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Prime Theory

All of nature's forces in a single theory!

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Bucharest, Romania, 2015

PREMIUS

Seventh edition, March 2022
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Cover design: Laurențiu Mihăescu

Premius Publishing House, 2015
Website: www.premius.ro
E-mail: info@premius.ro

ISBN 978-606-93843-3-6

To the memory of my father

Contents

1. INTRODUCTION

Why this theory?

- Because we still do not have a unified and complete theory of the Universe at this moment.
- Because it is not reasonable to believe that interactions simply propagate through space and exert some influence at a distance, without the presence of an intermediary agent.
- Because actual physics does not offer coherent explanations or theories of mass, gravity, electric charge, fields and elementary particles.
- Because the Theory of Relativity (Einstein) alone cannot create the whole foundation of the physics domain.
- Because the modern Standard Model of particle physics is incomplete, very abstract and it does not explain some basic concepts and principles.

In our time, with all the large particle accelerators and the unprecedented evolution of science in general, a complete model of the reality we are facing is still not available. Complex theories are describing the phenomena, the fields and the interactions. Vast quantities of experimental data and scientific observations accumulate, but they still do not reach the critical level needed to make qualitative improvements in explaining the elementary notions used by these theories. However, no philosophical, mathematical or any other form of barrier can stop us from discovering everything, because our thinking powers, our sense, logic and technology are continuously growing and developing.

This means we are evolving every day and will eventually overcome all potential obstacles.

Any experimental limitations, any principles or theorems that deny our possibility to fully understand the closed system named Universe may be surpassed by human creativity and intelligence. This statement represents my optimistic vision on human knowledge, being in fact a general postulate that is formulated right in the Prime Theory's introductive words.

It was my passion for electronics and physics, arising in my early school years, which led me to eventually become an electronic engineer. The experience acquired until now in this field, at first mostly practical, was reinforced by a logical and mathematical exercise in the field of information technology; all this helped me gain a complex and interdisciplinary view of the surrounding reality. The decision to dedicate time to this theory came from noticing the lack of concrete accents in modern physics (especially in quantum mechanics and astrophysics), which through an excessive number of abstract theoretical models moved away from the objective meaning of things, at both largest and smallest scales. Equally important was the lack of unanimously accepted theories on fundamental physical quantities, concepts and phenomena, such as gravity, mass or electric charge. A descriptive approach, causal and logical, without complicated mathematical equations that may easily hide the significance of real phenomena, was likely to shed more light upon these matters.

Conceived to comprehend and to integrate as much as possible of nature's essence and principles, Prime Theory is entirely based on the classical and relativistic mechanics; however, some new laws and postulates were added as a personal contribution. To keep it simple, intuitive and very accessible, all of its important statements are followed by graphic representations and geometric drawings.

This theory tries to explain in detail some new concepts, such as the granularity of space and the interactions of the elementary units of matter, also some new rules that could be considered as the most fundamental principles of quantum mechanics. My hope is that a new perspective will help us to build a more solid basis of all modern physics and, equally important, will allow us to clearly see *the true nature of reality*.

2. SPACE

2.1. Initial hypothesis

Space is the unique constituent of our Universe. Matter represents a special form of space in which the elementary components are in a structured state. Mass, energy and time are physical quantities derived from some special features of these material components of space.

This hypothesis changes the paradigm of whole physics: the genesis, evolution and dynamics of space are the base for the formation, shaping, motion and transformation of all things in the Universe. All the quantities and constants of physics are thus determined only by space, through its parameters at a given moment. The emergence of space means the emergence of the Universe. For a detailed analysis, we may consider as a starting point some current cosmological theories and models (temporarily taken for granted), such as the Big Bang and the theory of cosmic inflation.

2.2. Characteristics

A precise definition is needed at first in order to clarify the meaning of the word *space* within this theory. In Newtonian mechanics, space is considered a three-dimensional empty framework, homogeneous and isotropic, with a linear metric, continuous, uniform and infinite, where matter can move and transform, waves can propagate and fields can exert their actions. Space has in some way an absolute nature; its measurement unit is presumed invariant in relation to other physical quantities, also considered to have constant values in time. Time flows uniformly in this frame, at a constant rate, and a body may move freely, at any speed.

Experiments have proven, however, that this simplified view is not accurate. There is a maximum value for speed in our Universe, the speed of light in vacuum, and in any frame of reference, it has to be considered a universal physical constant (as postulated by the Theory of Relativity). This fact, in addition to the invariance of the laws of physics under a shift of inertial reference frames, fundamentally changes the way space, time, mass and energy are to be described. These physical quantities are no longer constant and uniform; they depend upon the relative speed at which an object in a frame of reference moves toward an observer and upon the presence of gravitational fields. As an absolute frame of reference is not introduced yet in modern physics, the relativity laws and their consequences are the mandatory concepts we have to use in any unified theory of our world.

Widening the perspective on things, we may realize that our location is right in *the middle* of the universe we wish to describe and understand. This is the reason why we cannot exactly "see" everything that is going on, especially if our Universe is *closed and finite*. We are not able to relate to anything outside this system, and all physical quantities should be defined in a relative and limited manner, with localized and temporary values that are just assumed to be absolute constants.

Let's make a simple mental exercise, presuming we are observers from *outside* the Universe, witnessing the moment it was born and its first seconds of existence. According to the current theories, we should notice at this time zero the so-called "singularity": an enormous concentration of immovable primal matter (of infinitesimal size), which suddenly comes out of the stable state of high-density and high internal cohesion by a huge "explosion". The word *matter* (not energy) is in the right place, as my main presumption is that the raw material of this primordial matter is the actual constituent of the *ordinary matter's* structures; moreover, it will also represent, in the broader area of this theory, the unique ingredient of *space*.

The Big Bang "explosion" has therefore created all the components of space and has triggered its expansion process (seen as a three-dimensional framework). Now, when there is a "place" and "something" to move through, it makes sense to introduce some new matter-related concepts, such as motion, speed, time and energy. It has to be mentioned that the current view of physics on the Big Bang event does not consider it as an explosion of matter that fills an empty space, but an inflationary process of space itself - which was expanding along with the concentrated energy. Also, the exact origin of the energy (or matter, as in my model) contained inside that singularity is still unknown. Prime Theory considers that space has a *dual nature*, namely:

- It is a three-dimensional, finite, linear, uniform, empty framework created in the primordial "explosion". The energy of this event determined an accelerated expansion of the spatial framework in the beginning, and the presumed uniformity and symmetry of that singularity implies it kept an almost perfect ball-shaped form during the process.
- It is a pseudo-fluid made up of an infinite number of identical spatial "granules" - bits of matter that are freely moving inside the three-dimensional frame mentioned above; the specific properties of this fluid will be discussed in Chapter 3.

The "explosion" of that singularity happened in an instant; the super-concentrated "raw material" has exponentially increased in volume and divided into an extremely large number of infinitesimal elements called "granules". At that very moment, all the primordial energy of the singularity was transferred to these granules in the form of kinetic energy.

My alternative scenario presumes that the motion of these granules will generate the three-dimensional space and will expand it continuously. Moreover, the spatial expansion does not require any energy consumption; it represents only a geometric increase in volume made by the granules through free motion or through their collisions with an elastic medium. Seen from the outer reference frame proposed above, the expansion of the newly born Universe takes place at a very high speed, probably over the actual speed of light in a vacuum, **c**. However, it is reasonable to assume that the expansion speed is lower or equal to ***C***, the speed from the Granular Postulate #1, Section 3.1.

All the granules formed in the primordial explosion will normally move in radial directions; as soon as the first ones reach the space borders, they are reflected back and thus the inter-granular collisions will start happening. Due to the expected irregularities in the distribution of the granular density, a huge number of granular aggregations will be formed immediately, leading to the creation of the first elementary particles; these elementary structures will soon group into composite particles and simple atoms, finally creating the ordinary matter.

3. GRANULARITY

3.1. Granular postulates

If the hypothetical genesis process described above holds true, then the spatial granules may be declared the smallest division of matter and also the smallest form of elementary, pure energy. They represent the primary constituent of space and of the Universe in general, being the key element of this theory. The fundamental properties of these tiny bits of matter are:

a) Granules, seen as the constituent elements of space, have *the smallest possible size* in the Universe. We may assimilate them with spheroids of diameter ***d*** - a value which is about the Planck's length [3] or even lower (for comparison, there are many other dimensions listed in Appendix 6).

b) All of the granules are the same size; therefore, they are *identical* and *equivalent* corpuscles.

c) They are mobile, moving freely in a straight line, at a constant speed. Their absolute speed is the *maximum* possible speed in the Universe, and this determines a speed limit for the movement of all particles and for the propagation of waves.

d) All of the granular collisions are *perfectly elastic*. There is no other kind of interaction between granules, and their shape, integrity and stability are maintained for an *infinite* time.

e) Two laws of conservation govern the granular collisions, namely the total *energy* and the total *momentum* are conserved simultaneously.

f) We cannot talk about mass at this scale, neither in a quantum nor in a macroscopic way.

Fundamental granular postulate #1

*All spatial granules are moving at the superluminal speed **C** (faster than light), which is the maximum possible speed in the Universe.*

Note 1: As all of the grains are identical, this postulate implies they all have the same value of *impulse* (a vector quantity, a special kind of *momentum*), denoted by ***p***, and the same value of *kinetic energy*, denoted by ***e*** (a scalar quantity). In fact, ***p*** and ***e*** are the primary quanta of impulse and energy, i.e. the smallest amounts of these new fundamental physical quantities.

Note 2: The absolute speed ***C*** may be measured by an observer from the outside of our Universe, in any direction; the rectilinearity of the granular motion is seen in the same way.

Note 3: This maximum speed ***C*** is a fundamental constant of our Universe, determined only by the primordial amount of energy stored in that presumed singularity.

Fundamental granular postulate #2

*The total number of granules in the Universe is constant (it will be further denoted by **N**).*

Note: With regard to the cosmological hypothesis described above, it is reasonable to assume the conservation of the initial quantity of raw material; as the only interactions between granules are the perfectly elastic collisions, which do not change their shape or their number, the conservation of the total number of granules is a simple and logical conclusion.

3.2. The granular fluid

The granular fluid is the material component of space and it virtually determines all its properties. As described above, the spatial granules move in all possible directions at their maximum speed. We may extrapolate from this simple fact several essential characteristics of this particular fluid:

- The granular fluid rapidly fills any free region of space, until the average local density is reached; this happens at the maximum speed of the granular movement, ***C***.
- Different values of its local density lead to spatial anisotropy, which influences the speed of propagation and the direction of any wave through space.
- The mean distance between two granules is much larger than their diameter; given the average spatial density, this leads to a certain non-zero probability of collisions between two granules and to a quasi-null value for the simultaneous collision of three or more granules.
- In this special fluid, where chaotic granular collisions are happening all the time, we may identify groups of granules moving simultaneously in the same direction. They form the directional granular fluxes, which existed ever since the first moments of the Universe. All the directional fluxes passing through a given space region, at a certain moment, are forming the local flux - simply designated as *flux*.

Why a granular *fluid*?

Because it has many properties and characteristics that are common to the macroscopic scale fluids, for example to a chemical element or compound in a gaseous state:

- It is made of numerous identical components that are elastically colliding;
- There are some specific fluid parameters we may assign to it, such as pressure, density, entropy;
- It allows the rectilinear propagation of waves.

3.3. Granular equivalence

Let be two granules, **A** and **B**, of light and respectively dark color, as shown in Figure 1. They move in the XOY plane at a constant speed ***C,*** on directions that form the angles **α** and **β** to the OX axis. You may observe their position at time **t1**, the perfectly elastic collision at **t2** and their final position at **t3**.

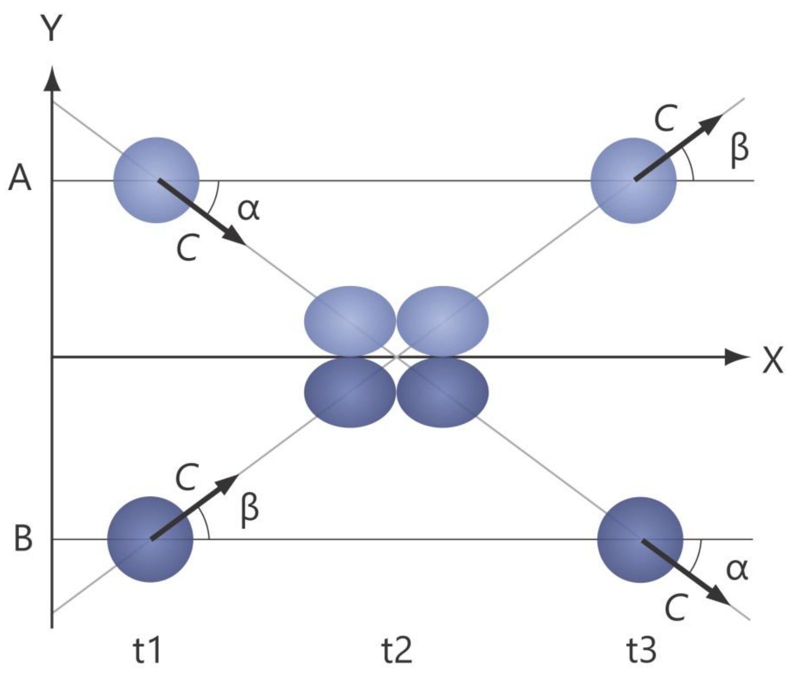

Figure 1 - *Granular equivalence*

By applying the conservation laws for this type of collision, we may see that the granule **B** virtually takes over the impulse of granule **A** and continues its trajectory, and vice versa. As for their trajectories, granules A and B are therefore *equivalent*, and a fundamental principle of the granular fluid mechanics may be inferred from this thing:

All directional granular fluxes maintain an absolutely straight line as global direction of propagation.

Moreover, we may calculate the average speed **ṽ** of a directional granular flux. Figure 2 shows how the granule **A** enters into a cubical region of side length **L**, and, after several collisions, exits as equivalent granule (**B**).

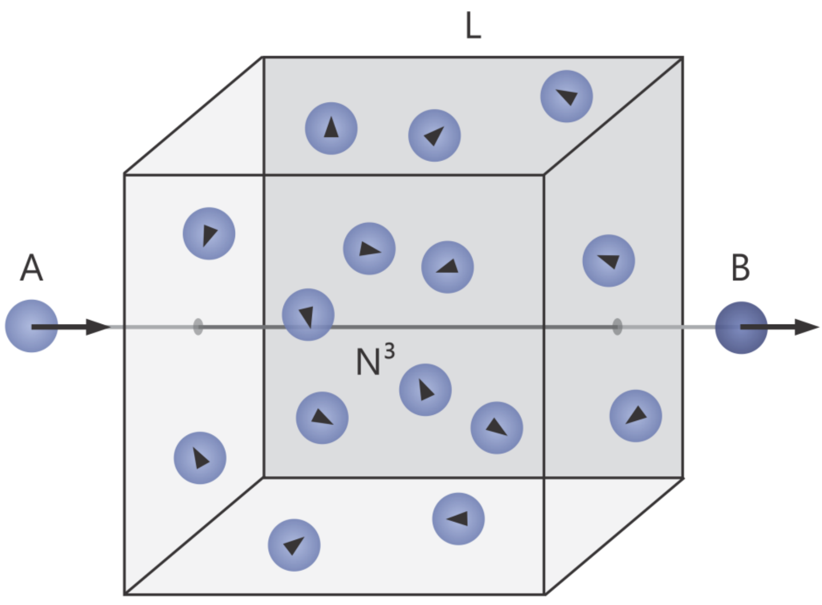

Figure 2 - *The average granular speed*

This cube contains $\mathbf{N^3}$ granules, and **P** is the collision probability on the direction of travel. We must also consider the non-zero duration **t** of the collision process.

Simple calculations give us the average speed of a granule:

$$\tilde{v} = C / (1 + C\,P\,N\,t / L)$$

We may easily observe that the average speed depends on the "linear density" of the granules, **N / L,** being always lower than ***C***; this allows us to infer another important principle:

The speed of the directional fluxes depends only on the local average granular density.

3.4. Granular collisions

If we are to analyze in detail the inter-granular collisions, considering the non-zero diameter of a granule, we may see a *deviation* in the equivalent granule's trajectory. This deviation has a zero minimum value and a maximum value equal to the diameter of a granule, ***d***, and it depends on the angle formed by the trajectories of these two granules.

