the flow of time and as movement is present at any scale, anywhere in the universe, we may conclude that the rate of the absolute time (its mean value) cannot change significantly and perceptibly (we are considering here the intrinsic relativism of a closed universe). At a local level, a certain physical system X may have the same state at two different moments, but its local time has passed anyway - even if there are no visible traces - and it also passed for all the other systems around!

System X cannot "travel" into the past, for example, because the universe as a whole cannot stop moving or make a global "jump" into a previous state.

System X cannot "travel" into the future either, as the universe cannot "jump" into a future state without passing through all the intermediate states. At the fundamental level, the matter has a speed limit and, consequently, *nothing can happen instantaneously*! All events are lining up on a time axis and they can no longer be moved or changed if the "now" moment has jumped over their current position. The current events cannot affect the past events; moreover, any kind of influence might exist between certain events - it cannot propagate faster than the speed of light **c** (we have to include here the quantum entanglement, which is in fact a pre-configuration of two different quantum states - spin, polarization - whose future observation will not affect them in any way).

Let's compare two different material systems. System X is at absolute rest, while system Y is moving away at relativistic speed. As system Y's local time flows slower, the events produced in these two systems may be added on two axes and spaced differently. A certain event called "now" may happen simultaneously in those systems, but all of the subsequent events will happen at different rates. This phenomenon is known as "the twin paradox" (The Universe [2], Annex 2, where you can find the traditional variant and my explanation based on the absolute motion), but time having different rates of passage is not exactly the same thing as the time travel. If we are to exploit this phenomenon using some relativistic speed rockets, humans could travel faster this way into a global "future" - as they pass slower through the time continuum. These astronauts would experience a different time, a time that passes slower than the absolute time; all their biological processes would be changed, and they will age less than their relatives on Earth.

However, time would not flow differently in two identical galaxies, on identical planets. Even if these galaxies would have a big relative speed, their local absolute - which is imposed by the granular fluctuations - should not differ and thus the rates of their local time will have the same value.

In my opinion, the time machines and the time travel as a jump into the past or the future, are just utopian ideas, good subjects for the SF movies - which are allowed to elude the laws of physics for "artistic reasons".

12.8. Perception

We know that all humans, as conscious beings, have the innate capacity to realize the passage of time - as a result of their biological processes and of their adaptation to the environment. Some biological processes are helping us to perceive the external environment through senses and, consequently, play an important role in setting the rate of the information we receive. For example, the sense of sight has the largest informational flow, giving us images from the surrounding environment at the maximum speed of 10..20 frames per second; our brain can easily process this string of data in real time, analyzing and comparing them with the stored images and patterns. Therefore, there is a perception speed limit imposed right by our eyes (by those sensors in the retina), and some faster events could be lost from sight (or they are unconsciously perceived). However, the adaptation of humans to the various environmental conditions is almost perfect; we depend entirely on the major changes in nature, we have a circadian rhythm, a lunar one, the seasons, etc. As intelligent beings, we fully perceive and understand the changes caused by the passage of time in all living organisms. "Now" is deeply embedded in our conscience, and we almost perfectly realize the passage of time as a continuous line of moments in this sequence: past - present - future. All of the biological processes, as direct results of the laws of physics and chemistry, have a specific pace (of relatively constant value) that can even dictate the speed of our thoughts. But there are other physical limitations to consider, such as the speed of the electrical impulses through neurons and the complex connections of these special cells.

Therefore, all human beings have a nearly identical perception of the rate at which time passes. There are some variations of subjective nature which are mainly depending on our current activity, on our mental condition and the pace of our social life. Technology advancements play an important role as well; also, the human age may alter or enhance the accuracy of time *perception*. On the other hand, the continuous changes of the environment lead us to a clear mental representation of the *arrow* of time. Moreover, as we all realize the finite duration of our existence, time gets the highest possible value for each of us. In conclusion, due to the human power to perceive and understand the most complex things, the illusion of time (as Einstein formulated) may be turned into a major factor of social and personal progress.

13. The wave-particle duality of photons

On realism, causality and locality

13.1. The new paradigm

In my classical view, a full description of the surrounding nature must be based on the three pillars of mechanical materialism - causality, realism and locality; therefore, we should be able to build and use models that have all these basic features for any elementary particle and for any known interaction. Consequently, the well-known particles of "light" - the photons - must also have a simple description based on these premises, to which we have to add a precise definition of the collateral wave concept. Once the granular level and its special mechanics have appeared and caused a paradigm shift within the quantum field, both materialism and determinism may come back to their normal positions.

But which is the actual connection between waves and particles in this larger framework, and are all these new explanations consistent with the uncertainty concept of quantum mechanics? This opens an old debate of quantum physics, which has big philosophical implications, but some clear answers are really needed in this field governed by fuzziness. For example, is the position of a particle correctly described by the wavefunction, being given as density of probability? Is a particle "real" all the time, having a well-defined position in space and an exact speed, even if it is not observed? Does the observational limitation impose these probabilistic laws, while the reality is clear and deterministic at the quantum level?

And what exactly is this entity named photon, which behaves sometimes like a wave and sometimes like a particle? Does it have intrinsic properties all the time, or this depends on whether a certain measurement is performed or not?

Continuing this subject, we may also wonder if the actual quantum mechanics can completely describe reality by using the generalized wave-particle duality and the wavefunction formalism. Moreover, does retro-causality really exist? Does the future influence the past - as some lab experiments seem to show? Also, is quantum nonlocality a real phenomenon or there are some theoretical and experimental errors involved? Do all quantum systems have well-defined states before measurements or everything is uncertain and probabilistic at this dimensional level, as in the Copenhagen Interpretation? If the latter version holds true, could we bring (at least hypothetically) some order and determinism to this chaos-dominated realm by using a lot of supplemental (hidden) variables that emerged from the granular level?

Many simple and complex experiments can be done with photons (such as the Double-slit experiment), all yielding strange results, raising questions regarding the wave or particle nature of light. Does the dual interpretation of this unusual behavior mean the photons are not well-defined until a measurement is carried out? So, which is the truth about photons and the other particles? Are they a part of one special, full of uncertainty micro-universe, very different from our clear and intuitive macrocosm? And can we really probe this universe, measuring some parameters, while its current status and intrinsic characteristics remain unchanged?

13.2. Photons

Photons were described in my previous works as multilayer structures of low granular density (less dense than the elementary particles, but the value is higher than the average density of space). For these two reasons - low-density value and distributed structure - it's difficult to assign a classical mass to photons, but they certainly carry a quantum of energy and may transfer it as a mechanical impulse. All structural compact layers of photons are moving in a single direction, and this represents the global direction of travel; furthermore, the helicoidal shape of photons (a double helix - as it is shown in Figure 40, where the secondary helix is wrapped inside the blue tube) remains absolutely unchanged during propagation. Their granular layers are accurately duplicating the movement of the emitting particle during emission, and it's obvious that the amount of energy stored in a photon (and which may be transferred) depends on how these layers are distributed in time and space.

In other words, all generic photons are in fact granular concentrations of specific three-dimensional shape (helical); they have resulted from the distribution of the small electrophotons (as described) produced by a particle during its transition on various atomic energy levels or during annihilation processes. Photons provide an accurate copy, a "frozen" image of the trajectory followed by the emitting particle, containing its both precession and global movements; therefore, the granular distribution encodes all variations of mechanical energy that the particle has experienced during emission.

13.2.1. Photons as particles

Prime Theory [1] and The Universe [2] introduced my first model of photons, assuming that these special particles have a certain *physical structure* and *definite materiality*. They have a specific granular structure and travel at the maximum speed imposed by the local space. Their internal structure is *fixed* and remains practically unchanged during the uniform motion; however, some characteristics of photons may change in different mediums or intense gravitational fields. Let be a normal photon **γ** (which contains two symmetrical parts), as shown in Figure 40, the upper picture. We may now reveal the correspondence between its physical characteristics and the magnitude of the associated quantities, in a classical approach (based on Maxwell's equations), where the generic photon will still be seen as a manifestation of the electromagnetic field.