For a granule that passes through a region of space with equal directional fluxes, this average deviation becomes null. Figure 3 illustrates the collision of two granules A and B (they are moving in the same plane XOY, in orthogonal directions).

The distance between the horizontal lines is **Δy** and this represents the deviation of the equivalent granule from the initial trajectory (in this case being equal to the value $\mathbf{d / \sqrt{2}}$).

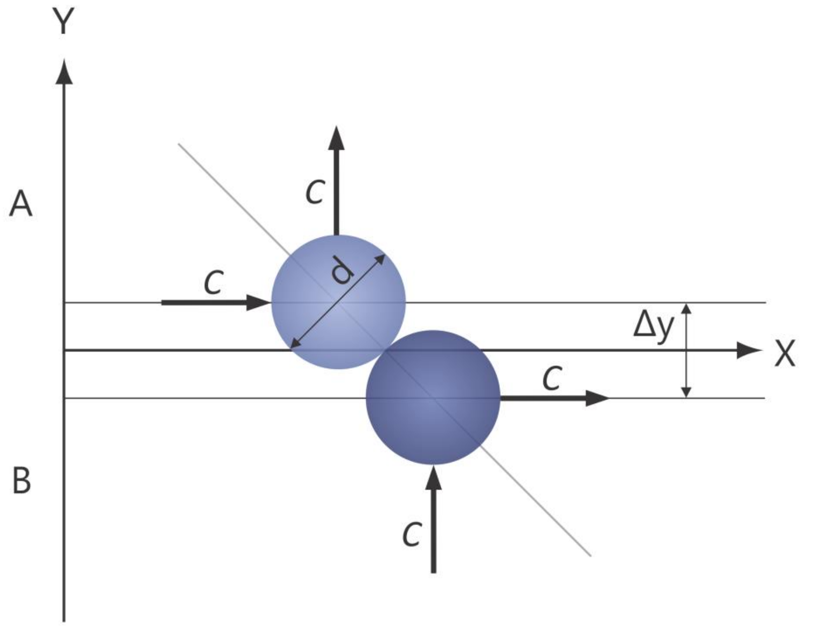

Figure 3 - *Granular collision*

If we add the supplemental flux **Φ**, vertically (upwards) oriented and constant over time, all of the granules will have an extra displacement (along the OY axis). Their velocity vector will temporarily become more inclined toward the bigger flux, and that angle variation is proportional to the flux intensity.

In other words, a granule is "attracted" to the source of the more intense directional flux, as shown in Figure 4. When those granules leave the area crossed by the increased flux, they all are resuming their movement in the initial direction.

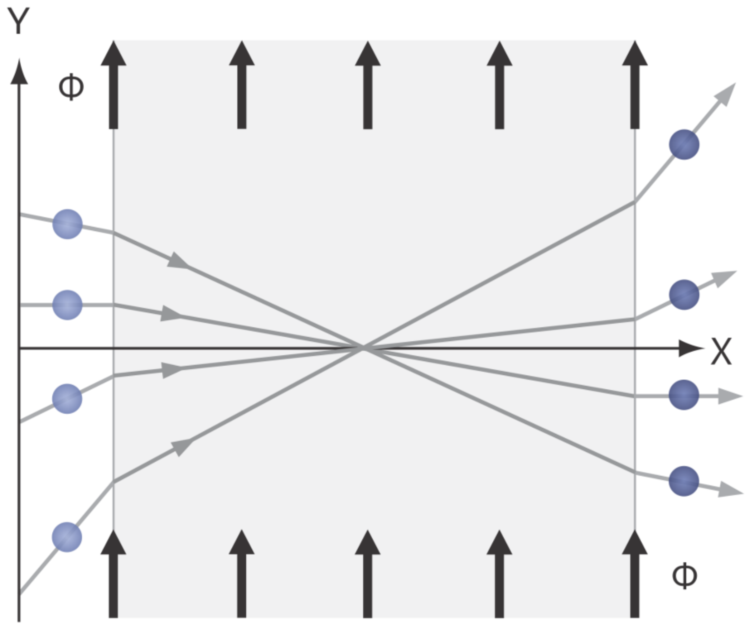

Figure 4 - *Granular paths in areas with intense flux*

Observation:

Moving through zones with bigger directional fluxes, a certain granule apparently experiences a speed increase. This happens because its movement is taken more often by the equivalent granules from that flux. Its "falling" speed is determined by the diameter of granules, by the intensity of that uniform flux and by the width of that area.

4. FUNDAMENTAL LAWS OF THE UNIVERSE

All of the data and postulates described in the previous chapters allow us to formulate a set of three fundamental laws that govern our Universe at any scale, i.e. from the granular level up to galactic proportions:

4.1. First law

Any distinct and quantifiable physical entity (waves, particles, fields) is in fact an organized structure of spatial granules.

It should be pointed out that these special structures are lying in the granular fluid of space; they all keep their structural integrity due to the special properties of this fluid (Chapter 3).

4.2. Second law

The vector sum of all granular impulses in our Universe is quasi-null.

Mathematically, this law may be put into this formula:

$$\sum \bar{\boldsymbol{p}}_i = \mathbf{0}$$

which also means that in a closed and finite universe, the total granular impulse is conserved over time.

The irregular shape of the primordial singularity or the nonuniform granular reflections during expansion can change the zero value of the total impulse, but we may assume that this difference is very small. If our Universe is a perfect sphere, then the granular reflections on its edges will preserve and "dilute" this non-zero value into its ever-increasing volume. As the spatial granules exchange their impulses during elastic collisions, their total impulse remains unchanged over time. This phenomenon may be extended, theoretically, for any granular system in a limited region of space with uniform local flux. However, a precise localization at the granular scale is not possible; here we are way beyond the quantum uncertainty and, actually, we cannot talk about any localization. At this level, the information itself is completely disseminated; it no longer makes any sense and practically disappears as a notion.

4.3. Third law

The total granular energy in our Universe is absolutely constant over time.

$$E = N\,e = constant$$

Any amount of energy, which exists somewhere or is exchanged between some physical entities, is in fact a *sum* of elementary granular energies. Consequently, any granular structure groups a number of minimal kinetic energies, its total energy being equal to the sum of all these energy quanta. Fractions of this energy may be transferred to other structures through the exchange of elementary granular impulses. All this granular mechanics automatically determines the relative character of the kinetic energy possessed by a physical structure; the value of this type of energy will depend on the relative speed of the structure to an observer located in a reference frame.

Note 1: These basic laws of physics are valid ever since the first moment of the Universe, just after the "explosion". As there are no real scientific experiments to deal with those orders of magnitude, all these laws may be assimilated to postulates.

Note 2: Due to their *elementary* and *absolute* character, the granular energy and impulse are *special* physical quantities, different from the macroscopic ones bearing the same names.

Note 3: These three laws do not apply to that presumed singularity, as its granules were in a different state - being in fact compressed and "glued" together.

Note 4: The last two laws are valid inside our Universe, but only in regard to that absolute, fixed frame of reference.

5. GRAVITY

5.1. Preamble

If we analyze the description of the granular fluid from Chapter 3, we realize that any part of space, at any scale, is continuously crossed by directional fluxes of granules. This phenomenon has begun at the Universe's birth, being an integral part of its structure. As a direct result of the Second law (Section 4.2), our Universe must have a symmetrical distribution of the directional fluxes (relative to its hypothetical center).

Let be (Figure 5) a cross-section of the Universe, where the visible area is drawn in light gray and **S** is a plane surface crossed by two perpendicular fluxes.

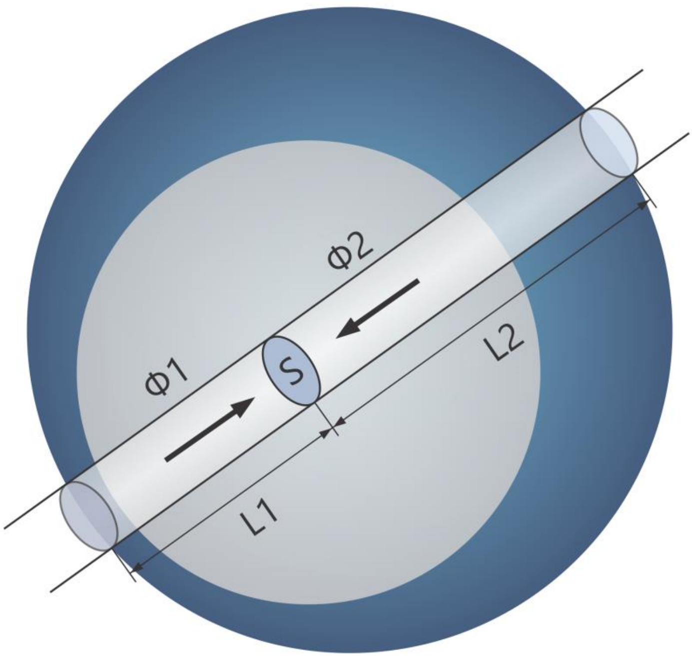

Figure 5 - *Flux intensity*

Both incident fluxes are represented as vectors, **ϕ1** is heading to the right and **ϕ2** to the left. The intensity of a directional flux is given by the number of granules that pass through a given area in a unit of time. From the total number of granules moving in the gray cylinder (generated by surface **S** projected onto the edges), a constant fraction composes each flux in its direction.

Therefore, a flux denoted by **ϕ** is directly proportional to the average granular density of the Universe N/V:

$$\phi = k\,N / V\,S\,t$$

V is the volume of the Universe, **N** is the number of granules, **k** is a constant and **t** is the time interval.

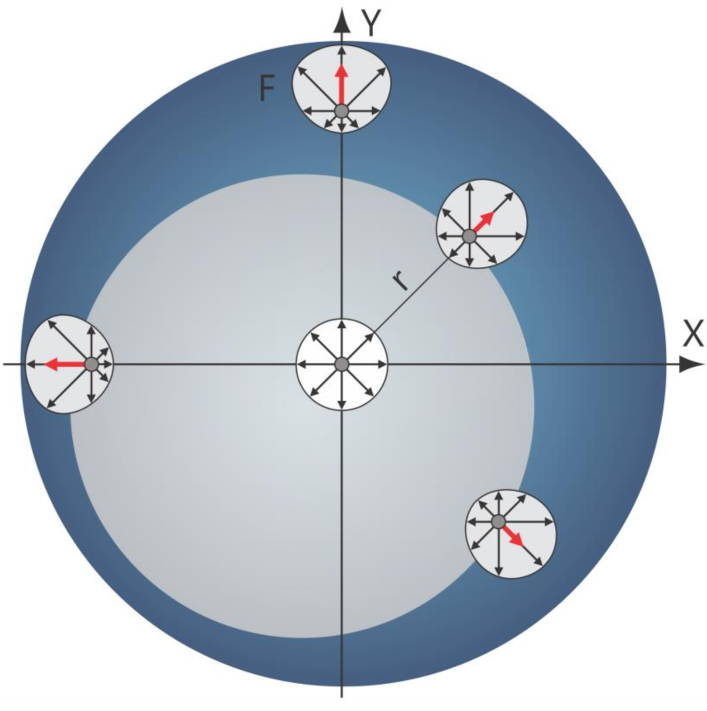

Figure 6 - *Granular fluxes in the Universe*

If we take into consideration the expansion of space (only geometrically, at the boundaries), a decrease in intensity of all reflected fluxes seems reasonable. A spherical body, placed in different regions of the Universe, has different distributions of incident fluxes, as shown in Figure 6. In the middle area, there is a balanced distribution of all directional fluxes; if that body is closer to the edges, the outward-facing flux becomes dominant. The red vectors (the thicker arrows) show the direction of the resultant fluxes for each position. The mathematical formula of these fluxes is not a linear equation with the distance **r**, as it has to include the rate of expansion of the Universe and the variable speed of propagation over time.

5.2. The gravitational field

The ensemble of all granular fluxes that are incident on a certain body is called gravitational field.

These fluxes interact with a material body through granular collisions (the incident granules collide with the particles from the body, especially with the atomic nuclei). There is a continuous transfer of impulse from the directional flux toward the body, which actually creates a pressure force in that direction (this kind of interaction will be detailed in the next chapter). It should be noted that, from all the incident fluxes, some will go through the body (depending on the density of its constituent matter) and some others will be scattered in multiple directions (the reflected fluxes are diffuse). There are pressure forces exerted in all directions, and their direct effect on that body is a continuous compression; this pressure equilibrates the internal forces and a steady state is reached eventually. However, if a single body would exist in the entire Universe, located in an off-center position, the only force that would act on it is the resultant of the local fluxes. Thus, this rigid body or formation would be pushed toward the edges of the Universe by a force **F** (the red arrows in Figure 6) that grows bigger near the edges (Section 5.1, due to the gradient of the resultant flux).

The most interesting case to study is the presence of two or more bodies in a "cosmic" neighborhood. They would be subject to the combined action of the force described above and of the gravitational "attraction" - a force to be described next. This new force "pushes", in fact, one body toward the other by the action of the omnidirectional fluxes. The incident fluxes are partially blocked by those two bodies (see Figure 7, the light gray area). As the size of these bodies is generally small compared to their distance, the solid angles that include the diminished fluxes will be also small.

Now, let's consider two spheroidal cosmic bodies **C1** and **C2**, of different diameters, **D1** and respectively **D2**, the distance between them being denoted by **L**. The black arrows represent the local flows, whose resultant generates the forces of "attraction" denoted by **F**; equal forces are exerted onto both bodies, along the line connecting their centers. To simplify, we will consider uniform local fluxes (of value **ϕ)** and an equal opacity of those bodies to the granular flux.

A few simple calculations (considering both bodies as discs and **D1 << L** and **D2 << L)** produce this formula (**k** is a constant):

$$\mathbf{F = k\,\phi\,D1^2\,D2^2\,/\,L^2}$$

which, at this level, is in full accordance with the *Law of universal gravitation* (Newton).

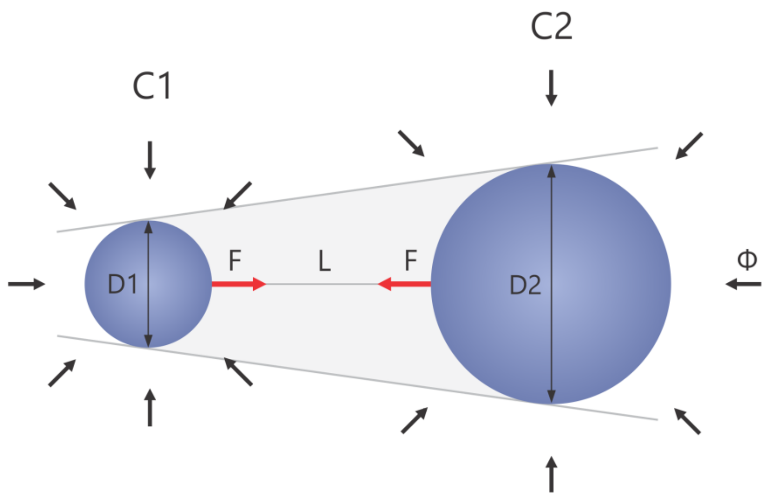

Figure 7 - *The attraction between two bodies*

Therefore, under the action of those dual forces above (determined by the flux gradient and by the shadow effect), two cosmic bodies "attract" each other if they are close enough and they are "pushed away" if they are placed at very long distances. If we analyze the size of the largest galaxies, we may estimate this threshold value - where this force changes its direction - around 100,000 light-years.

Note 1. In this context, the inflation theory should be also changed; space is continuously expanding, for certain, but not only by a uniform increase in itself. Space, as a geometric frame, increases mainly due to the addition of more volume at the edges of the Universe - a volume created and expanded by the local granular fluxes. The galaxies are receding from one another, and this is mostly caused by the flux gradient described above (and not only by the inflation of space). In the same way, the redshift of photons coming from distant star clusters (photons emitted billions of years ago) is essentially explained by these three effects:

- The non-relativistic Doppler effect, because most of the galaxies (their component stars that emit photons) are slowly moving away from us.
- The decrease of the average granular density of space with its expansion, which leads to a gradual increase in speed and wavelength of the photons crossing the intergalactic vacuum (this is the well-known relativistic cosmological redshift).
- The gravitational effect, as the intensity of all granular fluxes changes near massive bodies.

Note 2. The existence of the attraction and repulsion forces at the cosmic level is consistent with the astronomical observations carried out on galaxies, which all have shown that galaxies are receding from Earth at a speed approximately proportional to their distance (**Hubble law**). During a very large time interval, after the first stars were grouped through the force of "attraction", the galaxies created in this way start repelling due to the force of "repulsion" - which becomes dominant at long distances. Nevertheless, this phenomenon is more complex, and it cannot be described by a simple linear equation; the Universe is continuously expanding, which reduces the average granular density of space and thus the intensity of the directional fluxes.

From a global perspective and at this point in time, all of the galaxies are receding faster and faster (their acceleration values increase with the distance to the virtual center of the Universe and decrease over time).

5.3. Conclusions

The gravitational field interacts with ordinary matter, i.e. the one made up of atoms and molecules, in a simple manner. Omnidirectional granular fluxes collide with all elementary particles (electrons, nucleons, etc.) and continuously transfer them a directional impulse; this phenomenon is equivalent to a pushing force applied in the direction of the resultant flux. The magnitude of this force is given by the intensity of the resultant flux and by the area of the surface on which it reflects. While a few data about this phenomenon were already revealed (but it will be described in detail in the next chapter, Elementary particles), we have to mention in advance that the area of particles is directly proportional to their inertial mass.

Several important conclusions may be drawn now:

a) At this level, the inertial mass is identical to the so-called gravitational mass, both physically and numerically.

b) The gravitational force acts *the same* upon all particles, and hence upon the atoms and molecules. This force "pushes" evenly on all the matter of a body (its magnitude is proportional to the body's density) until equilibrates the internal forces of electromagnetic nature.

c) At the atomic scale, this gravitational force has a very small value, many orders of magnitude below the intensity of the other forces. However, if the scale is lowered down to the atomic nucleus and its components, this force significantly increases and even equals the other forces acting at this level.

d) The mechanical work done by the gravitational force within an atom is zero, as well as the one produced in a system of atoms (for example, the movement of electrons in closed orbits within this uniform field does not produce and consume energy). As a result, the presence of this *constant* force at the atomic scale cannot increase the temperature of matter, and cannot disintegrate or transform it; the matter is only compressed until it reaches a steady state. In the case of big celestial bodies such as planets or moons, gravitation may indirectly cause heating due to tidal forces. In the case of stars, which have a much higher mass, the internal pressure exerted by the gravitational forces increases their density and this raises their temperature until the nuclear fusion reactions are ignited.

At the bigger scale of the Universe, the directional fluxes and their resultants are distributed as shown in Figure 6. Their intensity, as well as the average granular density, is not constant over time; all these values are continuously decreasing with the space expansion.

6. ELEMENTARY PARTICLES

According to the fundamental *First law* (Section 4.1) stated above, an elementary particle is an organized, minimal structure of spatial granules, a formation that can freely move through the granular fluid of space. My granular model of particles includes some defining characteristics of all these elementary corpuscles:

a) An elementary particle has a determined three-dimensional geometric shape that is stable over time.
b) Every particle interacts with the surrounding granular fluid, but this thing does not affect its geometric shape.
c) A free particle is either at rest or in motion with a constant velocity (its value being lower than the speed of light, **c**).
d) A particle has, during its whole lifetime, a constant granular density of the maximum possible value.
e) Any particle has a non-zero mass - which is defined for now as a measure of its inertia.

6.1. Explanations

As it was postulated in Chapter 3, all of the grains are having an absolute, superluminal velocity of value ***C***. Therefore, any granular structure, and hence the particles, must preserve this fundamental granular property; at the same time, the structure as a whole may have any subluminal velocity, in any direction. These two aspects could come together only in a special construction, like the one shown in Figure 8; there is a section through an elementary particle, of a *hypothetical* spherical shape, immersed in the spatial fluid crossed by the uniform directional flux **ϕ**.

All of the granules from inside the particle, regardless of their position, move with the maximum speed ***C*** on circular trajectories that form a certain angle **α** (alpha) with the particle's direction of movement (see the velocity vector **v** - the red arrow).

As the particle always has a non-zero speed, the angle **α** will also have a non-zero value. This difference between the angular velocity of the particle (seen as a solid object) and its direction causes a permanent precession movement to all granular structures of this type. It may be also noted that the granules in a particle have different angular speeds, as they are rotating at constant speed on circular trajectories of different radius values.

The granular layers of a particle are therefore spinning at *different angular speeds* (they rotate differentially). The trajectory of any free granule is rectilinear, while the granules from inside a particle will actually follow curved paths at all times. This thing must be corroborated with the continuous granular collisions between the external layer of a particle and local fluxes, leading in this way to simple explanations for the global movement and structural stability of any particle:

a) The stability and the structural integrity of an elementary particle are provided and ensured by the permanent impulse transfers that occur in all collisions between the granules of the incident fluxes and the granules from the outer layers of the particle. This kind of external "pressure", which is exerted continuously, causes the equilibrium and the internal cohesion of all particles; at the same time, it determines a maximum possible density for the internal granules, as they all are practically "glued" together.

b) The fluxes that are incident on the particle's surface transfer impulses to the granules of the outer layers and then return, under normal conditions, with the same intensity. Due to its high internal density, a particle acts in fact as a "solid" body, reflecting the incident granules; this phenomenon does comply with the general laws of reflection. If that particle is moving at relativistic speed, these granules will have a kind of relativistic reflection. In both cases, each granule of the fluxes transfers an equal, evenly distributed impulse, whose value *does not depend* on the particle's speed.

c) The total impulse received by any particle from the local fluxes is null; if these fluxes are uniform, the particle will keep moving at a constant speed **v**, on a straight trajectory, executing the precession motion described above. If the intensity of the incident fluxes varies in a certain direction, that particle will be accelerated or decelerated. The effect produced on particles is averaged during a larger time interval, when they rotate several times and expose all their sides to the different flux; therefore, their shape and structural integrity are not affected.

d) Seen from that virtually fixed frame of reference, all the component granules of a particle are moving at speed ***C*** on a helical path; the particle, as a whole, follows the same type of trajectory, having a pitch proportional with its linear speed **v**.

e) Any change in a particle's uniform motion is produced by the action of a directional flux, the final effect being the increase or decrease of the particle's kinetic energy.

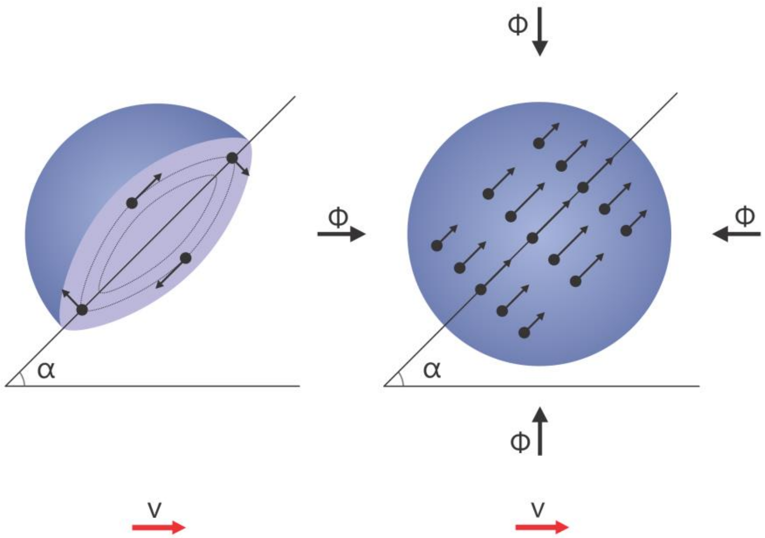

Figure 8 - *The internal granular impulses of a particle*

6.2. Mass

A particle moves at the constant speed **v1** (Figure 9), being observed from an inertial frame of reference. An additional flux **ϕ'** starts to flow at time **t1**, constantly, in a certain direction and for a certain duration. Each collision between its grains and the particle's surface will transfer a new impulse to the particle; the sum of all these impulses constitutes the total impulse transferred to the particle, in that direction. This phenomenon is completely equivalent to the action of a force **F** that "pushes" the particle during the same period of time. At the moment **t2**, when the flux **ϕ'** stops, this particle will have a higher speed **v2** (v2>v1) and a bigger linear momentum. As the total impulse does not depend on the particle's speed, we can assume that, as long as the additional flux exists, the particle has been accelerated by a force **F** of constant value.

In non-relativistic conditions, that particle will therefore have a uniformly accelerated motion; its equation is given by the fundamental law of motion **F = m a** (Newton), where **a** is the acceleration and **m** is the mass. The particle's mass, as in the case of macroscopic bodies, shows the inertia (the amount of resistance) of the particle while its state of motion is changed. Where does this inertia come from? If we take a look inside the particle at time **t2**, we may see that the plane in which the granules rotate is now making a different angle with the particle's direction of movement, **α2**. Why? Because these granules keep moving with their absolute speed and the orientation of their velocity (impulse) vector is adjusted in order to compensate for the increased speed of the whole structure. In other words, the global impulse that is transferred to the particle by the additional flux will change the direction of all granular impulse vectors. Analyzing these data, we may observe that the inertia is directly proportional to the total number of granules of a particle (granules that have changed the direction of their impulses when the whole particle changed its speed).

Mass is, in fact, a measure of the total impulse needed by a particle to adapt all its internal granular impulses to the global change in speed.

As the particle has a symmetrical shape, we may conclude that:

The absolute rest mass of a particle is a scalar physical quantity that only depends on the number of its constitutive granules.

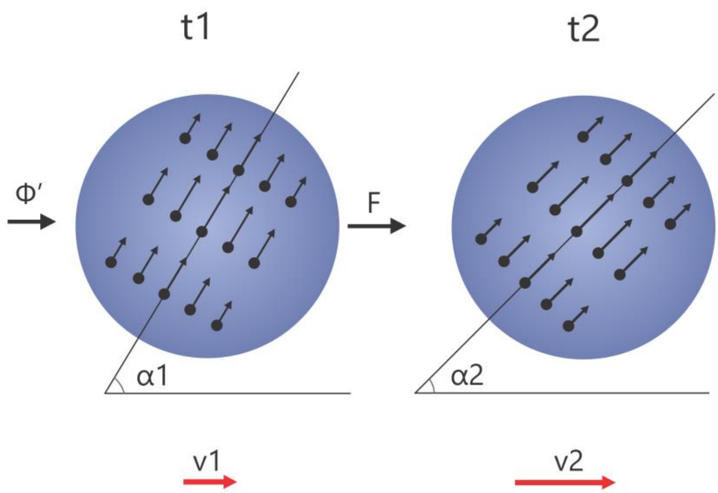

Figure 9 - *Direction of the impulse vectors*

As the particle's inner layers have the highest possible degree of compactness, the granular density (the number of grains per volume unit, **ρ**) will have a constant value; therefore, the absolute rest mass of a particle will be directly proportional to its volume (**k** is a constant):

$$\mathbf{m_{00} = k\ N = k\ \rho\ V}$$

The closed system formed of the new flux and of that particle, seen from an inertial frame of reference, conserves its total energy. The incident flux, through the impulse it transfers to the particle, generates the conservative force **F** that performs mechanical work on the distance between the particle's positions at those two moments (**t1** and **t2)**. This mechanical work shall be equal to the increment in particle's kinetic energy; the speed increase is bigger if the particle's mass is smaller. We may infer from this statement that the minimum energy of a particle is reached when it stays at rest, and, using the mass-energy equivalence (Einstein), we may write the formula:

$$\mathbf{E_{00} = m_{00}\, c^2}$$

The energy of a particle that moves with an absolute velocity of value **v** (relative to the fixed frame of reference) is:

$$\mathbf{E = m_{00}\, c^2 \sqrt{1 / (1 - v^2/c^2)}}$$

In a relativistic case, the particle's mass increases with the velocity value, but the number of the component granules remains constant. This is happening because the amount of energy required to change the direction of all granular impulses is now higher. Close to the speed limit **c**, the average angle between the impulse vectors and the direction of the particle movement has a minimum value; although the speed of all granules is ***C*** (***C*** **>** **c**), this value cannot be reached by the particle as a whole due to the granular collisions described in Section 3.4. If we look at the dynamics of these things, we may see that the absolute rest mass is given by the number of granules in a structure; however, the constant **k** is finally determined by the magnitude of the granular impulse quantum (the elementary and universal impulse value, the minimum amount of momentum that can be transferred through the inter-granular interactions).

6.3. Electric charge

Considering the explanations given in Section 6.1, my model of elementary particles uniquely connects the charge feature to their geometric shape. Any charged particle has a discoidal shape, its diameter being much larger than its thickness (estimated ratio of at least 100). This regular shape, which is *perfectly symmetric* to a central plane, is among those special shapes that could maintain the particle's structural stability for a long time. Figure 10 shows a generic elementary particle with half-integer spin (angular momentum); you may see its average angular speed **ω** (left) and the trajectory it follows moving in a horizontal direction at the constant speed **v** (right). In fact, all its real movements can be seen there: rotation, precession and global translation.

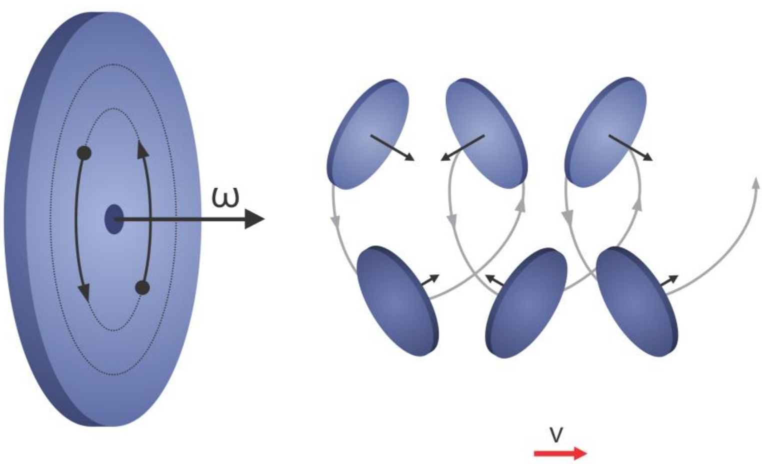

Figure 10 - *The geometric shape and the trajectory of a particle*

A closer look to this complex motion can be found in Appendix 1. In the middle of the disc, there is an empty space of cylindrical shape, with a very small diameter; as it does not play a significant role in the internal dynamics of particles, it will no longer be graphically displayed. In addition, all of the particle's edges have in fact a round shape, being circular arcs in any section. In addition, both lateral surfaces of the disc are not flat, and this allows us to formulate a definition for charge:

The charge of an elementary disc-shaped particle is a measure of the concavity/convexity of its side surfaces. Due to the perfect symmetry, the amount and type of charge are identical on both sides of the disc.

Charge is an additive quantity; therefore, the total charge of a particle is twice the charge of a single side. We may establish this simple convention for biconvex and biconcave particles:

The positive charge is the attribute of the convex discs, while the negative charge is the attribute of the concave ones.

Moreover, all the particles with a negative charge are graphically represented in blue, while the positive ones are red.

If the local fluxes hit this type of surface, they will reflect back following the rules described in Chapter 3; they actually converge or diverge, creating a gradient in the resultant flux and a slight variation in the average granular density near the particle. Therefore, all the charged particles will generate "fields" in their vicinity, exerting either attraction or repulsion forces onto the other charged structures.

The side surface of a charged particle has a special round shape that in geometry is called a *spherical dome (cap)*. The magnitude of the charge, intuitively speaking, is the degree to which the incident fluxes are dispersed or concentrated, and thus it will be directly proportional to the reflecting area of the particle and inversely proportional to the radius of the sphere that includes this area. Numerically, the charge **Q** of a particle side is:

$$\mathbf{Q = k\ A / R}$$

where **A** is the area of the spherical cap, **R** is the sphere radius, **k** is a constant, as shown in Figure 11. Applying the formula of the cap area, it yields:

$$\mathbf{Q = 2\ \pi\ k\ h}$$

where **h** is the height of the spherical dome. We can see that the magnitude of the charge - which will be called *electric charge* - depends only on the height of the spherical dome. The volume **V** of the spherical cap is:

$$\mathbf{V = \pi\ h\ (3\ r^2 + h^2) / 6}$$

where **r** is the radius of the spherical dome.

If we consider that the value **h** (thickness) is constant for different particles (and **h << r)**, the volume of a charged particle will be proportional only to the square of its radius; therefore, the rest mass of a charged particle will have the same dependency. The volume of the circumscribed disc of the spherical dome, excluding the cap, is:

$$\mathbf{V = \pi\ h\ (3\ r^2 - h^2) / 6}$$

being also approximately equal to the cap's volume for **h << r**.