The **velocity** of photons, **v**, is a vector quantity whose orientation corresponds to their direction of travel and whose value is normally equal to the speed of light in a vacuum, **c**. This is in fact the maximal value of the absolute speed for any material structure in our Universe, being set by the granular density of the local space. As the homogeneity of space is implicitly assumed (i.e. the lack of gravity) in addition to its perfect vacuum, all photons will have rectilinear trajectories.

The **electric field** is given by the sequence of unidirectional electrophotons (zero divergence) that are making up the body of the photon, i.e. by the variation in density of their granular layers (seen in the direction of propagation). This field is simply represented by the vector quantity **E**, whose magnitude has an averaged value that does not depend on the exact manner in which the precession movement was stored in those granular layers. The central graph from Figure 40 illustrates the approximative correspondence between the electric field intensity and the physical 3D model of the photon. A complete photon contains two halves (front and rear) and each half stores one semi-oscillation of the electric field, which means a variation in intensity from zero to a maximum and back to zero. The curvature of the emitting particle (i.e. the type of its electric charge) is not practically stored inside this spiral of electrophotons and therefore *we cannot give a certain sign* to the E-field; however, in order to keep the consistency and compatibility of this theoretical model, the first half (from the front) is considered positive and the second half is negative. Consequently, we may postulate that *there are no structural differences between the photons that are generated by particles and those generated by antiparticles* (for example by electrons and positrons). The electric field does not depend directly on the physical form of photons (a photon differs from another, even if they all have exactly the same frequency) or on their length; it actually depends on the *speed at which the granular density* **ρ** varies along the component layers (see the detail of the central graph depicted in Figure 40). We could show this direct proportionality by the following formula:

$$E(t) \sim \partial \rho \,/\, \partial t$$

The **magnetic field** is given by the variable orientation of the successive electrophotons constituting the photon's body. Each granular layer forms a certain angle with the global direction of travel, and the value of this angle changes in time (it decreases with the increase of granular density, as the granular layers accurately replicate the orientation of the particle's surface on the emission moments). As a vector quantity, the magnetic field is denoted by **H** (it can be seen in the bottom graph of Figure 40, where is a detail illustrating the variable orientation of granular layers) and its intensity is proportional to the variation of the angle:

$$H(t) \sim \partial \alpha \,/\, \partial t$$

Both E and H fields are therefore variable in time, and the only reason for this is the uniform movement in a certain direction of the whole structure of photons. Seen from the rest frame of these particles, the so-called "fields" do not vary at all; they become simple granular distributions within a larger structure - a fixed one, whose shape is not changing over time.

Going back to the physical phenomenon that has generated this photon, we may notice the strong correlation between the E and H fields during emission. Once the emitting electron accelerates, denser electrophotons will be generated and the angle of their internal layers increases (maximum 90 degrees relative to the direction of propagation); a similar phenomenon occurs when the electron slows down. The physical mechanism that lies behind the photon production leads to a simple connection between E and H, confirming all of *Maxwell's equations* - for example, the Maxwell - Faraday equation:

$$\nabla \times E = -\,\mu\, \partial H \,/\, \partial t$$

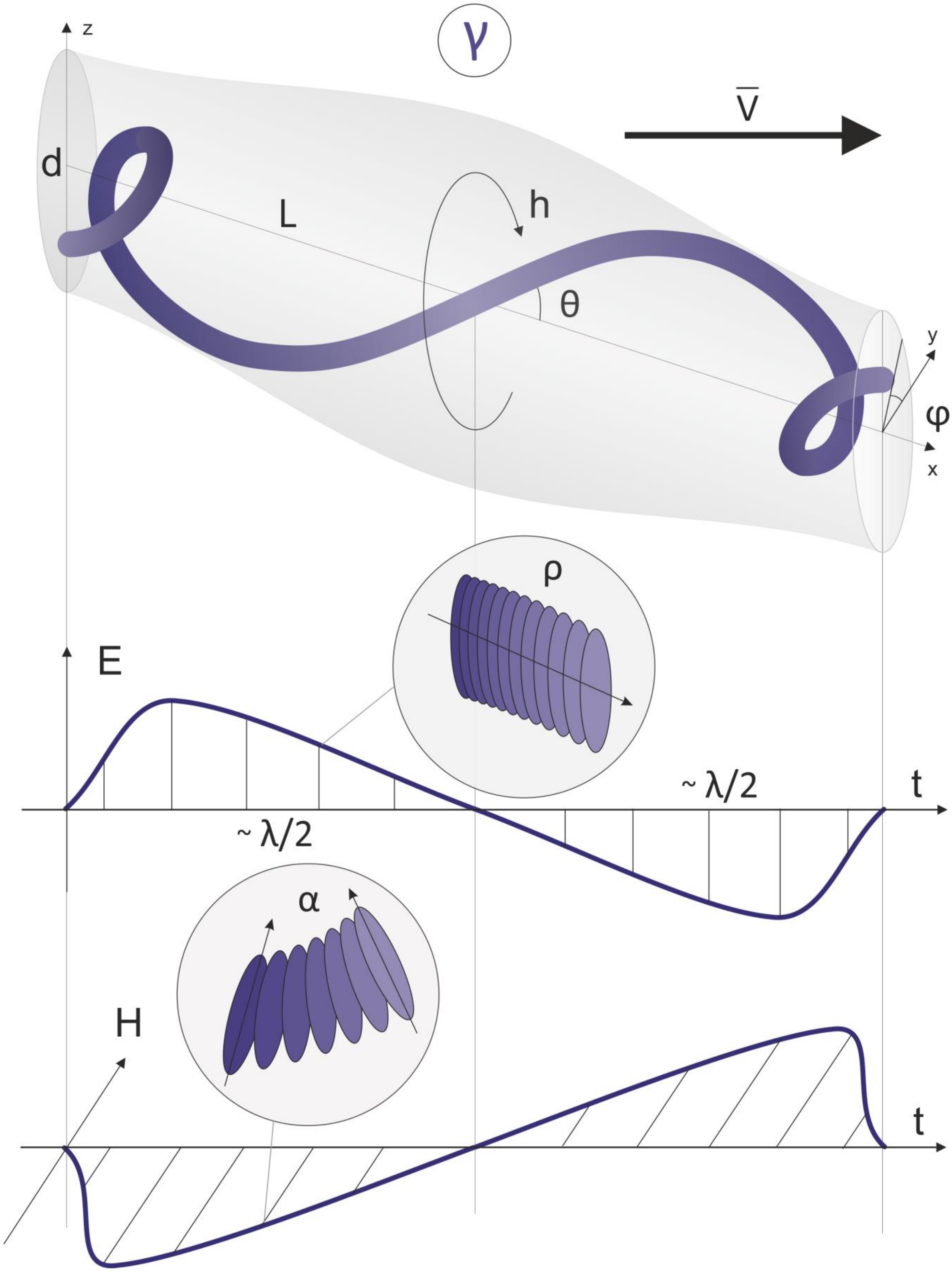


Figure 40 - *The physical shape of a photon*

Seen as stationary granular formations, photons do not contain in fact electric and magnetic fields. If observed from another frame of reference (which may have a lower speed value, less than **c**), photons will dynamically display the "fields" hidden inside their sequences of granular layers. These fields now behave similarly to the usual electric and magnetic fields, as all of the photons practically preserve the original distribution of electrophotons that emerged from the emitting electron.

Moreover, we can never talk about an *independent, isolated magnetic field;* this type of field derives in fact from the electric one, which is based on the intrinsic movement of the charged particles. It represents the variation in orientation and position of all electrophotons that are coming out from a charged particle - of its electric field - which is transmitted at a distance and may exert an influence upon other electrically charged particles. Therefore, the magnetic field is only generated by the changes that occurred in the electric field of charged particles - and this is the *real determinism*, the real correlation mechanism that allows photons to be created and which eventually leads to the well-known theoretical representation through those specific quantities and equations.

Remark. The actual variation of these fields (E and H) is not a perfect sinusoid, due to a presumed non-uniform variation of the particle's speed in the relativistic range; even if that particle would be uniformly accelerated, its mass does not vary linearly with speed. On the other hand, the sinusoidal-type solutions for E and H - seen together as an electromagnetic field - are just a good approximation of the physical reality, but they practically can describe very well these special particles called photons.

Photon polarization is fully determined by the physical shape and is given by the planes in which the granular oscillation manifests itself. The three-dimensional helical form of photons, as shown in the upper picture of Figure 40, expresses a *circularly polarized state.* Both E and H fields rotate during the oscillation intervals and this rotation reaches a certain angle in the end. If we consider the coordinate system XYZ (OX along an internal symmetry axis), we may identify the starting angle (to the axis OY) as an **initial phase φ** (not that of the attached waves). There are left and right circular polarization states (depending on the clockwise rotation of the fields). This parameter of photons corresponds to the spin angular momentum - which is called **helicity** and is denoted by **h**; it characterizes the *circularly polarized photons* and its values are $\pm \hbar$, expressing right-handed and respectively left-handed helicities. If the rotation angle of the E and H fields remains constant along the entire body of the photon, there will be a single oscillation plane and this particular case will be called **linear polarization state**.

Note 1: The photon depicted in Figure 40 has *left circular polarization*, but this has to be seen in the opposite direction in the case of absorption.

Note 2: The oscillations of both E and H fields were graphically represented in a single plane, identifying a linear polarization of another photon.

Note 3: There are incomplete photons, having incomplete field oscillations (whose initial and final phases are not directly given by the physical characteristics of their helical body, being stored in fact within photons' internal granular distribution).

Note 4: Photon's spin is associated with the *complete* "rotation" of the curved tube, which practically means two full oscillations of the granular density. This aspect actually quantifies the integer spin value, while the physical shape (helix's virtual direction of rotation) influences only the sign of the spin.

Photon's frequency ν (nu) is the most important parameter of the photon, a fundamental characteristic that also lies in its granular distribution. It indicates how "fast" the emitting particle has accelerated and oscillated during emission, i.e. the mechanical energy involved in this short-time process.

Photon's wavelength is also an important parameter, which is definitely connected to its physical form and to its corpuscular nature. Denoted by **λ** (lambda), it is associated with a certain space length that integrates *a full oscillation* of the electric field (or the distance between two crests). The wavelength is clearly linked with the photon's frequency; if its frequency is higher (the oscillation has happened more quickly, within a shorter period), this leads to a smaller space extension of the granular structure. The two quantities are connected in this formula:

$$\mathbf{c = \nu \lambda}$$

where **c** is the speed of light in a vacuum.

Note 1: In an absolute perspective on their propagation, one of the previous chapters has explained why the photons coming from distant galaxies have a certain redshift (their wavelength is longer). This was caused by the speed of light, which has significantly increased over time; at a fundamental level, this increase is due to the lower granular density of space.

Note 2: The photon's shape, and hence its wavelength, are not directly dependent on the medium's quantum fluctuations; these fluctuations will only lead to certain synchronization between the speed of photons and the local "absolute" (see [3]).

Note 3: The speed of photons traveling through various mediums and materials is lower than **c**, the speed of light in a vacuum. This is not the consequence of some changes at the granular level; it's just about a global delay of all the incoming photons, which is caused by the repetitive processes of atomic absorption and re-emission. The excited electrons are shortly re-emitting the absorbed photons, but this process takes some time - a duration that depends on their wavelengths. Therefore, the average propagation speed and the equivalent wavelength of the photons are significantly smaller in materials with a refractive index greater than 1, while their frequency (energy) remains virtually unchanged!

Note 4: Photons do not rotate during the free propagation. However, a point of their structure will apparently follow a curved path; for example, the top of the electric field vector will have a helical trajectory only if we take into consideration the uniform motion of the whole photon's body.

Mass, momentum and energy. We may consider photons as unitary bodies, although not all their component granules are adjacent. Their average granular density is greater than that of the empty space, even if some internal layers may have lower values. Therefore, a symbolic mass may be assigned to these special particles, given by the number of all their component granules (Chapter 5). If we expand this concept of mass, as the ability of a body to transfer a certain momentum, a rest mass could be introduced - given by the scalar product between the symbolic mass and the value of a granular impulse. The directional mass, which means the mass a photon would show in a hypothetical interaction with larger particles, is identical to the rest mass (all of the granules have exactly the same direction of propagation).

However, the reality seems to be more complex, and we may better explain these things once we come to understand the way a photon is formed and what exactly is stored inside its granular structure. If an electrically charged particle speeds up and then slows down, many of the electrophotons it normally emits will be concentrated in a single direction. A certain amount of energy will be consumed within a certain period of time, and the exact value of energy depends on the range of particle's speeds: the initial, the maximum (let's say **c**) and the final ones. These speed values depend on the atomic orbitals of the emitting electrons, but in fact *their relativistic thresholds* are only counting. This thing automatically implies a precise *quantification* of the energy stored in photons, an energy that is directly reflected by their frequency. The granular gradients in the photon's structure accurately

reproduce the path of the emitting particle and also its changes in speed and orientation. The photon absorption is a similar process, but it will take place in reverse order. When the electron from a certain atomic orbital is hit by a photon, its precession and global movements are all changing and synchronizing due to the transfers of granular impulses. The electron's variations in speed (due to the additional energy it receives during absorption) are thus *identical* with those of the emitting particle in its potential field, between the thresholds we mentioned above. The amplitude of this oscillation is therefore almost constant, and what exactly discriminates the photon energy is the *period of this oscillation*, implicitly its frequency. It's easy to observe now the direct correlation between the physical length of photons and their wavelength, their energy in the end. As those cosmic photons have a certain redshift - i.e. an elongation, an increase in length - we can observe an apparent drop in energy, their actual frequency being lower (it is measured through absorption, at the current value of the speed of light **c**). The energy contained in photons, which was confirmed as mechanism and quantization since the first experiments on the photoelectric effect, is therefore correctly expressed by the well-known formula (**h** is the Planck's constant): $\mathbf{E = h\,\nu}$
The energy is not implicitly given by the amplitude of the magnetic and electric fields that are stored within the granular layers of photons; instead, it is directly proportional to the *rate* they varied between those two energy levels and spatial positions of the emitting particle. Quanta of energy are thus simply emitted, stored and then absorbed in all-or-nothing processes, but the reality seems to differ sometimes. As we have already seen, there are incomplete photons and also remains of photons; the absorption process, which may be shortly followed by re-emission, can also be partial. The surrounding space and the objects around us are continuously crossed by photons having a wide frequency spectrum, from Gamma and X-ray radiation to the visible one, infrared and radio waves. These photons - complete or not - are not "mixing" together, but their effects on particles may compose in several ways; moreover, we must not forget the "noise" that is added to all these processes by the omnipresent quantum fluctuations.
Global momentum is that quantity conserved when a particle absorbs a photon. As that particle is part of an atom, which is part of a larger structure of atoms, its momentum varies and this difference will be transferred to the whole structure (while the granular layers of the absorbed photon will dissipate into the surrounding space). We have to notice the particle-like

behavior of the photon, which has transferred only a discrete amount of energy during this interaction, a quantum.

The phase velocity. Both their physical structure and the conventional electromagnetic wave model of photons lead to a *sinusoidal-type* variation of the granular density and, consequently, of the associated electric field (which may be considered a plane wave). Therefore, the theoretical solutions that could satisfactorily reflect the entire evolution of these waves in time are the equations of this particular form:

$$E = E_0 \cos(\omega t - kx + \varphi_0)$$

ω - is the angular frequency (the rate of change of the phase)

φ_0 - the initial phase angle

K - the wave vector magnitude, $k = \omega/v$

v - phase velocity of the wave, the speed at which the phase propagates in space. In a normal medium, the phase of the frontal layers of photons - seen as spatial distribution, as well as the phase of the E and H fields - seen as attached waves, do not change during propagation, and therefore the phase velocity is constant, v = c.

13.2.2. Photons as waves

As three-dimensional structures of spiral form that uniformly propagate through space, photons are very similar to the sinusoidal mechanical waves. Regardless of the internal arrangement of their granular layers (the frozen image of the E and H fields), all photons may thus have this mechanical-like undulatory behavior. However, if two or more photon structures are overlapping at a given moment, there is no real composition of their internal fields. They will pass through each other and no interaction will occur (in accordance with their QM's boson attribute, photons can occupy the same space). Only their effects sum up in a particular manner, like the superposition of mechanical waves; given the physical similarity between the propagating photons (length, phase, frequency and wavelength) and the mechanical waves, the composition of continuous waves of photons will have similar equations and properties, varying with these parameters.