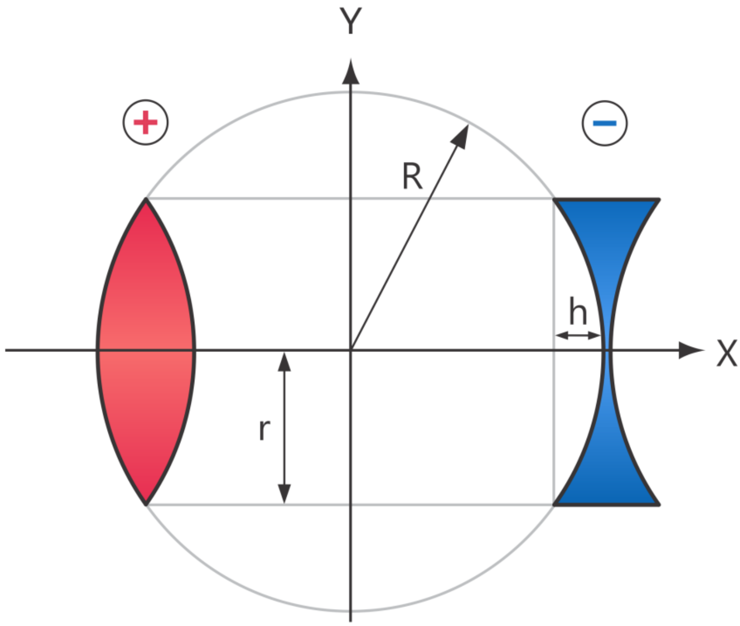

Figure 11 - *The charge of electrons and positrons*

6.4. Electrons and positrons

The electron, which has one negative charge unit (-1), and its antiparticle - the positron, which has one positive charge unit (+1), are the smallest particles carrying electric charge; they both have the same mass and the same half-integer spin. It is well known that *like* charges repel each other, while *unlike* charges attract one another. The mechanisms of these actions are shown in Figures 12, 13 and 14. As mentioned above, electrons are drawn in blue and positrons in red; for more clarity, they are figured with a stylized shape and a bigger thickness **h**. In addition, we will further assume that the distances between these particles are much bigger than their diameter.

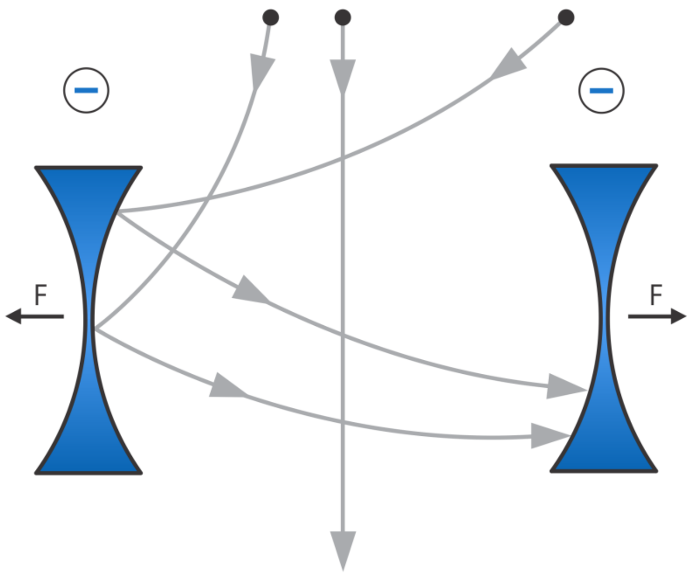

Figure 12 - *The repulsive force between two electrons*

Charged particles may modify the trajectories of the local fluxes (represented in gray), and this was previously described in Section 3.4. The curved paths are caused by the nonuniformity of the reflected fluxes, as their intensity changes with distance (this variation will be shown in Section 6.5). The electrons will slightly "attract" the granules, while the positrons will "repel" them in the same measure.

The pictures below show the paths of three granules coming from the top and right sides of the frame; all of the other granules will have similar, symmetrical trajectories. Figure 12 shows two electrons that are repelling each other due to the reflection and concentration of the local granular fluxes flowing in the free space between particles.

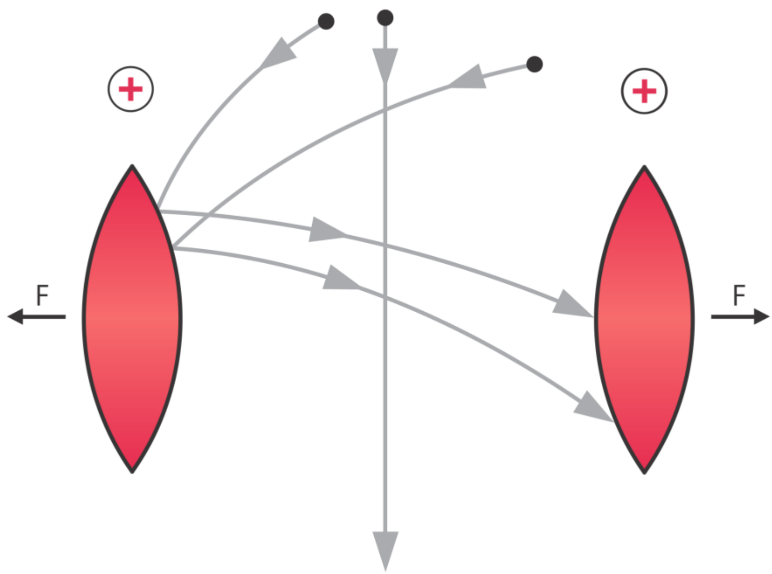

Figure 13 - *The repulsive force between two positrons*

A similar mechanism works between two positrons, as in Figure 13, where the reflected fluxes concentrate and become more intense. In the case of particles with no charge or of those with no net electric charge, the granules are not significantly deflected or their deviations are compensated; therefore, the local fluxes will exert a total null force on this type of particle. Figure 14 shows the mechanism that generates the force of attraction between particles with opposite signs. Many equivalent granules are deflected by the positive particle and bounce back, being trapped in the field of the negative particle and bumping it from behind. At the same time, they no longer equilibrate the fluxes flowing around the positron, which is equivalent to a "push" toward the electron.

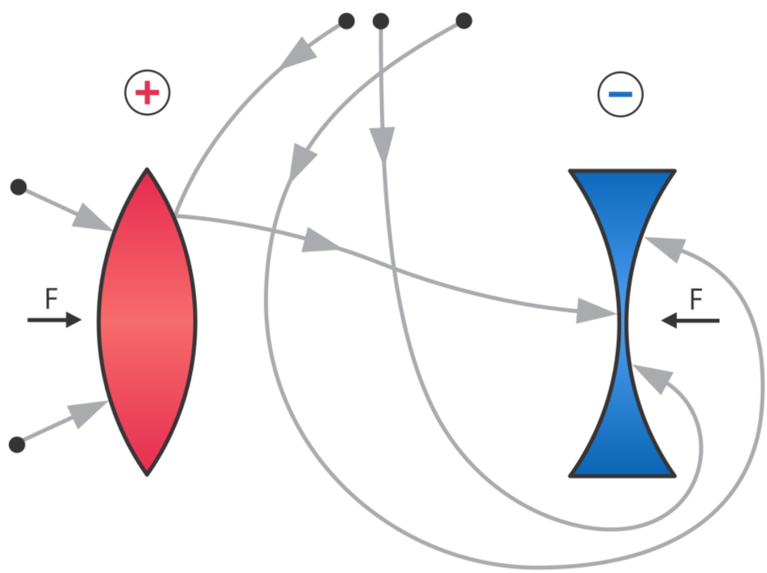

Figure 14 - *The attractive force between electrons and positrons*

It should be noted that the granular deflection around the charged particles is not uniform, and this is due to the following simple reasons:

a) All free particles are continuously moving and rotating, as shown in Figure 10.

b) Their specific shape determines a more intense phenomenon in axial directions.

c) The divergent or convergent fluxes decrease in intensity with the distance.

d) Each particle moves with a certain global velocity.

The forces acting between particles with charges of the same sign will create a torque, which perpendicularly aligns their angular momenta - as average directions. This leads to the important quantum mechanical principle of exclusion (Pauli exclusion principle), which states that two identical fermions cannot occupy the same quantum state simultaneously (considering the quantum state as the direction of the angular momentum). It explains the inner structure of the atoms (electron shells) at the quantum level, the volume they occupy and their stability in time, as well as the wide variety of chemical elements and their combinations.

6.5. The electric field

The ensemble of the convergent or divergent granular fluxes created by any electrically charged particle in the surrounding space is simply called an electric field.

The electric field is a vector field; its direction is given by the resultant flux and by the sign of the electric charge, while the magnitude is given by the intensity of the flux passing through a surface perpendicular to its direction. All of these divergent and convergent fluxes have conical shapes and their section area increases with the distance from the source.

It follows that the intensity of the global flux generated by a charged particle (flowing through a constant section) will diminish with distance, and therefore its electric field will vary in the same way with distance.

Figure 15 shows a section through a positively charged particle and the variation of the divergent flux it reflects through a circular area, in the axial direction.

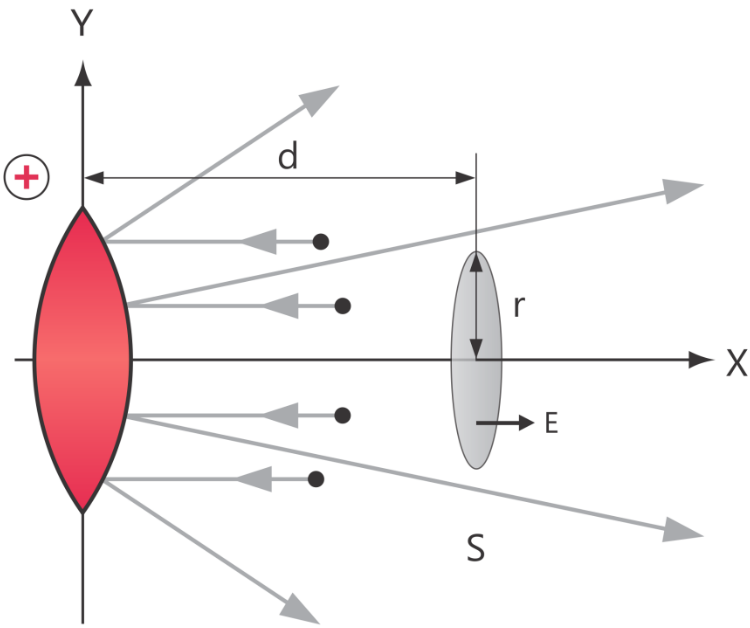

Figure 15 - *The electric field of positrons*

As shown in Section 6.3, the charge **Q** is a measure of the divergence of the flux reflected by a particle; the intensity of this divergent flux, defined as the number of particles passing through a surface perpendicular to its direction in the unit of time, has a maximum value at the particle's edge. If we analyze only the horizontal fluxes (which flow perpendicularly to the particle's plane), we may see how just a part of the reflected fluxes passes through the observational section **S** - a part that gets smaller as the distance **d** to the particle gets bigger.

The radius **R** of a virtual surface located at the same distance, through which would pass the entire reflected flux, will be proportional to the distance **d**. Thus, the flux **E** (which passes through the surface **S**) is only a fraction of the reflected flux and its intensity is proportional to the ratio of those areas:

$$\mathbf{E = k\,Q\,S\,/\,(\pi\,R^2) = k2\,Q\,r^2\,/\,R^2 = k3\,Q\,r^2\,/\,d^2}$$

where **k**, **k2**, **k3** are constant values. This relation is similar to the formula of the electric field (derived from *Coulomb's law*). If we take into account the continuous precession motion, the electric field around a charged particle (considered as a point) may be considered uniform and its average value may be given by this relation; consequently, these things lead to the validation of all known equations of the electric field (Maxwell). Figure 16 shows a negatively charged particle and the variation of the convergent flux it reflects through a circular area, in the axial direction.

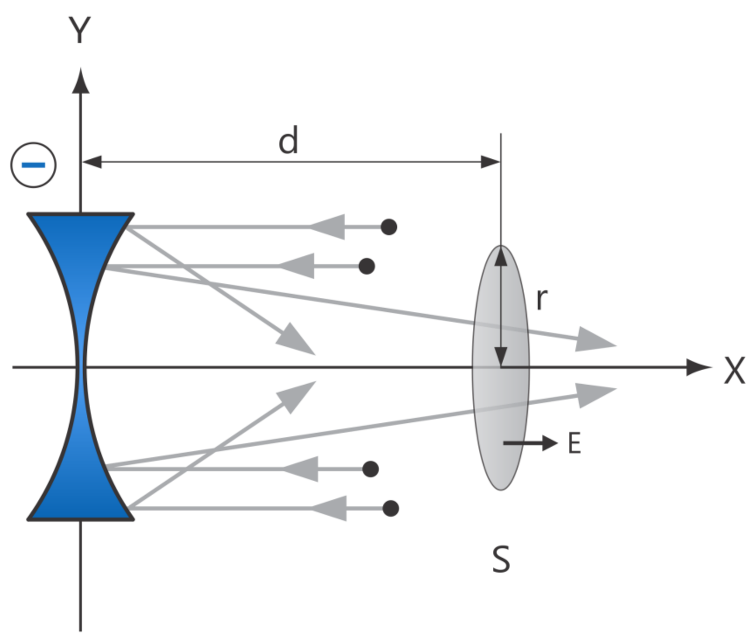

Figure 16 - *The electric field of electrons*

Area **S** is crossed, as in the case of positive particles, by a concentrated flux that decreases in intensity with the distance **d** to the particle. In other words, the "focused" part of the total reflected flux decreases with distance because a fraction of that flux becomes divergent. The conclusion we may draw about the negative particles is this: the concentrated flux, i.e. the electric field, decreases with distance following the same rule as for the positive particles.

6.6. Quarks and the strong interaction

Quarks are elementary particles that are similar to electrons and positrons; they all have the same half-integer spin, but a higher rest mass (and a higher volume). In my model, all the quarks will have one unit of electric charge, i.e. they might have the same curvature (h) as electrons and positrons (Section 6.3).

They are stable particles that are only found in certain combinations (hadrons), formed of two quarks (mesons) or three quarks (baryons). The Standard Model of particle physics describes six types (flavors) of quarks (and their antiquarks), but we will only analyze the **up** and **down** quarks (they are included in the composite particles that form the atomic nuclei).

Quarks are confined into hadrons by a fundamental force called the *strong interaction*. Figure 17 shows **u** and **d** quarks (and their antiquarks), along with an electron and a positron.

All quarks were created in the earliest stages of the Universe when the granular density was very high. They have rapidly combined and formed nucleons (baryons) - the main components of the future atomic nuclei; quarks remain stable in these formations, as the strong interaction was not significantly dependent on the granular density of space.

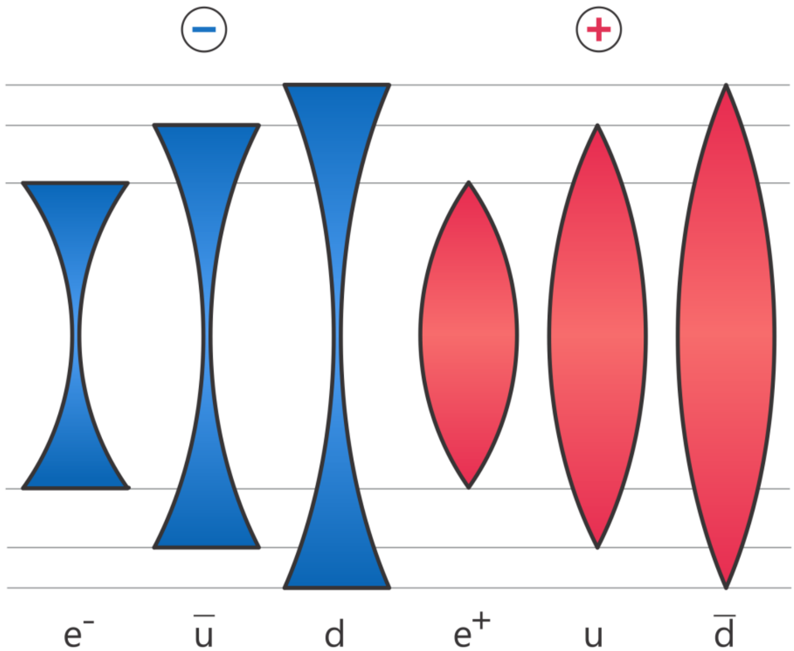

Figure 17 - *Electrons, quarks and their antiparticles*

The quark's mass, larger than the mass of electrons, prevented the quark-antiquark pairs to accelerate enough before the strong interaction appears; therefore, they could not annihilate each other and remained bound in steady structures. Figure 18 shows a generic **rho** meson (a composite, unstable particle) and the "strong" connection between the two constitutive quarks.