The Double-slit experiment, an old test in which photons of visible light are passing through a pair of closely spaced slits and then form an interference pattern - as some light waves originating from both slits would produce - is the simplest case showing the wave nature of light. Moreover, this type of experiment illustrates the same non-classic behavior for ordinary particles (the electrons, for example, which have an attached *de Broglie* wave); they are also interfering, following a possible path that is given as probability by their wavefunction. In accordance with a QM rule (the physicist *Max Born* has introduced it), particles will have a certain spatial probability distribution that depends on the existence of each slit and another one that results if particles are passing through both slits (pairs of slits in general)! This interference pattern would therefore be the result of the constructive or destructive composition of those waves (attached to particles and of the photons). However, which is the physical mechanism behind this superposition and self-interference that Max Born has postulated, and why the wave seems to follow all possible trajectories? And what would be the alternative explanation based on my granular model of photons?

13.3. The "Tree" Model

The main assumption of my model (as it was previously described in Chapter 2) is the granularity of the physical body, of the long and fixed helical structure of photons. Consequently, many characteristics of photons must be similar to those of the mechanical *waves* (manifested during propagation) and of the *particles* with mass (during their interactions with matter). These two sets of features are exclusively activated and the different behavior of photons, wave-like or particle-like, seems to depend on the particular type of experiment or measurement performed. Beyond this old quantum uncertainty, a photon must be something "real" at any moment, even when it is not observed. It's easy to presume that different interactions of photons with matter could determine some changes in their structure and their trajectories, and these changes could force a certain type of end result. Therefore, in order to include this shifting of shape and to justify the dual behavior - as part of the global QM's wave-particle dualism, my first model of photons must be completed with several inherent parameters.

13.3.1. Assumptions

As it was stated in Chapter 2.1., the granular density of the primary photon (which has not interacted yet with matter) has two peaks along the axial direction and these peaks are separated by a wide interval of very low density (the average density of space). Moreover, there are a few more assumptions and details we have to add to this model:

a) *The dual structure of the normal photons.*

A normal photon usually contains two distinct regions, **A** and **B**. *A* is the frontal region (on the wave's direction of propagation), followed at a certain distance by region *B* (as it was previously described in my books: Prime Theory [1] and The Universe [2], Chapter 5). This separation can be considered a hidden variable of the granular model.

Therefore, each of these two regions includes a granular density maximum, and their spatial extent on the X-axis is proportional to half of the photon's wavelength (see Figure 41, where one primary photon is represented in a three-dimensional perspective as granular distribution). In the same way, each region ideally contains one complete semi-oscillation of the E and H fields (whose "sign" is not known yet).

Both regions of a complete photon have the same speed (c) and the same direction of propagation. However, in some special interactions, the two parts may separate and then move in different directions. These two components are not perfectly symmetrical to the center. With all that, the projections of these parts could generate some other general descriptions, like up/down or positive/negative (relative to a specific reference plane that includes the axial direction of photons). Considering their granular distribution, these two halves should have a different behavior during interactions. A is the *active* region; it accelerates an atomic electron and, in case of a "match", may trigger the absorption. The absorption process is completed by the *passive* region B, which can quickly push the electron into the new orbital.

b) *The real photons*

The tubular structure of a photon is not perfectly delimited in space, and its granular distribution extends in all section planes. Once an atomic electron enters this region, the capturing process starts and the electrically charged particle receives supplementary granular impulses, changing its movement in accordance with the photon's granular patterns. As in the case of the transparent materials with a refractive index greater than 1, the electrons will shortly re-emit the photon (this phase delay depends on material and wavelength). This process repeats on many atoms; fragments of photons are thus superposing and this decreases the apparent wavelength of the new emitted photon and decreases its actual propagation speed in that material (phase velocity). Moreover, lots of partial "waves" will gather around the initial photon, each having a certain phase difference (a constant value for a particular material). Therefore, the photons of visible light are "multiplied" while passing through transparent materials, many of these real "clones" (granular layers that remained from the previous photons, not completely dispersed during the absorption) being added to them. Due to the phase delays, most of the clones are positioned in front of the real photons, increasing their size on both X and Y axes. As for directions in space, the majority of these clones are parallel with the initial photon's direction of propagation, but we can assume a certain level of *divergence* that results from the change of momentum in some interactions.
This thing has two important implications:

(1) As a consequence of the interactions with matter, a newly born photon could immediately turn into a *real* photon - an extended granular structure that contains omnidirectional clones of the same frequency and phase (as shown in Figure 42a).
(2) This intricate structure from all around the primary photon increases in size during propagation and, at the same time, "loses" a number of clones because of dispersion (see Figure 42b). In time, the overlapping regions of the clones included in this network become smaller and smaller, and they will eventually lose contact with each other. Due to this separation process, the primary photon will be surrounded in the end only by the parallel clones (Figure 42c). The initial divergence and the final parallelism prevent

all the clones that come from *a single source* to self-interfere. This configuration - a body and a chain of clones that precedes it - is probably the most common structure of photons in nature.

c) The extended functionality of the real photons

The real photon has the same energy as the primary one. Its additional clones are in fact the electrophotons that remained from the previous processes of emission and absorption, granular bits that temporarily have the same direction and thus may form a "larger" photon (whose construction did not require any extra energy).

In principle, a real photon has the *same functionality* as a primary one, only its structure is bigger, with many extended "branches". The large numbers of chained clones (which are all in phase) allow the formation of such branches and give them a significant lifespan; in this way, all clones are in direct contact with the primary photon, "communicating" through this dense network of interlocked granular "tubes". For a short period of time, until a certain degree of granular dispersion is reached, *this solid structure will function as a whole (a single particle);* the size and distribution of its internal ramifications represent a new hidden variable of the model.

Under certain conditions, the frontal extension of a visible photon could reach many wavelengths in size (their physical equivalent), while its thickness could reach about one wavelength (before dispersion). If this photon moves freely again, its ramifications will only spread laterally; as all the clones have the same speed, its axial dimension will remain constant.

During the passage through specific regions, many clones will follow the contours and local geometry at the atomic level; they may create, depending on the wavelength, some special nodes - distinct sources that will emit other photon clones. These new groups of omnidirectional clones may *intersect* and *interfere* with the primary photon's group, creating different interference patterns, thickening or thinning the initial branches and producing secondary ones. Therefore, the constructive interference leads to the emergence of some *temporary branche*s (their high level of granular density makes them "solid" objects); due to the relatively long lifespan, we may definitely consider them *functional extensions* of the primary photon. These continuous extensions can serve as energy conduits; moreover, a photon may directly interact through one of them and transfer all its energy. The interaction propagates, as we already know, through the granules that exchange their elementary impulses; as many of the granules involved are already joined together, the overall speed of this "communication" process may exceed the **c** value.