However, which is the exact mechanism behind the strong interaction? In the first place, it should be mentioned that the scale at which this force operates is extremely small, i.e. the distance between the two quarks may be compared to their size (to their diameters), as shown in Figure 18.

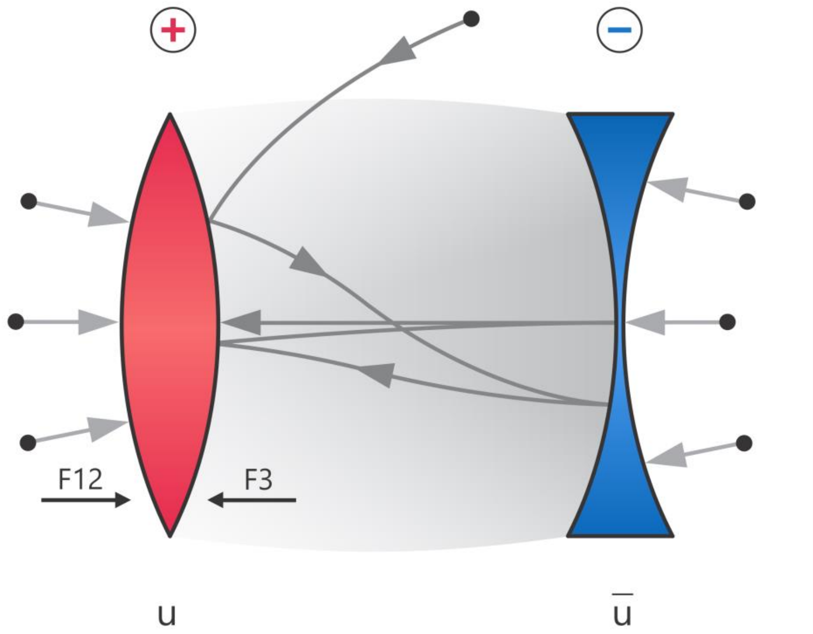

Figure 18 - *The internal structure of a meson*

Being so close, these particles are mutually blocking the granular fluxes coming in axial directions. Therefore, this asymmetry of the local fluxes creates a force that "pushes" the particles toward each other. At the same time, external granular fluxes enter the space between particles, reflecting repeatedly on their inner surfaces. This thing creates a wide cylindrical region (the gray area), where the granular density is much greater than the average local one. The very intense fluxes in this region constitute the *gluonic field*; their constant action on the particles generates a "repelling" force, which is simply called the *strong force*. It equilibrates the pushing force explained above, and, as a manifestation of the gluonic field, provides apparent stability to this system. The distribution of fluxes within the gluonic field is not uniform; the biggest density is in the axial area (dark gray), but there is also a certain convergence toward the negative particle. With its very high density, the granular structure called gluonic field adds a significant mass to mesons; in fact, almost the entire mass of the meson is given by this field.

Both quarks that compose a meson have the same value of spin, **1/2**; they can have this vector (the angular moment) aligned, one parallel with the other – causing a null total moment for the entire meson, or misaligned when the meson rotates and its global spin has the value **1**.

An asymmetric force applied to only one quark, or a small perturbation of the gluonic field might cause the loss of the structure's symmetry, so the meson will quickly become unstable and it will eventually disintegrate (decaying into a pair of unstable **pi** mesons). The gluonic field generates, due to its gradient, an uneven distribution of forces on the quark's surfaces; the negative quark is "pressed" harder to its center and the positive one to its edges. This may result in an additional curvature of the quark discs, adding a *color* component to their electric charge.

The charge on quark's external sides may have different colors (color and anti-color); anyway, the value of the total charge remains unchanged (zero). Gluons (those bosons of the Standard Model of particle physics that mediate the strong interaction and carry the color) can be thus assimilated with compact, tubular-shaped granular structures of the gluonic field.

The attraction between those two quarks is caused by the force **F12**, a global force that is determined by the pressure of the local fluxes and by the force of the electric field. It equilibrates **F3**, the force generated by the gluonic field. Appendix 2 describes the equations of these forces and how their resultant, force **F**, leads to a zone of stability for the distance between quarks (this will eventually make the whole ensemble to behave elastically in a certain range).

7. PROTONS AND NEUTRONS

7.1. Internal structure

Protons are composed of two **u**p quarks and one **d**own quark, placed as shown in Figure 19 and bound together by the strong interaction. This composite particle has a global positive charge +1 and a half-integer spin, being perfectly stable (either as nucleon or as a free particle). Its electric charge can no longer be considered as a point charge; due to the presence of different polarities in its structure and due to its global spin, we may assume that the time-averaged distribution of charge (a dipole in section) is uniform, having an almost perfect spherical shape.

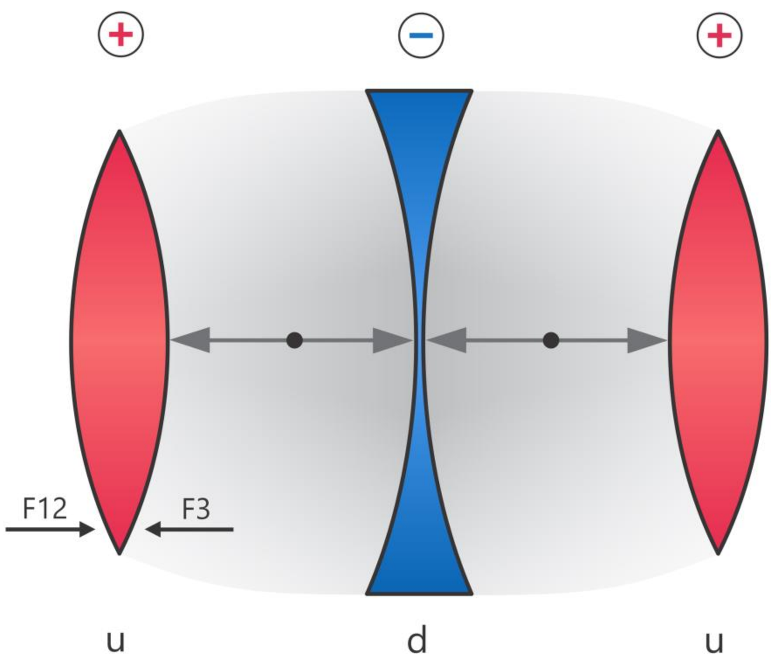

Figure 19 - *The internal structure of a proton*

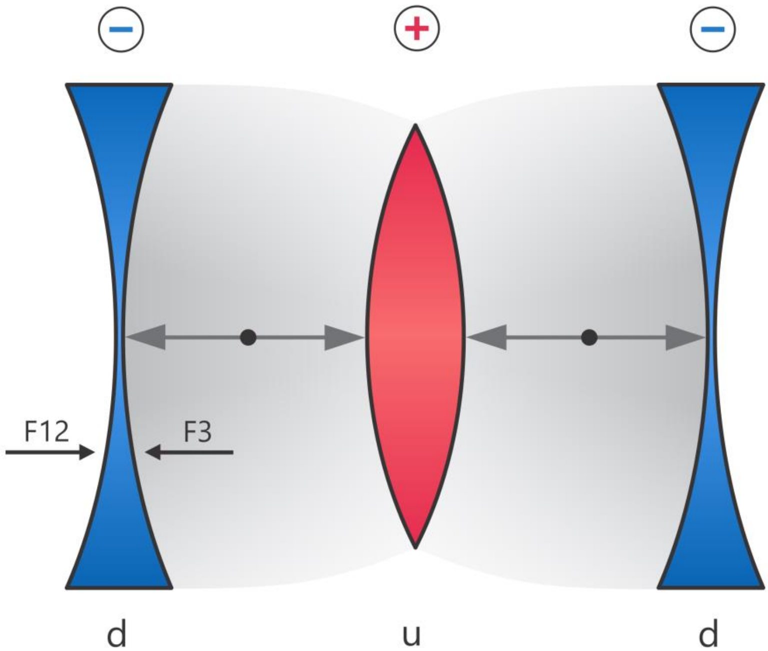

Figure 20 - *The internal structure of a neutron*

The aligned spins of those three quarks and the mass distribution (the greater density is at the center) determine the stability of this composite particle. In the complex dynamics of the gluonic field, different color charges may be added to the quarks, but the global electric charge of the proton is conserved.

Neutrons are composed of two **d**own quarks and one **u**p quark (as shown in Figure 20) that are bound together by the strong interaction. This composite particle has a null global charge and a half-integer spin; it is stable as a nucleon and unstable as a free particle. Its total charge, which should be equal to -1 (the sum of charges on the external surfaces of the **d**own quarks), is in fact zero due to the additional color charge produced by the strong interaction. The external surfaces of the **d** quarks will have both positive and negative electric charges, which will cancel each other; it has to be mentioned that the **d** quarks are represented with normal surfaces in Figure 20, without the color components.

A free neutron is unstable, and a possible explanation could be the place of the heavier quarks (which are located on the outer sides) and the denser gluonic field in their vicinity.

The strong interaction, manifested through the forces described in Appendix 2, is also responsible for the stability of all atomic nuclei. Protons and neutrons (stable as nucleons) are held together in balance by this interaction, which acts on the slightly larger distances, separating them in the same way it does between the quarks of a single nucleon.

7.2. The weak interaction

In the case of high-energy interactions (when the exerted force exceeds a certain value), the quarks of a nucleon may come very close to each other, concentrating the gluonic field on a small area. This region of high granular density and very intense field (located for a short time in the inter-quark zone), which can lead to the transformation of quarks into other particles, generates the *weak interaction*.

In the Standard Model of particle physics, this type of force is carried by the $\mathbf{W^+}$, $\mathbf{W^-}$ and **Z** bosons. A free neutron (composite particle) is unstable and it decays, due to this type of interaction, into a proton and emits an electron and a neutrino (an electron antineutrino in fact). One of the **d**own quarks of the neutron interacts with its adjacent gluonic field, being converted into an **u**p quark and an electron (the global charge is conserved).

$$\mathbf{n\ (ddu) \rightarrow p^+ + e^- + \bar{\nu}_e}$$

Figures 21, 22 and 23 show two-dimensional geometric representations of the decaying process (beta decay), where neither the particles nor the distances between them are drawn to scale. The very dense granular flux "presses" one of the **d**own quarks and deforms it; consequently, its peripheral zone will come off and the remaining part will self-adjust to the shape and mass of an electron. In this process, the ellipsoidal region with dense flux is compressed, its density will increase and it will finally turn into an **u**p quark. This quark is repelled, but it will be shortly attracted by the other **d**own quark (of the former neutron); thus, it will be included very fast into the new proton.

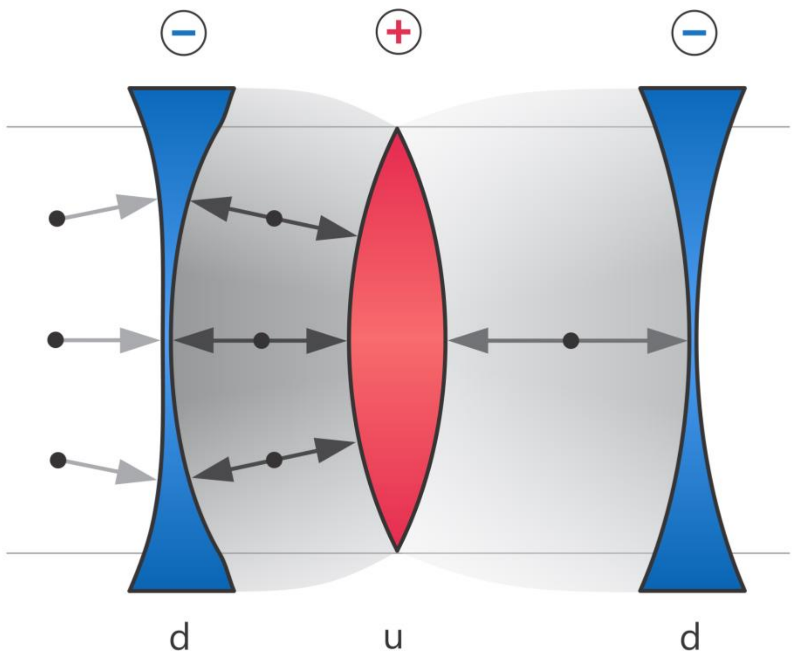

Figure 21 - *A denser gluonic field*

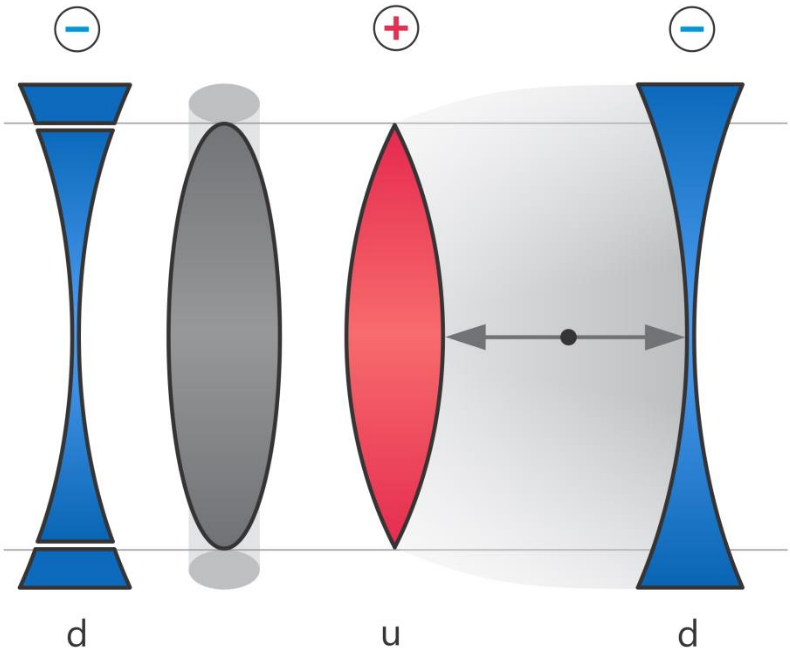

Figure 22 - *Formation of the new particles*

The remaining part of the **d**own quark from the left side, meaning its peripheral zone, shrinks itself; it will become a neutrino particle (toroidal form, electrically neutral), which has a very small size and mass. The null external charge of the left quark was conserved because the internal charge has been transferred to the electron and the new **u**p quark (-1 and +1).

During this interaction, the outer part of the gluonic field will generate another granular toroidal structure, similar to the one that remained from the down quark. This is congruent with the newest theories of the neutrino particles, which assume their non-zero mass and their oscillation between the three known types (flavors): electron, muon and tau.

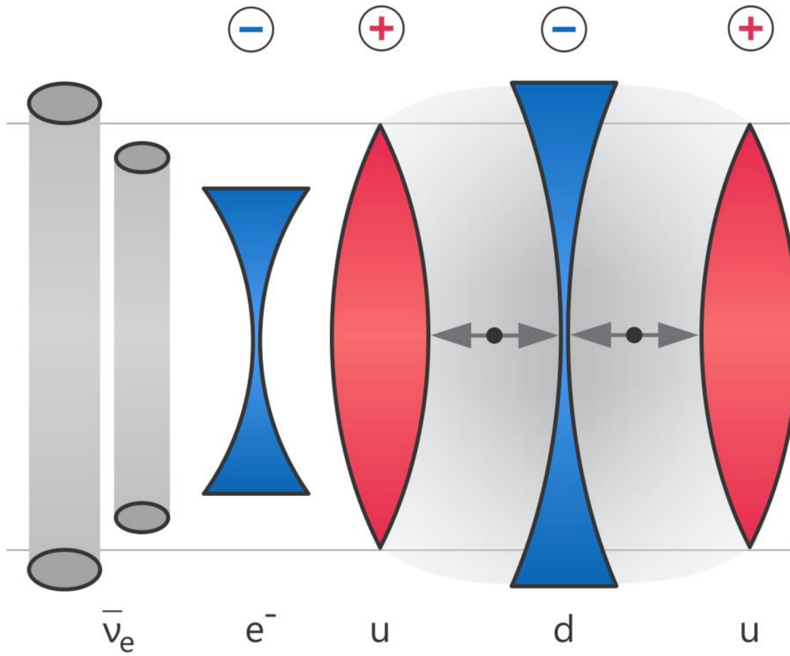

Figure 23 - *The new proton, an electron and a neutrino*

The two hypothetical structures of half-integer spin that compose a neutrino particle (Figure 24) may execute the precession movements at different frequencies (they are dephased due to their different diameters and masses). These intrinsic motions are not synchronized all the time, and this could be a reasonable explanation for the experimental observations showing the neutrino oscillation. In addition, the shape and mass of these two components could also explain the helicity of the neutrino particle and its antiparticle.

The spin of neutrinos is antiparallel to their velocity vector, while the spin of antineutrinos is parallel to their velocity; this phenomenon might be linked to the different masses of their toroidal components:

- If the torus with a smaller diameter has greater mass, it will rotate slower than the one with a larger diameter and the neutrino particle, as a whole, will have an antiparallel spin;
- If the torus with a smaller diameter has a smaller mass, it will rotate faster than the one with a larger diameter and the neutrino particle, as a whole, will have a parallel spin.

The neutrino particle is stable because its two components are very close; there is a small force of attraction (due to the shadow effect of the local granular fluxes), greater when they are perfectly aligned. Very small mass, very small diameter and no electric charge are the main causes of the minimum interaction between neutrinos and ordinary matter.

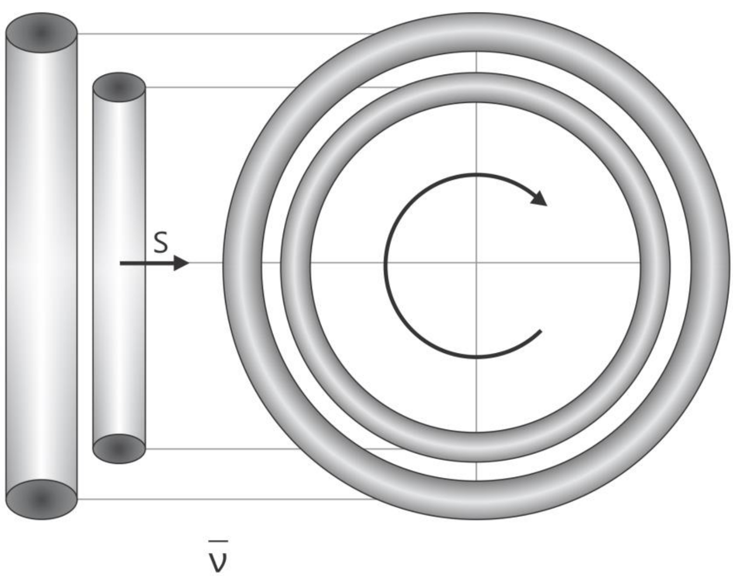

Figure 24 - *A hypothetical neutrino particle*

8. PHOTONS

8.1. Internal structure

Photons are special formations of parallel fluxes, high-density granular structures that occupy a certain volume and propagate rectilinearly at the constant speed of light, ***c****.*

This important characteristic, namely the propagation on an absolutely straight line, is valid only in the ideal conditions of a uniform spatial flux (as described in Section 3.2). If photons enter a region of a different granular density, they are slightly "refracted"; this change in direction is determined by the different moments of time at which the granular layers (the photon structure is considered rigid in section) change their speed. Seen from its rest frame of reference, a certain photon looks like a fixed spatial distribution of granules over a tubular region that has a quasi-constant cross-section area. Analyzing the longitudinal sections through that cylinder, we may observe a complex modulation of the granular distribution, in both density and shape. From another inertial frame of reference, a propagating photon may be seen as a "wave" that consists of two intensity oscillations of the directional granular flux.

To generate the granular structure of the photon, a certain amount of energy has to be consumed; more energy is required when the variation of granular density occurs quicker, on shorter distances. All of the energy stored this way within the granular structure propagates along with the photon, being integrally released at the absorption moment. If we accept two fixed limits, upper and lower, for the difference between photon's granular density and the local average one (which actually represents the relative intensity of that flux), then the energy stored in a photon is inversely proportional to the length of its cylindrical zone (presumed of a constant diameter):

$$E = k / L$$

where **k** is a constant, **L** is the cylinder length and the wavelength of the two oscillations. The photon energy can be written:

$$E = k / \lambda = k \nu / c = k2 \nu$$

where **ν** is the wave frequency and **k2** a constant. This formula is perfectly similar to the photon energy expressed by the well-known equation of quantum mechanics.

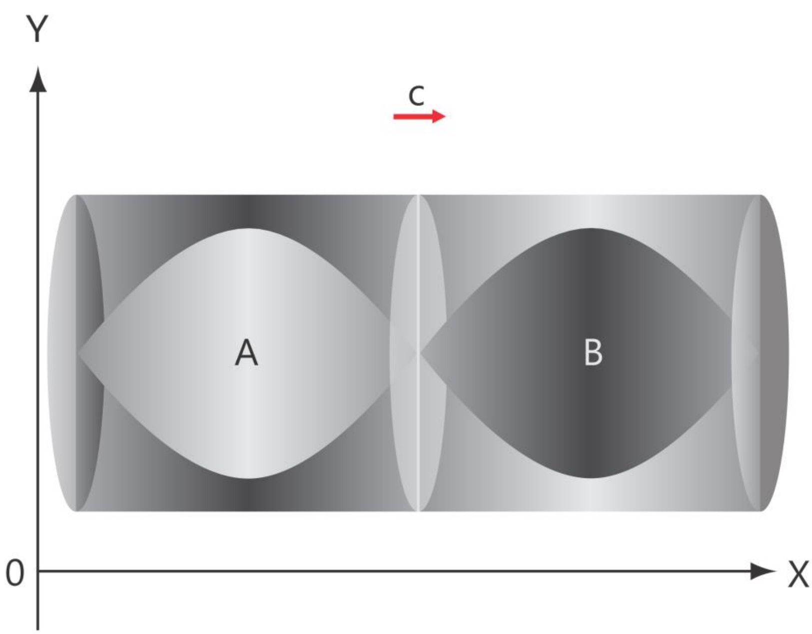

Figure 25 - *The cross-section of photons*

Figure 25 shows a cylindrical-shaped photon composed of two granular density oscillations, the regions **A** and **B**. In this longitudinal section, region **B** is denser than **A**, being drawn in dark gray. Photons may be considered symmetric about their longitudinal axis, thus the same density distribution would be observed in any section. We may note four important aspects:

1) A photon moves at speed **c** in the red arrow's direction, and the region of higher density is at the front;
2) There is a small free space between the two regions **A** and **B**, with an almost null granular density;
3) The diameter of the photon's cylinder is slightly larger than the size of an electron or positron.
4) Both photon regions **A** and **B** are about the same size.

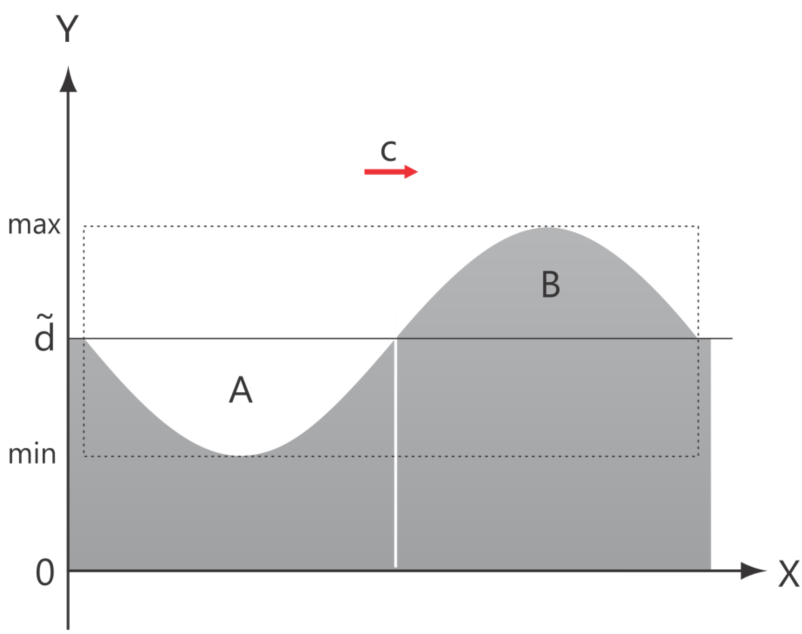

Figure 26 - *The granular density of photons in the axial zone*

Figure 26 shows the graph of the granular density **d** on the length of a photon (OX), in its axial zone. We may see the sinusoidal shape of the density oscillation around the average value $\tilde{\mathbf{d}}$ and the space of very low density between the two regions **A** and **B**; the denser region **B** is placed in front of the photon, in that direction it propagates.

8.2. Creation

We will consider two mechanisms by which the photons can be produced: the electron-positron collision and the transition of an atomic electron to a lower orbit. In both cases photons are generated in a similar manner, namely by accelerating an electrically charged particle until it reaches a very high speed, close to **c**, followed or not by a period of deceleration. Two distinct processes will take place simultaneously while the particle's speed increases:

1) As shown in Appendix 1, Figure A1.4, the spin of a high-speed particle stays oriented to its direction of movement. If the speed increases, the average direction of its spin gets closer to the global velocity vector, and the particle's helical trajectory takes a higher pitch. Thus, the particle's surface becomes almost perpendicular to the global direction of movement.

2) Section 3.4 described the granular trajectories near charged particles. If we ignore the deviation caused by the variation of density, we may see how the granules of the local fluxes, moving at speed **c**, collide with the particle's surfaces and then bounce back through a simple process of reflection (that complies with the well-known laws of this phenomenon). In the case of relativistic particles, these granular reflections will become relativistic too. Thus, they will generate a new flux, parallel with

the particle's global velocity. If we look from the particle's frame of reference, we may see that the granular reflections generating the collinear fluxes comply with the reflection law (Figure 27, right side and Appendix 3, relativistic angles), and thus the angles of incidence are equal to the reflection ones. From a fixed frame of reference (Figure 27, left side), we may note, however, that the direction of incident fluxes changes if the particle's velocity increases. The incident fluxes reflect and therefore create a horizontal flux in front of the particle, their solid angle increasing with the particle's speed. If the acceleration process continues and that particle reaches a relativistic speed, the horizontal flux it reflects to the right becomes more intense when its speed gets higher.

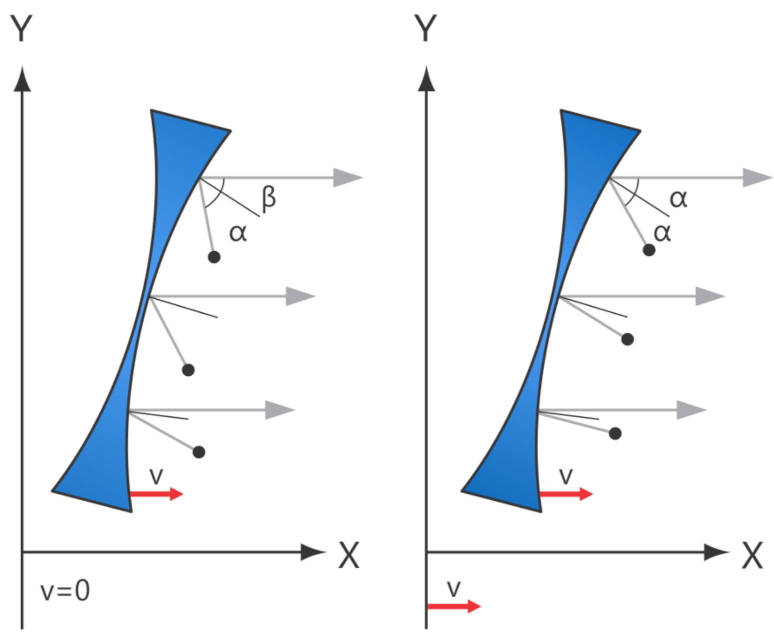

Figure 27 - *Relativistic reflection*

This phenomenon is presented in detail (Figure 28) for an electron, but things are quite similar for a positron. At the same time, the horizontal flux reflected in the back of the particle, flowing in the same direction, will decrease in intensity when the speed gets higher.

The cylindrical space occupied by a particle while it executes the intrinsic rotation, which is not much larger in section than the particle's diameter, normally contains some horizontal fluxes of a presumed constant intensity. However, the perturbation produced by the accelerated motion of the charged particle in these uniform fluxes creates an imbalance between the total granular impulse it receives from the front and from the back, on its direction of movement.

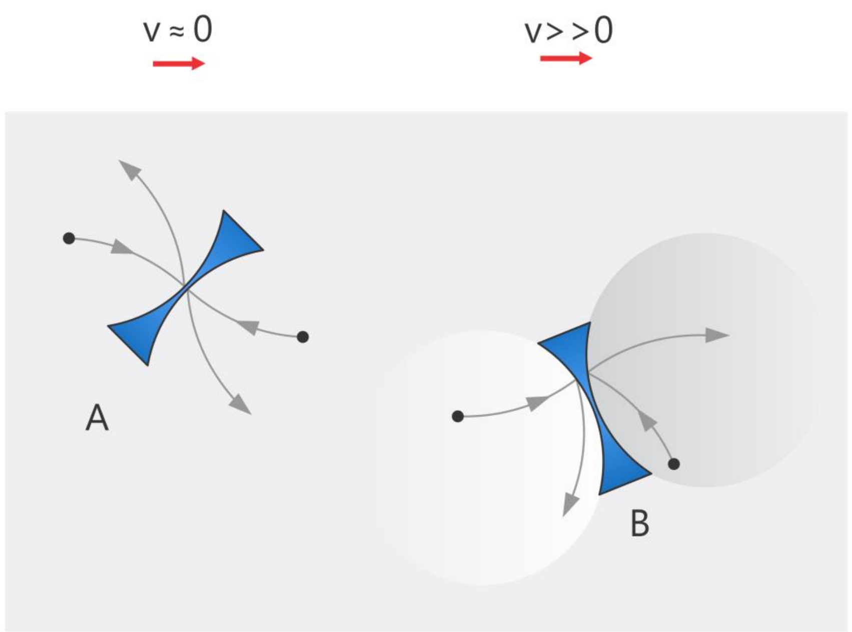

Figure 28 - *Relativistic electrons*

A variation of the local flux is equivalent to a certain deceleration force - whose value increases as the difference between the incident front and back fluxes gets higher. Over a certain period, the force increase is proportional to the difference between the strengths of those resultant fluxes; this is reflected in the difference between the initial and final velocity, which is practically equal to the acceleration of that particle.

This directional modulation of the local flux extends and occupies a certain space, creating a new granular structure called *photon;* this structure freely moves at speed **c** in the same direction as the emitting particle. As photons have a bigger granular density, they are able to transfer a certain impulse to particles during collisions; therefore, we may assign non-zero values for their energy and impulse, which both could be considered corpuscular features.

A particle-photon system will conserve its global impulse and energy. Although photons are composed of many granules moving in the same direction, we cannot speak about their mass (as it was defined in Section 6.2) because they are not in fact solid structures of maximum granular density. Considering the way a photon is generated, its granular density may describe a full oscillation (as shown in Figure 25) or only a partial oscillation.

If the acceleration process of the charged particle is followed by deceleration to its initial speed, the newly generated photon will be complete; otherwise, if that particle disintegrates after the speeding up phase, the new photon will be incomplete.

Figure 29 shows all stages of the creation process, depicting how exactly the complete photons were formed during the fall of atomic electrons on lower orbits.

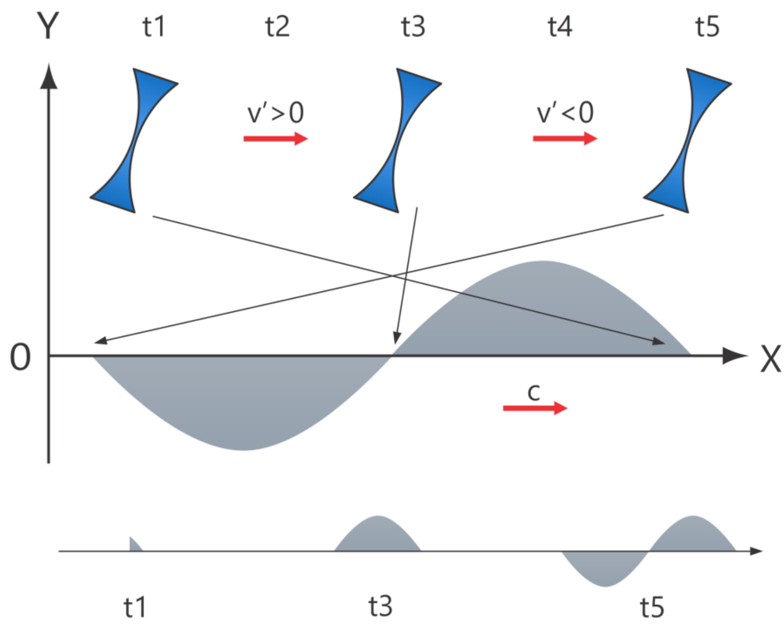

Figure 29 - *Stages of the photon creation*

It has to be noted that the cylindrical shape of the photon is not perfect; a photon may be emitted by particles that spin while accelerating, so its shape may have an additional curvature or it may be helicoidal. A photon is composed of successive layers of granules, circular in section, arranged on a helical path; this path is similar to the trajectory of the charged particle that created the photon (Figure 30 depicts a very small region of photons).