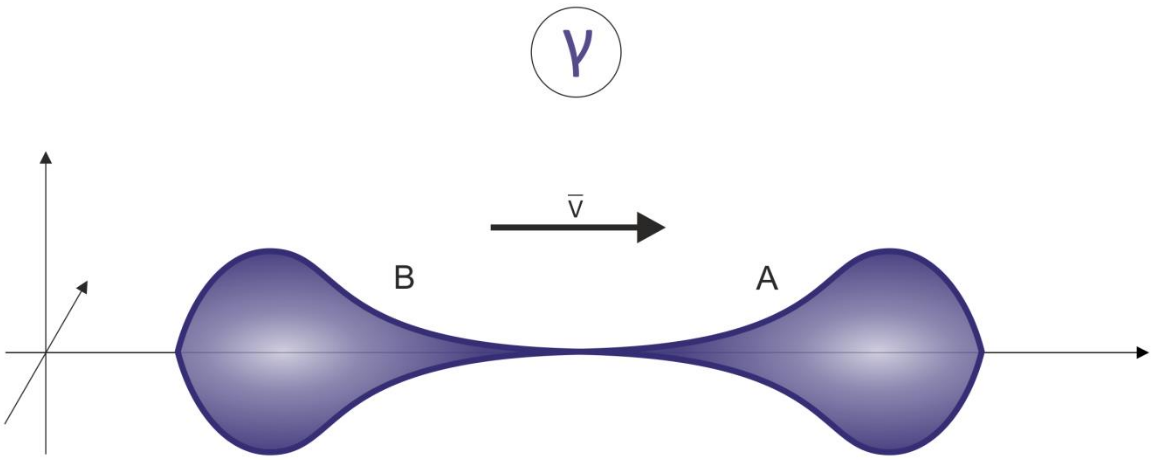


Figure 41 - *Generic representation of an ideal photon*

13.3.2. Explanations

There are two classic experiments made with visible light photons, both still suitable for new explanations and interpretations; they will be analyzed here from the perspective of the current quantum mechanics (and of the Pilot Wave alternative), respectively from that of granular mechanics (of the Tree Model).

a) The double-slit experiment (Young)

Richard Feynman: "The double-slit experiment has in it the heart of quantum mechanics. In reality, it contains the only mystery."

Stage 1. This simple setup is used at first, a source of monochromatic light (Laser L) and a screen S placed at some distance, as shown in Figure 43a - the upper picture. Light photons are emitted to the right and a bright spot may be seen in the exact place where they hit the screen. In this case, we could assume a certain position of each particle, somewhere on the straight line connecting the source and the bright spot (even the photons are not observed during the flight). The time and position uncertainty was not considered here.

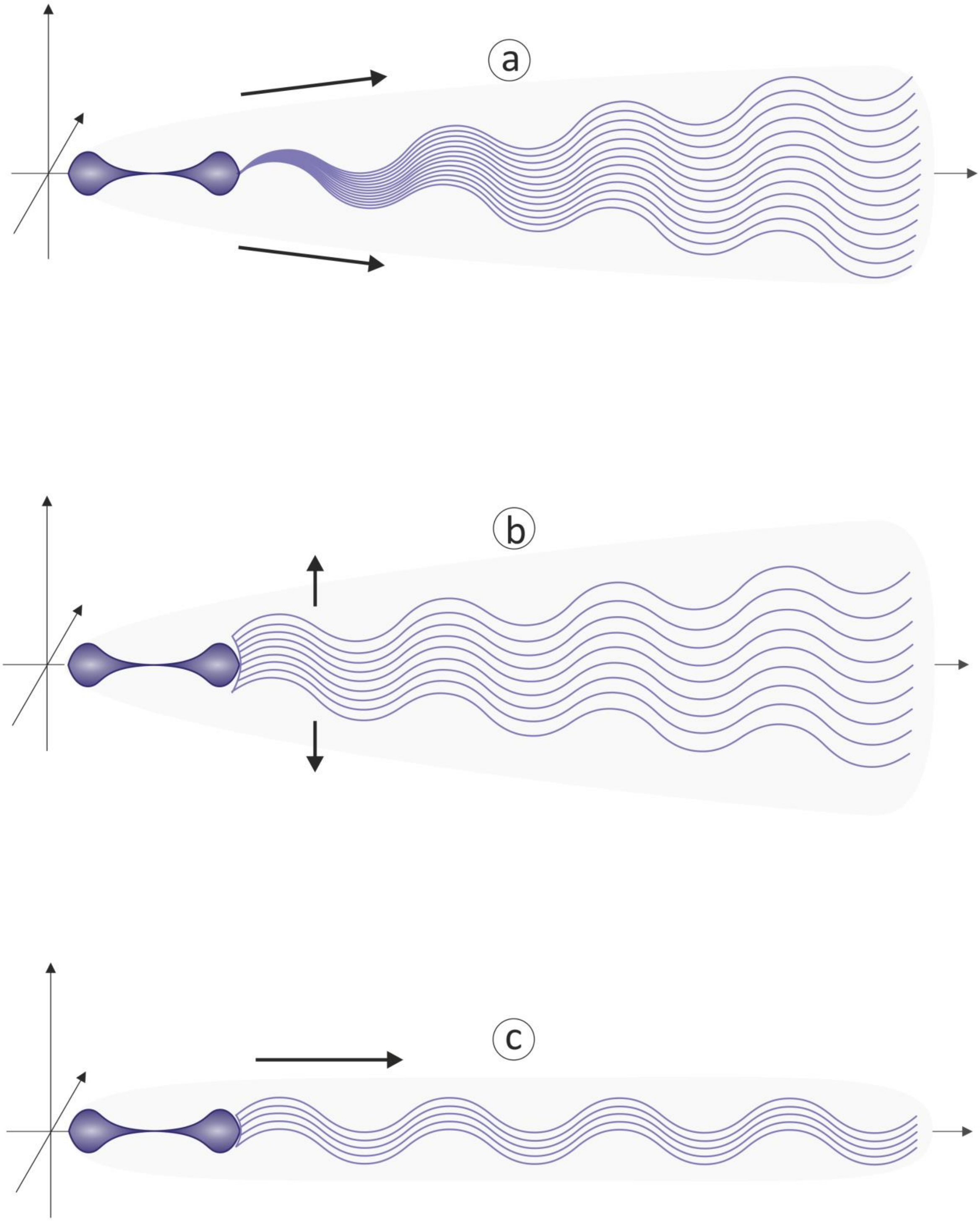


Figure 42 - *Various stages of a real photon formation*

Stage 2. An opaque board with a single slit (its width is about one wavelength) is now inserted on the trajectory of light. Things are quite similar; a bright smudge of light will appear in the same place, but the light is spread out in the horizontal direction and two faint side bands appeared due to diffraction. Apparently, neither the propagation nor the behavior of photons were significantly affected during the passage through that narrow slit; some of the photons are deviating a little from the initial route, other ones are "going around" the obstacle and concentrate in some brighter areas on the screen (see Figure 43b).

Stage 3. The single-slit board is now replaced with another assembly that has two parallel slits, the distance between the slits being about the light's wavelength (Figure 43c). This changes all things fundamentally, the screen will show an interference pattern composed of multiple bands of light placed at certain distances - as two light waves coming from the slits would interfere. It should be noted one important aspect: when a single photon is emitted at a time, this interference pattern still appears. An obvious question arises immediately: which was the actual trajectory of each photon? A photon takes one of all the possible trajectories, following a wave that has interfered with itself? Moreover, how we may find out the exact slit a photon has passed through, *which way it has taken*?

Stage 4. In order to solve this mystery, the photon detector D is added in front of one slit (Figure 43d). Interestingly, the pattern formed on the screen disappears. Another legitimate question arises now if the simple observation (a detector placed somewhere at the slits) sends a signal back and forces the photon to take one certain path of all the possible ones. And there are more general questions, beyond the classic dilemma *wave or particle*, all being related to some global issues such as realism, locality and causality in quantum systems with photons.

(**Quantum Mechanics**) First, what exactly are the photons - those bosons carrying the electromagnetic force - waves or particles? For now, we may assume that photons are particles; one photon is released, then it travels in straight line (Stage 1) and hits the screen. However, during the second and third stages of the experiment, light behaves differently, like a wave; it goes around obstacles and produces an interference (diffraction) pattern on the screen. As we try to find out which way a photon goes (Step 4), its particle-like nature is revealed once more. How can we explain all this? The type of measurement decides how the photons behave?

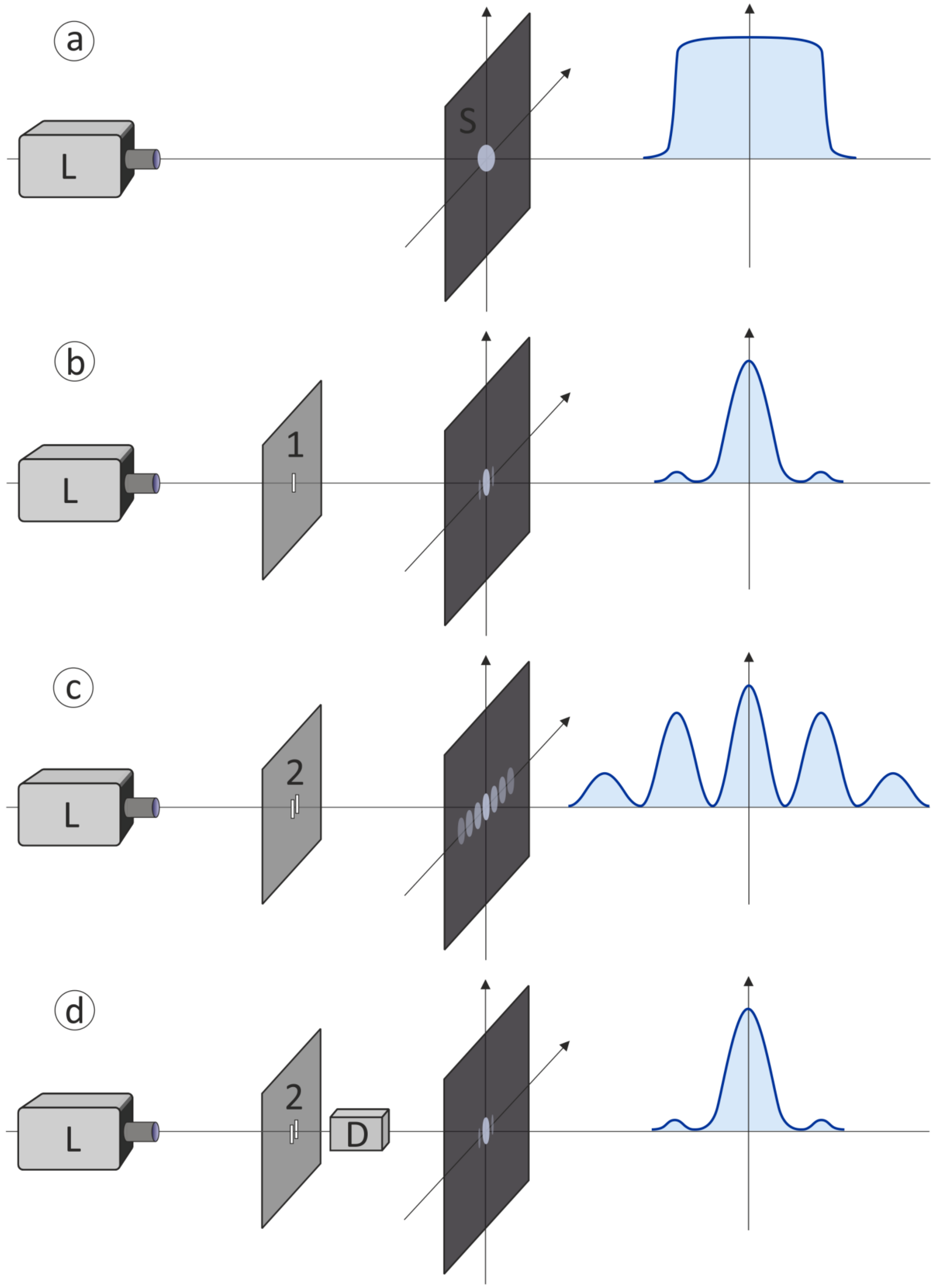


Figure 43 - *The double-slit experiment*

Taking the undulatory approach, we could simply start from the Huygens' Principle, which states that every point of a wave is a secondary source of spherical wavelets and the sum of these wavelets forms the wavefront. Different parts of the wave interfere while they take different routes toward the observer, generating interference fringe maxima and minima and proving in this way the clear wave character of the photons. Based on that, quantum mechanics has reached a much better explanation for interference, taking into account the fact that any particle - photons too - has an associated wave function. De Broglie theorized that each photon is guided by a *wavefunction*, following a path that is a random choice of one of many possible paths. In our experiment, these paths are determined by the concrete configuration and the component parts, while the wavefunction solutions will give them in the form of probabilities. As it was already mentioned, Max Born has introduced a rule telling that the probability distribution in this interference pattern results in fact from some interactions due to each slit individually and due to both of them together.

Another important principle must be enounced now: Niels Bohr's *Principle of complementarity*, telling that the wave/particle aspects of any quantum object are mutually *exclusive* and the type of measurement actually determines which property is exposed.

This quantum experiment may be seen from a different angle. Considering a causal view of the whole process, we may find that once the uncertainty in position decreases when photons are passing through slits, their uncertainty in momentum (direction) will automatically increase - in accordance with Heisenberg's *Uncertainty principle*.

Seemingly, all these fundamental principles and rules form a complete framework. Quantum mechanics thus offers perfect solutions, matching the experimental data. Any quantum object may be described by a wavefunction and this formalism has proved to work well. Therefore, the quantum realm seems to be profoundly probabilistic and we have certain limits in observing, probing and measuring all of its properties and parameters simultaneously.

However, something is missing here! What is hiding in fact behind the wave function? And how we may adapt the concept of wave in the case of one photon, how exactly it splits into several waves and produces interference patterns? Its quantum of electromagnetic energy, the internal E and H fields are really dividing into smaller "parts"? Moreover, this randomness - which may be linked to its polymorphism - does not contain any bit of determinism?

All of these questions are justified and they automatically lead us into another dimensional domain, where the real causes of the quantum phenomena must hide. The generalized probability could lie in a huge number of variables that are hidden in this subquantum realm, all having undefined values. Unfortunately, considering the uncertainty and the observational limitations we are facing, both causality and realism that would emerge from this granular level and would shape the quantum world might permanently remain beautiful theoretical speculations... Based on simple mechanical rules, the models built in this dimensional range can provide consistent and logical answers for our experiments with light; however, the objective barrier imposed by the discrete configuration of reality still cannot be avoided.

(**Granular Mechanics**) As we have already seen, a real photon has a certain granular distribution, occupying a very long cylindrical space whose diameter may be compared with one wavelength. The real photon contains, in general, a large number of primary photon replicas; we also know it behaves like a wave during propagation. When this granular entity tries to pass through a "narrow space", it automatically interacts with the peripheral atoms of the opaque material (dispersive or not). Consequently, their electrons will start to vibrate, the "rhythm" being imposed by the wave's frequency. The impulse received by the peripheral atoms will also propagate transversally as soliton and, depending on the barrier configuration, this vibration will reinforce the continuous emission of clones; moreover, some stationary waves will appear in this way. This particular complex process of synchronous vibration multiplies exponentially the number of clones, and more and more granular copies of the primary photon are re-emitted in all possible directions. We could compare this with an expansible *fluid* that spills all over the obstacle's surface; the clones with different phases continuously move and aggregate in wavelength-size groups, following the microscopic outline of the obstacle (Figure 44a). Depending on the wavelength and on the discontinuity represented by the slit, some distinct directions will quickly form; the clones moving in those directions are denser, they had a constructive interference (which means a temporary joining of the in-phase copies). Slits became in this way *clone replicators,* or *secondary sources* that multiply the incoming clones and emit copies in all directions. Groups of waves originating from these different sources may intersect and interfere on their way toward the screen, and this happens even if the primary photon did not pass yet through slits. If these thicker "branches" (which are more or less divergent) of the newly created network are still connected with the primary photon, they will become its virtual extensions, being able to directly interfere with an atomic electron. The entire photon energy - its quantum - may be transmitted through this dense granular channel (as through a solid) QUASI-INSTANTANEOUSLY (this speed was explained in Chapter 3.1, also the causality and the speed limit), and we may consider that the photon has already "hit" the screen. When the absorption process is complete, the primary photon (regardless of the position it reached) and the interacting branch will disintegrate, and all the inactive clones will eventually dissipate into space. If a continuous beam of photons is emitted, each photon will form random branches and a brighter self-interference pattern will be visible on the screen.

Due to the physical discontinuity, those slits have formed in fact two *independent sources,* and their emitted waves may therefore combine and interfere (Figure 44b); some *new* channels were born in this way, new granular conduits for the photon energy. Things may be seen differently in both cases (single-slit and double-slit experiments): the primary photon has expanded and got extended functionality or it was simply multiplied by several clone sources. Anyway, it no longer makes sense to identify the exact slit a photon passed through, *which way* it followed. As its clones spread out in many directions (depending on the geometry and material characteristics), multiple granular channels were created and one of them has intermediated the action; therefore, the precise location of the primary photon at the absorption moment has no meaning at all.