A complete photon, composed of two full oscillations of granular density, contains in the middle part a zone of low granular density that was formed during the uniform motion of the emitting particle. In our case, that electron accelerates between **t1** and **t3** (the time when it reaches the maximum speed) and decelerates between **t3** and **t5**.

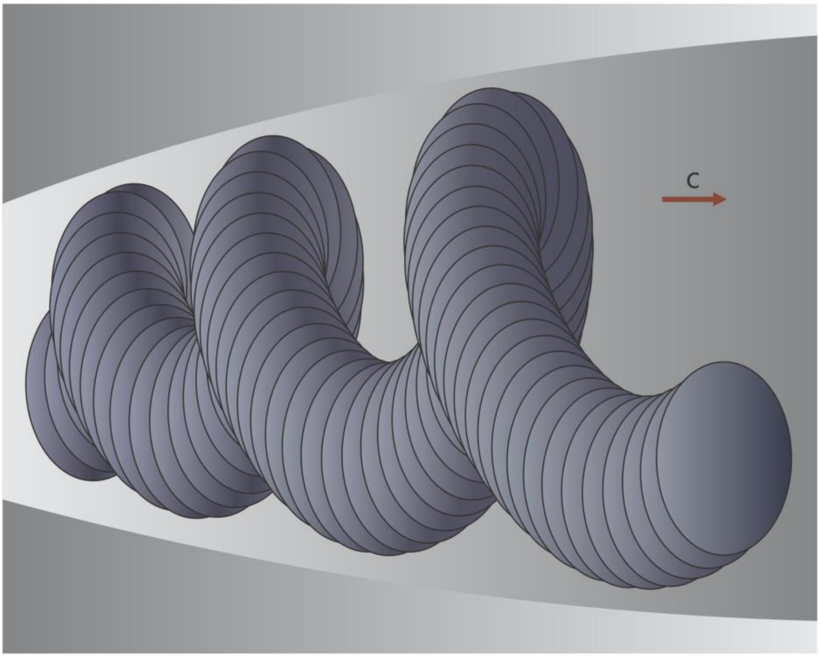

Figure 30 - *Longitudinal section of a photon - details*

For each of these moments, a graph with the current stage of creation is also shown (the granular density is on the vertical axis and the length on the horizontal one). If it had been the case of an electron-positron collision, in which both particles accelerate at first and then annihilate each other, the photons would have been incomplete and their density variation would look like the graph at time **t3**.

Figure 31 schematically shows how photons are generated by those two methods above, and we may clearly observe in there the global conservation of the system momentum. The upper part of this figure displays an electron (its velocity vector is **v**) that travels toward a positron being at relative rest.

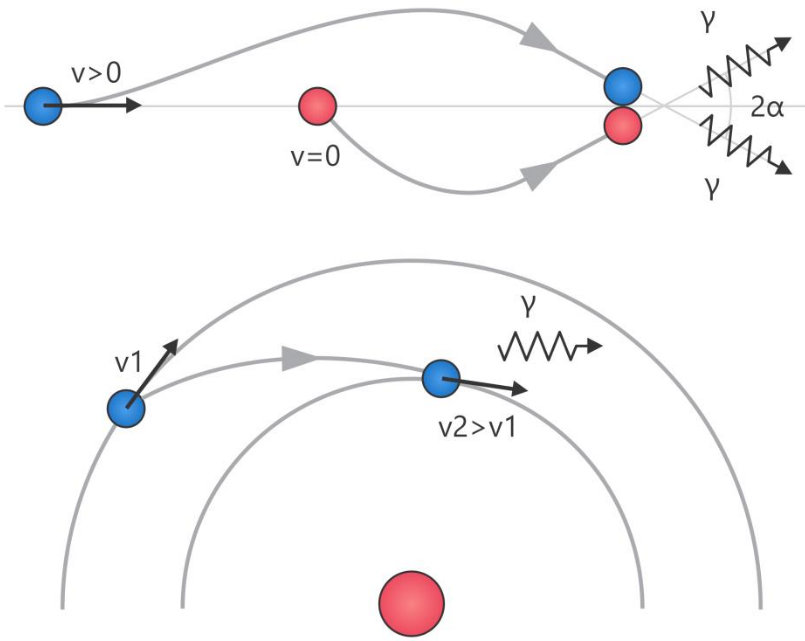

Figure 31 - *Photon creation*

As they come closer together, both particles tend to align their spin vectors in perpendicular directions (all variations of their electric fields are forcing them to move on circular trajectories). On the right (next to the gray arrows), where the alignment process is completed, the force of attraction becomes dominant; now, these particles move faster and faster toward each other, until they collide and annihilate (the annihilation process means that both particles will disintegrate and their component granules will spread out into the spatial fluid).

During the accelerated movement, they both got relativistic speeds and thus each particle will emit a gamma photon in the pointed directions. The *alpha* angle of the emitted photons to the initial direction of particles is calculated in Appendix 5, and it only depends on the electron's speed (and therefore on its momentum). These two gamma photons are incomplete, as they contain a single density oscillation - from the mean value up to the maximum one and back.

The lower part of Figure 31 shows how an atomic electron emits a photon when it "jumps" to a lower orbit. This transition increases its kinetic energy and decreases the potential energy of the electron - nucleus system. The energy difference is emitted in the form of a complete photon, whose frequency can be easily determined (Appendix 5).

8.3. Features

a) As it was stated at the beginning of Section 8.1, the photon energy is directly proportional to its frequency, being given by this well-known formula of quantum mechanics:

$$\mathbf{E = h\,\nu}$$

where **h** is Planck's constant and **ν** is the frequency.

What does the frequency of photons depend on?

Obviously, only on their wavelength, because their speed has a constant value (**ν = c / λ**). The wavelength is the length of the complete photon's structure, of that cylinder containing both granular oscillations. If we make a qualitative analysis, by assuming a constant variation of the density in any complete photon, it follows that the length of photons depends only on the acceleration and deceleration intervals of the charged particles in relativistic motion:

$$\mathbf{\lambda = (t1 + t2)\,c}$$

where **t1** and **t2** are those durations, of approximately equal values. We may therefore consider:

$$\boldsymbol{\lambda = 2\,\tau\,c}$$

where **τ** is the acceleration interval. The photon energy may be finally written:

$$\boldsymbol{E = h\,\nu = h / 2\,\tau}$$

and thus we may see that the photon energy is inversely proportional to the time interval.

The equation of motion for a particle is not very simple, as the acceleration is not constant in time (it depends on the Coulomb's force of attraction $\boldsymbol{\sim 1 / r^2}$, **r** being the distance, while the mass increases at relativistic speed) and the change rate of the decelerating force is not exactly known. Appendix 4 shows a simplified equation of motion for charged particles, from which we could deduce the approximate time a particle takes to accelerate up to a speed close to **c**.

The photon momentum is simply obtained from the equation $\boldsymbol{E^2 = p^2\,c^2}$ (where the rest mass of photons is considered zero) and it has this formula:

$$\boldsymbol{p = h / \lambda}$$

b) We have shown that the rest mass of photons has to be considered zero, and obviously, their electric charge is also zero. As photons are bosons, they have an integer spin value. This spin parameter is somehow misused here because photons are not solid structures that actually rotate (however, after an imaginary rotation of 360 degrees on any axis, they return to the same position). All photons have a fixed granular distribution, and they only exist in motion, traveling at the maximum speed **c**. If we take a look at their particular structure while they are in motion, we discover the *wave properties* of photons, all due to the sinusoidal form of their granular distribution. Moreover, we may assimilate their helical granular distribution with a rotation, giving in this way a physical representation to the axial spin projection. This component is called *helicity*, and it can have the values **+/-1** (+/- $\hbar$ as a matter of fact, because the global spin is $\sqrt{2}\,\hbar$). The helicity value of **+1** means, by convention, the rotation to the right (clockwise) about the photon's direction of movement.

c) In the common, classical understanding, this helicity is known as circular polarization state. It would be generated by the "electrical" component of the wave, resulting from the addition of two vectors of the electric field (rotated at a certain angle). However, as it was described above, the intrinsic movement of the particle that has generated the photon gives the physical meaning of this rotational motion. Moreover, this angular moment has two fundamental roles: to synchronize the spins during the absorption process (caused by atomic electrons) and to explain the Compton Effect. Once again, my model gives a physical explanation to the abstract concepts of quantum mechanics and clearly establishes a connection between the corpuscular theory and the wave behavior of photons.

d) The photon polarization has a wider meaning, and this is due to their three-dimensional shape (not always a regular cylinder). As it has already been specified, their cylindrical shape may have an additional circular (or even helical) deformation, depending on the trajectory followed by the emitting particle and on its energy. This curved shape is stable during propagation, and it will transfer a supplemental momentum on absorption; if photons are seen in motion, as waves, we may get a wider spectrum of polarization states, from the linear ones to the elliptical ones.

e) All photons have the propagation speed **c**, the speed of light in a vacuum. As established in Section 3.3, a "free" photon, seen as a fixed structure of granular fluxes, travels in fact at a speed that is given by the average value of the local granular density.

f) The photon-particle interactions can be of several types:

- A photon may be entirely absorbed by an orbital electron;
- A photon may inelastically collide with an electron, and thus a lower energy photon is emitted (the Compton effect);
- A photon (whose energy is bigger than a certain threshold) may collide with an atomic nucleus, transforming itself into an electron-positron pair.

The first two interactions are similar to the process that produces photons, seen in reverse order. The granular gradient along the photon, having the helical form described above, determines the amount of impulse that is transferred to a particle. Thus, the first part of the photon will accelerate a particle through the granular collisions caused by the intense flux, and then the second part of the photon will decelerate the particle by its weaker flux (the frontal flux becomes stronger). All these interactions will have a different impact, and this depends on energy, direction and on the actual system of that particle. Still, the creation of pairs is a completely different interaction, and it will be explained in the subsequent section.

g) This model is also compatible with the "wave" feature of photons. We may associate their variation in density on the axial direction to the evolution of an "electric" field, and the variation in direction on the helical trajectory to the intensity of a "magnetic" field. Therefore, the equations describing the electromagnetic wave propagation, deducted from Maxwell's ones, are all valid.

h) Most photons emitted or absorbed in atomic electron transitions are in the visible spectrum, and their internal structure was described above. If we consider the photons of lower frequencies, for example, radio waves, we may wonder if they have the same structure, but only a greater length. To answer this, we have to check out how such waves are created. The oscillating electric circuits, including radio antennas, maintain a constant oscillation frequency over a certain distance in a conductive material. The electric field forced the free electrons of this material to oscillate at the same frequency, periodically accelerating and decelerating them. The amplitude and phase of their motion depend on the electric field intensity, but also on their exact position along the conductor. Each free electron generates in this way a different photon, and all these photons will be part of a larger, *multi-photon* structure; this big structure may be associated with a complete electrical oscillation. The wavelength of the multi-photon structure is determined by the frequency of that electric oscillation, and its speed of propagation will be equal to the speed of light. The spatial extent of this structure will thus be given by the oscillation frequency and by the interference of all electrical waves inside that conductor, while its polarization must be associated to the direction of the electric field oscillations.

8.4. Pair production

A high-energy photon (its energy is greater than 1.022 MeV) may interact with a heavy nucleus and thus an electron-positron pair is produced (the mass of the particles is 2 x 0.511 MeV). The photon's remaining energy will be found in the kinetic energy of the new particles and the additional momentum of the atomic nucleus. This pair creation mechanism is shown in Figure 32, being entirely based on the special field that exists between the nucleon's quarks or between nucleons. The new pair - a particle and an antiparticle - may annihilate (the process was described above) and two gamma photons will be finally emitted.

As shown in Section 3.3, the granular speed is only depending on the granular density of the local fluid. In a region of high granular density, as the gluonic field, the speed of an incident flux becomes *very low*. Let's consider that the incoming flux belongs to a high-energy photon, whose energy is higher than 1.022 MeV. While passing through this region, this photon suffers a "compression" process, its length decreases in a proportion equal to the ratio of the speeds in those two mediums. In this way, the successive granular layers of the photon (Figures 25 and 30) will all stick together; we may see that a new high-density structure of cylindrical shape is being created, whose diameter is about the photon size. If we add the higher density in the middle of the gluonic field, which will bend the granular trajectories toward the axis, we may understand why the new structure becomes more compressed, as both length and diameter, until the maximum possible granular density is reached. Furthermore, the helical arrangement of the photon's successive layers generates an angular momentum to the new structure; it will start to rotate, continuing its "slow" motion through the gluonic field region.

If we analyze the gradient of the granular density within a virtually compressed photon, in an exercise of imagination, we can see that its first half has the exact shape of a positron. Therefore, the first structure created by a photon passing through a high-density region is therefore a positron; the same mechanism will generate an electron from the second half of the photon. The low-density gap between the photon halves will separate the two particles and will create a short delay between their exit moments. If the incident angle is not zero, photons are "refracted" upon entering the gluonic field, and the newly created particles will keep this new direction. The high-energy photons were completely absorbed in this process, and their granular layers have been incorporated and distributed into the structures of the new particles.

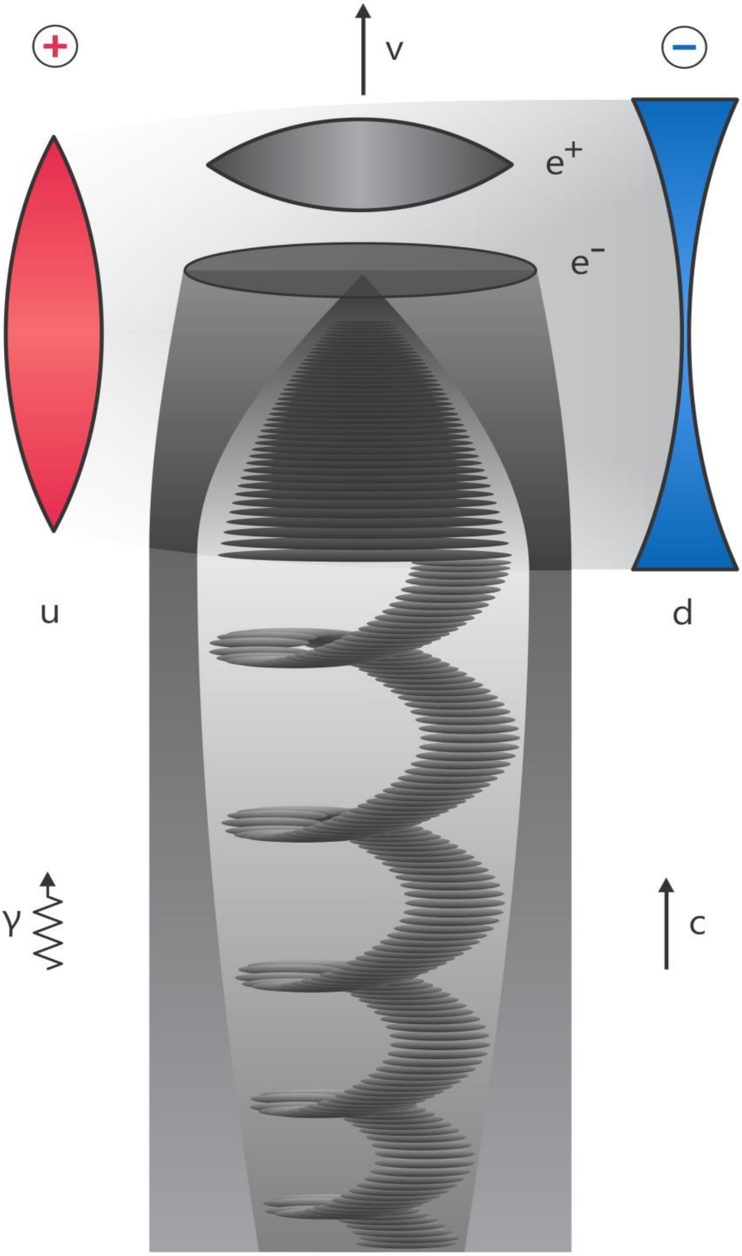

Figure 32 - *Production of the electron-positron pairs*

9. THE MAGNETIC FIELD

All variations of the convergent or divergent granular fluxes that flow around an electrically charged particle are simply called magnetic field.