If we try to observe the wave (which would imply absorption or at least new geometry for clones to follow) coming from one slit - seen as an independent source, a certain granular channel will send back the "information" *this path is blocked* and that source will stop the emission in all directions (Figure 44c). The wave from the other source can no longer interfere; as in the single-slit experiment case, the interaction propagates through one of the already existing branches.

b) The delayed-choice experiment (Wheeler)

This experiment is based on the initial structure of the Mach-Zehnder interferometer, a few components being modified to prolong the trajectories of photons (in order to allow a "delayed" insertion of the second *Beam*

Splitter). Figure 45 shows the simplified configuration of the apparatus and three distinct situations in which a photon seems to behave differently - as a particle when it takes a single path and as a wave when it splits and then interferes. This experiment is used in a particular manner, by choosing the type of measurement with a certain delay (the presence of the secondary *beam splitter*). As the interference pattern still appears, one classical explanation would be the photon went "back in time" and "changed its character" from particle to wave... Or, a more realistic explanation would be a photon has no intrinsic properties until a certain measurement is performed...

The experimental setup contains a monochromatic light source (the Laser L), two half-silvered mirrors (A and B), two normal mirrors (M1 and M2) and two photon detectors (D1 and D2). It has to be mentioned that the light source is specially configured to emit one photon at a time.

Case 1: The source L emits a photon that immediately reaches the BS A and then takes either Path 1 or Path 2, hitting one of the two detectors with 50% probability. In this first case, our photon behaved like a particle (Figure 45a).

Case 2: A visible photon behaves like a wave and goes on both ways, its wavelets interfering in BS B. The length of both paths is specially chosen to allow the constructive interference only on Path 1, and therefore that photon has a 100% probability of showing up in detector D1 (Figure 45b).

Case 3: This case is almost identical to the first one, just another beam splitter (BS B) is added; the second BS is activated at the last moment, after the photon would have already chosen one of the paths and apparently behaved like a particle. We have the same result: detector D1 will signal the presence of the photon (Figure 45c).

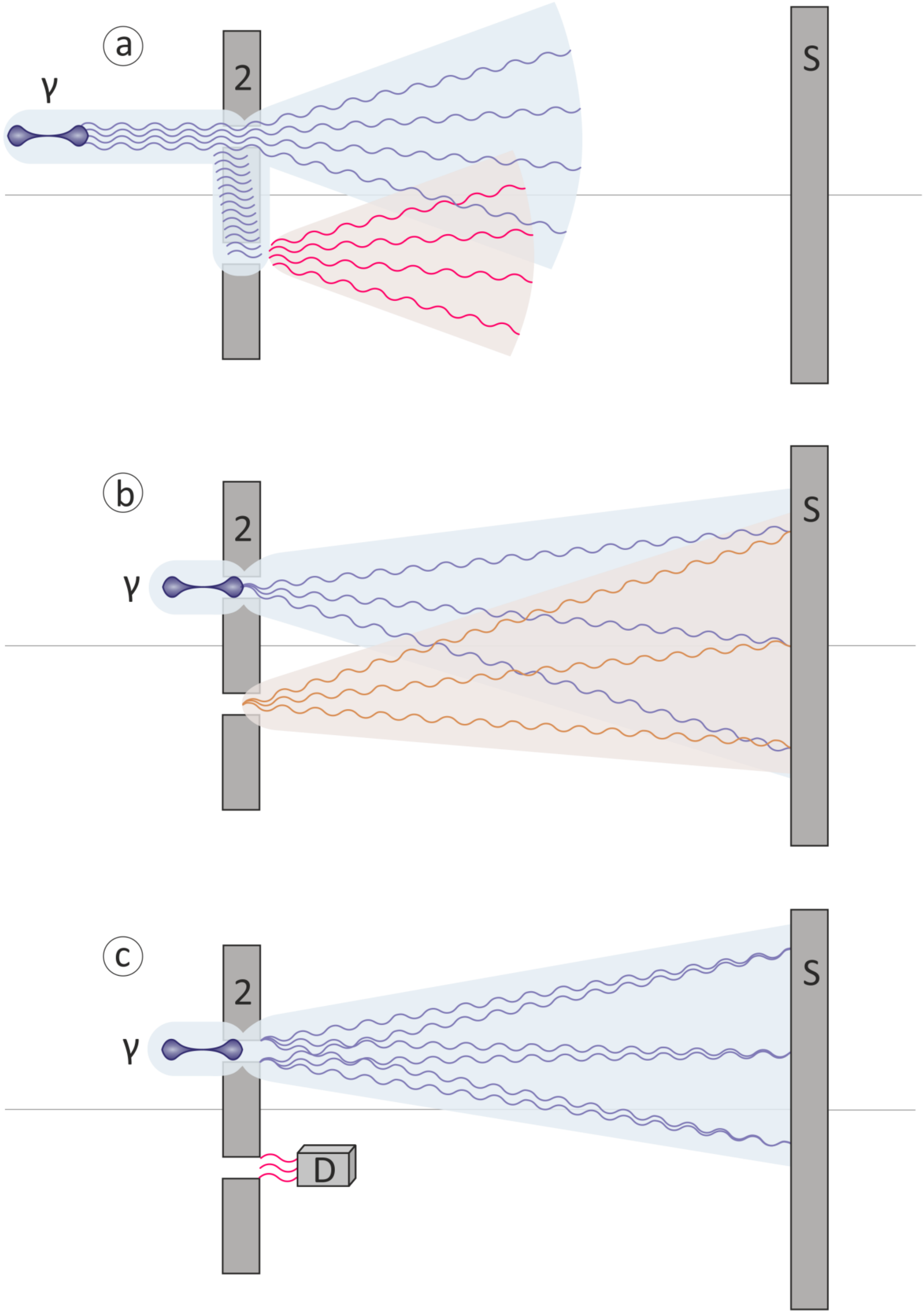


Figure 44 - *The interference patterns*

(**Quantum Mechanics**) Paradoxically, this simple experiment is not fully explained yet, even if we consider that the type of measurement could force the photon to act one way or the other. These results indicate retrocausality or the lack of local realism (the quantum objects would become real only upon measurement, as in Copenhagen Interpretation), both aspects being very difficult to accept.

A big step forward has been taken with *Bohm's Interpretation* [8] of quantum mechanics, which restores the causality and the classical behavior of all particles. The *de Broglie-Bohm theory* (pilot wave) postulates that the position of any particle is defined by the wave function by a *guiding equation*. Unfortunately, the position of a certain particle depends on the positions of all the other particles in the universe, which means this theory is explicitly nonlocal and thus incompatible with special relativity. Anyway, it is perfectly capable of explaining the delayed-choice experiment.

We may consider the photon in our experiment as a particle that always has a definite position (which is a hidden variable); it also takes only one of the two possible routes, while the guiding wave goes through both paths. However, the wavefunction changes once we modify the global configuration (by adding the BS B, as in Case 3) and this happens faster than the speed of light. This interpretation, a deterministic and realistic alternative to standard quantum mechanics, provides the best results and explains very well the wave-particle duality revealed in the delayed-choice experiment.

(**Granular Mechanics**) A photon is generated by the Laser L (Figure 45a) and it immediately reaches the BS A, where a lot of in-phase granular clones are emitted in both parallel and perpendicular directions. As in the previous experiment and for the same reasons, all these clones form granular waves that precede the photon (its speed decreases a little inside the splitter) and reinforce the already existing ones, extending the photon in each direction. These waves will therefore travel along both paths (the red and respectively blue rays), reflect in the mirrors and, crossing each other, will finally reach both detectors. The photon will take one of these routes, hitting one detector (probability is 50%); it seemed to show a particle-like behavior, but the primary and secondary granular waves were present all the way.

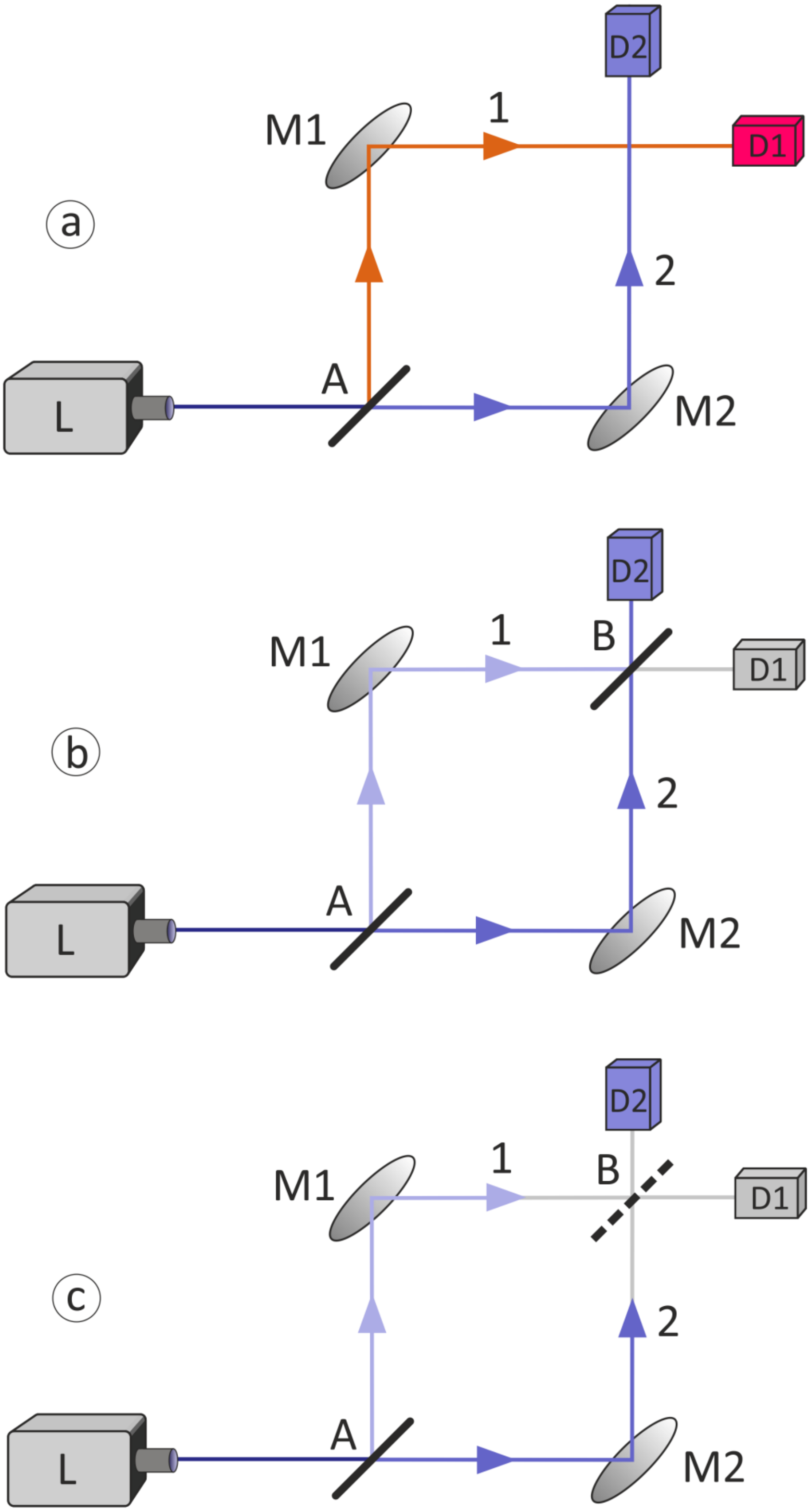


Figure 45 - *The delayed-choice experiment*

Case (b) includes another splitter, BS B; those two waves take both paths (1 and 2) and arrive at this second beam splitter, where more secondary waves will be emitted toward the detectors. They all will combine, interfering constructively only on the path to detector D2. This process creates two granular branches, a thicker (denser) one moving toward detector D2 and a thin one moving to detector D1; these branches have a long lifespan, a period long enough for the photon to arrive at BS B. Upon arrival, regardless of the route taken by photon (which now has no relevance), the interaction begins to propagate *through the thickest branch* and a certain atom of the detector D2 will be excited immediately. This detector will therefore signal 100% of the incoming photons.

The insertion (activation) of the splitter BS B is delayed in Case (c), it happens just after the photon would have passed the BS A - after it "would have chosen the path to take as a particle". However, the granular waves have been already generated and they follow both ways, producing secondary waves and interfering at BS B. Obviously, the detector D2 will be activated for all of the emitted photons.

As the action of a photon is unique, we simply cannot find out which way it went; however, its interactions in various materials and the experiment type do reveal different behaviors, but in fact we are dealing with a single entity. It has a "real" configuration all the time, regardless of the path it takes.

13.4. Conclusion

There is a certain similarity between my model and *de Broglie-Bohm's* theory ("Pilot Wave" [10]), as for the determinism, realism and the so-called "hidden variables" they both assume. However, the formalism of the *Pilot wave* should use a different description of the wavefunction and of its collapse, which must include all the changes of the actual waves traveling with a photon and the limited influence of its surroundings. The explanations for quantum nonlocality are based only on fundamental principles (already introduced by the Prime Theory [1] and The Universe [2] books), and my theoretical model above is thus fully compatible with the combined framework provided by the *Theory of relativity* and my *Theory of the absolute* ([2], Chapter 3 and [11]). A lot of positive opinions are currently expressed about realism, along with some

adaptations of the modern QM's formalism and with several experimental data that support it (as shown in [9]).
Defining characteristics of the Tree Model:

- Photons are granular entities with variable configurations; passing through various environments and materials, they *may extend in size by multiplication*, by adding numerous clones of the same frequency to their primary structures. These clones may interfere like the normal waves, creating denser formations in some directions - like the tree branches.
- This real photon has the *same functionality* as the primary one, only it can directly interact through one of the branches formed by the in-phase clones.
- The photon energy is transmitted via one of the *thicker branches* (randomly chosen) or via the parallel branch, if it is unique. The interaction may therefore be triggered by a frontal clone, even if the primary photon is not directly connected with the particle that absorbs it. As a final result of the interaction, that channel and the primary photon dissipate into space, as well as the remaining divergent clones.

Major implications of the Tree Model:

- The interaction of a photon with matter may actually happen before the "arrival" of its main body, and which way this part went through is no longer such a piece of important information; however, the cause-effect relationship is not affected in any way, while *the retro-causality is not involved at all* - as we are talking about a single quantum entity!
- For the same reason, we can also talk about the *Principle of locality* when the real photons interact with matter. All divergent clones go along with the photon, but their density continuously decreases and, after a while, they can no longer form active branches; therefore, the surrounding space cannot be completely "probed" during this fixed period, and this *limits* its influence on the trajectory of photons - which are all determined *locally*.
- Photons are in fact *particles with wavy shapes,* whose spatial extent and inner structure may vary over time. The type of experiment will impose

what characteristic of photons is manifested upon measurement, but the wave/particle complementarity becomes a little artificial in the *tree model*'s context. We can therefore speak of *realism:* a photon may be observed or not, but it has a definite shape all the time.

Some of these implications may also refer to "classical" particles, such as the electrons, because they all have a wavy trajectory [1]. However, the observational uncertainty - an intrinsic feature of the quantum world - is always present; it cannot be avoided, no matter how "smart" is the experiment. There are hidden variables that cannot be measured and quantities that cannot be measured simultaneously. The quantum world has therefore some *absolute* secrets. Anyway, the exclusive wave or particle characteristic of photons has now become an observational particularity that is linked to the actual type of experiment being performed, not a real property that is changed by the measurement.

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Acronyms and conventions

AFR - Absolute Frame of Reference

FR - Frame of Reference

TR - Theory of Relativity

GTR - General Theory of Relativity

TA - Theory of the Absolute

PT - Prime Theory

"Abc" - Figurative language

CMB - The Cosmic Microwave Background

Big Bang - A theory on the Universe's birth

QGF - Quantum Gravitational Fluctuations

IFR - Inertial Frame of Reference