This field is a vector field; as direction, this vector is perpendicular to the granular fluxes, while its magnitude is given by the intensity of their variations. All magnetic fields are produced by the granular fluxes of the moving charges, and they show us their degree of interaction with other electric charges in motion. The main vector quantity of this field is **B**, which is called magnetic induction; this vector is shown in Figure 33, where we may also see that the field lines are circular. The direction of the induction vector is given by the right-hand rule: if the thumb points in the exact direction that charged particle is moving, the curl of your fingers gives the direction of B.

After some simple calculations (see Section 6.5, the formula of the electric field), we may notice that the magnetic induction is proportional to the electric charge **q**, to the particle's speed **v**, and inversely proportional to the square of the distance to particle, **r**. If the versor of the distance from that charge to the point where induction is calculated is not perpendicular to the velocity vector, then the induction value will be given by the velocity component that is perpendicular to that versor. All this fully complies with the Biot-Savart law for point charged particles, moving at constant velocity (**v << c**):

$$\bar{\mathbf{B}} = \boldsymbol{\mu_0}\, \mathbf{q}\, \bar{\mathbf{v}} \times \hat{\mathbf{r}} \,/\, \mathbf{4\, \pi\, r^2}$$

where $\boldsymbol{\mu_0}$ is the magnetic permeability of the vacuum.

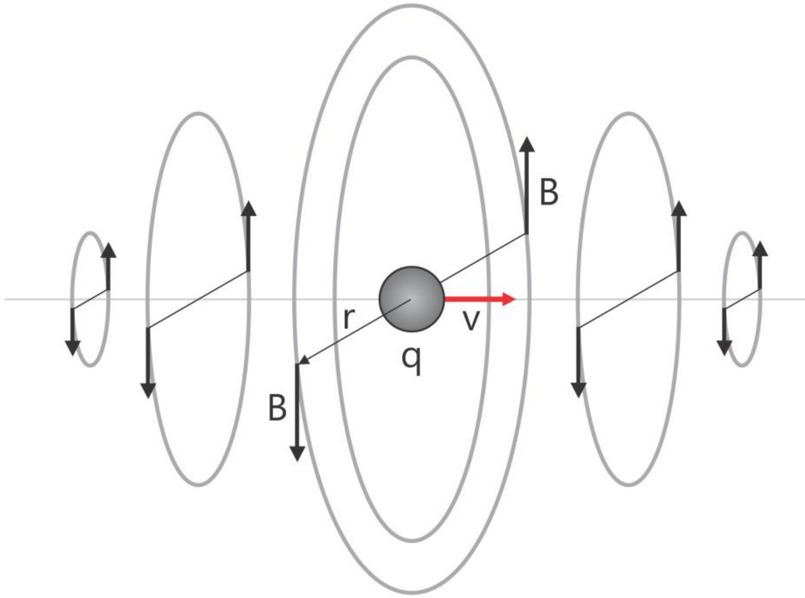

Figure 33 - *The magnetic field of a charged particle*

The motion of another electrically charged particle in the vicinity is determined by the combined action of two forces, electric and magnetic (this force is called the Lorentz force):

$$\mathbf{\bar{F} = q\ (\bar{E} + \bar{v} \times \bar{B})}$$

All particles that are experiencing these forces will have a helicoidal trajectory, which results from the simple addition of rotational and translational motions. A certain magnetic field, exerting a force perpendicular to the particle's trajectory, will give it a circular motion.

A charged particle, which has an intrinsic motion of rotation and precession (as shown in Section 6.3 and Appendix 1), features a continuous spatial and directional variation of the reflected fluxes. Such fluxes will accurately follow the evolution of the particle's spin vector, whether the particle is in motion or at relative rest. Therefore, regions with inhomogeneous rotational fluxes appear all around the particle; these fluxes will produce different forces in different points, and thus mechanical momenta. These moments are called *magnetic moments*; they are induced by the rotating particles, and therefore *spin magnetic moments* will be the term used in quantum mechanics. For example, a free electron has only a spin magnetic moment (intrinsic), but an electron orbiting within an atom has, in addition, an orbital magnetic moment. In other words, the interaction of rotational granular fluxes (produced by charged particles in their complex motion) is the base of the magnetic field's actions. The fluxes around each charged particle concur by superposition to the global magnetic field generated by an electric current or by a magnetic material. The magnetic field will exert forces on the charged particles moving in conductive materials, and thus it can generate electrical currents or attracting and repelling forces.

We may see that these fields, electric and magnetic ones, can be converted one into the other, and therefore they can be unified under a single name, the *electromagnetic* field. They have similar actions, determined only by the granular fluxes of the charged particles, through their intensity or their variation in time and space. We can now draw the general conclusion that all known interactions (gravitational, electric, magnetic, strong, weak and photonic) are generated by the specific variation, distribution, intensity and convergence of the granular fluxes.

The preceding chapters have shown that all particles are composed of spatial granules, and their stability, as well as the interactions between them, is determined by the particular dynamics of the granular fluxes.

Prime Theory explains the genesis of all particles and unifies all fields into a single granular motion of mechanical nature, everything being determined by the granular features of space and their evolution over time.

10. TIME

Time, as origin, is a derived physical quantity; as there is a special medium and matter can move through it, such quantity may be used to describe the rate of this motion. This is possible in fact due to the particular features of the spatial fluid - whose simple mechanics is based on the constant speed of the granular motion. All of the changes, transformations, movements and oscillations these spatial granules are going through, as fluxes or dense structures, are happening at a certain rate; this rate may be compared to the constant rate of a known and reproducible phenomenon, which means we can measure the passage of time. However, all movements through space have a *relative* character; a body in a frame of reference has a relative speed, and so does the flow of time in that system. The laws of physics take the same form in any inertial frame of reference, as they all relate to the physical quantity *local time*, which does not have a constant rate in all systems. Let's imagine a fixed clock, which ticks 60 times in a minute and whose second is set by a constant oscillation of mechanical, electrical or optical nature; if this clock is accelerated up to a relativistic speed (which then remains constant), it will show *the same* flow of time to a local observer. However, the time interval of one minute, measured by the clock during its relativistic motion, is longer than the minute shown when the system is fixed, at rest. This has a simple explanation: all of the physical phenomena (mechanical, electrical, etc.) are happening slower in a mobile system than they do in a fixed one, from the atomic scale up to the macroscopic level. The dynamics of all physical phenomena changes with speed because nothing can happen instantaneously; we have shown that the properties of space determine the existence of a maximum speed, which is the limit in this Universe. Any system that accelerates close to this speed limit slows down all its internal processes, because the component particles may not exceed that maximum speed, regardless of their direction of movement.

This theory has unified all the possible interactions into a single one, of a mechanical kind, and thus it is obvious that any mechanical action (of the granular fluxes) exerted on particles will depend on their mass. In a mobile system, as masses increase with speed, all the phenomena will have smaller velocity and acceleration values. Thus, any mechanical or electrical oscillation (which can be used in the mobile system as a reference to calibrate a clock) will have a lower frequency, and therefore a longer period of oscillation.

The same time dilation also happens to systems located in strong gravitational fields, i.e. in regions with more intense granular fluxes in certain directions. The dominant flux will "increase" the mass of all the particles moving in its direction, and therefore all the interactions between them will happen at a slower rate. Similarly, the frequency of any oscillating process (that would be used to calibrate a clock) has a maximum value in regions with uniform granular fluxes.

Any material system has, at a certain moment, a global state that is given by the states of its constitutive granules; all these granules, as shown in Section 3.1, are in continuous motion, colliding and exchanging impulses all the time. The way they are moving changes the global movement of the whole structure, which will also be in a state of relative and continuous motion. If we consider time as the resultant of this continuous motion of a structure in the three-dimensional space, we may associate it a certain "direction", from the current state of movement to a future one. Thus, time became a kind of vector quantity, whose "arrow" shows "the movement" from a state that has just passed to one that is to follow, and whose magnitude is given by the ratio of its changing rate to another rate, presumed constant, of a reference process. The meaning of the *changing rate* - as a transformation of a "past" state into a "future" one - shows time being a special vector, whose direction may not be changed. The time difference between two systems moving at relativistic speeds, i.e. between the rates at which they are changing their states, corroborated with the possible intersection of their spatial trajectories, may lead (by mutual reference) to an apparent "time travel", where two vectors meet: the past and the future. However, this is not a paradox; the processes within these two systems happened at different rates, and this can only be realized through direct comparison. For observers located in each system, the processes took place in exactly the same way, at the same speeds, with the same frequencies, and on the same distances. Clearly, the current state of a system determines in a causal manner its future state; this happens at any level, it is the "true nature" of things, which will always set up the direction of the arrow of time.

An observer, who cannot actually "look" beyond a minimum scale of things, could interpret what it finds only as hazard, uncertainty and probability. Adding to this frame the huge numbers we can talk about at a granular level, we may conclude that, under a certain dimension of things, our reality can only be described using a statistical approach, with temporal and spatial average values. Following this logic, the spatial graininess (which automatically implies a kind of temporal granularity) can be mathematically averaged, and the actual physical phenomena can be exactly modeled by continuous equations at any spatial and temporal resolution unless that critical level of dimension has not been reached.

My current model has presumed that space is continuous; thus, any object that would move through it, from granular structures to galactic formations, would have a smooth, uniform motion, all intermediary positions along its path being occupied successively. Therefore, the time granularity remains only a virtual attribute; and there is no need for time quantization at the granular scale since time cannot be directly measured at this dimensional level.

11. GALAXIES

11.1. Formation

As space expanded in all directions, its granular density has sufficiently dropped at some point, allowing the development of the first elementary particles. Quarks have quickly combined into protons, which attracted cold electrons and thus the first atoms of hydrogen were formed. The forces of attraction between atoms, of electromagnetic and gravitational nature, have allowed these raw gaseous materials to accrete and thus they clumped together to form the first stars (mostly composed of hydrogen and helium). Usually much larger than our Sun, these stars of the early Universe were spinning very quickly; they also had a short lifetime, a few tens of millions of years. Once ignited, their inner fusion processes created new elements, heavier than helium; when these reactions consumed all fusionable materials (that can generate energy), the equilibrium of these stars may no longer be maintained and they exploded. A part of the stellar matter was spread around and it became the fuel source for the future generations of stars, while the other part collapsed gravitationally into a very dense core, composed of heavier elements. The star genesis continued, leading to the emergence of various star systems, where gravity is balanced by centrifugal forces. Large clusters of stars have been born this way, forming the first *galaxies*. We have analyzed in Section 5.2 a few causes that determined the size of galaxies, but something should be added here. Some stars of very large masses turned after explosion into superdense cosmic bodies, of very small size, for example, neutron stars or black holes. The stars of this latter type, having an extreme gravitational pull, continue to absorb the interstellar matter or to incorporate other stars and even other black holes.

They reached in this way an enormous mass, of several million solar masses, and a huge density, which produced an even more powerful gravitational field. These stars further played a very important role, because they attracted groups of regular stars around them, leading to the formation of larger galaxies. Most of the galaxies were formed around a supermassive, central black hole, and this stabilized the movement of their stars and determined their global dynamics. If we analyze more carefully the relation between the gravitational field and the supermassive black holes, we will be able to explain in a simple manner the shape of many galaxies, the movement of their stars, and even the "dark matter" they might contain.

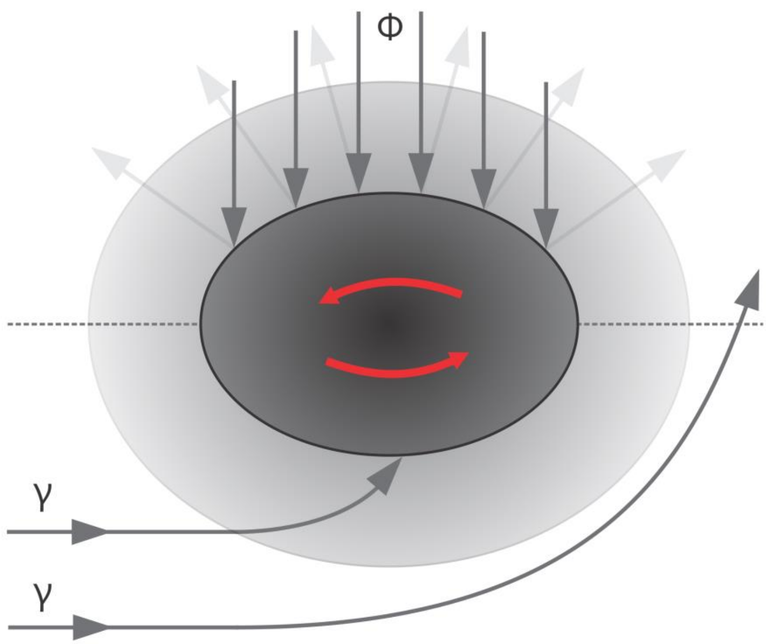

Figure 34 - *Section through a black hole*

11.2. Black holes

During the gravitational collapse of stars, the angular momentum is always conserved. Initially, a massive star spins with a peripheral speed of tens or hundreds of kilometers per second. After the explosion, as it has shrunk and transformed into a black hole, its surface may reach a relativistic speed of several tens percent of **c**. Figure 34 shows a section through a black hole, where the granular flux **Φ** is reflected on the surface and two **γ** photons are passing nearby. For such a supermassive star, located in the center of a galaxy, we may state the followings:

a) Its shape is not a perfect spheroid; the star is a little flattened due to the fast rotation around its own axis.

b) The incident fluxes do not cross through the star's body; they are relativistically reflected in all directions, forming a region of high granular density around it. The gravitational field of these stars has a maximum possible intensity, and this creates several layers in their internal structure. Thus, if the star's surface may still contain quarks confined by the strong interaction, as we go down toward the center, this interaction diminishes and quarks get closer to each other due to the higher pressure. At a certain depth, where the granular fluxes virtually disappear, the elementary particles can no longer hold their structures and they will transform into a super-concentrated granular mass. This is a new kind of "horizon", placed inside the star, beyond which only the granular fluid of maximum density may exist. We may even say that the interior of this type of star is a new "elementary particle", of really huge size and mass.

c) The reflected fluxes have a rotational component, which has the highest value in the central plane of the star (a plane perpendicular to its rotation axis). Their gradient determines the "attraction" of the galactic stars to this plane and this explains the lenticular structure of most galaxies. The direction in which the reflected fluxes rotate will determine the global rotation of the stars in every galaxy. Furthermore, the presence of these fluxes might explain why most stars spin quasi-synchronously on orbits, regardless of their distance to the center of the galaxy.

d) Photons are deflected into the star mainly due to the gradient of the granular density around it, which changes their direction of travel (see Section 3.3). As a photon has a non-zero diameter, its component granules will successively and unevenly change their speed, so there will be a "refraction" phenomenon that changes the velocity's direction toward the higher-density region. At the same time, all of the granules will automatically "fall" into the star in the presence of a dominant flux (Section 3.4). As seen in Figure 34, there is a certain area (gray) around the black hole - the event horizon - from which the photons cannot escape. The material bodies that reach into this area, at any speed, are inexorably attracted to the star's surface, being "stretched" due to the gravitational field's gradient.

e) The stratification with depth and the relativistic rotation of the star's matter make a part of the incident granular fluxes to be diffusely reflected by the surface and another part to be retained between the particles of the first layer. Therefore, the intensity of local fluxes will decrease proportionally with the depth and their remaining part will gradually be integrated into the granular fluid of the star's core. This phenomenon of *granular absorption*, combined with the accretion of the gaseous matter surrounding the star, leads to a continuous increase of the black hole's mass. Moreover, this granular accretion process should be added to the current genesis models and stability theories of the supermassive black holes.

f) The granular fluxes that cause gravity also keep the shape and the internal structure of the black holes. Their intensity diminishes over time with the decrease of the average granular density of space, and this determines the decrease of the black hole's growing speed through absorption. Therefore, the actual quantum theories regarding the evaporation of the black hole through radiation and particle emission do not completely describe the real phenomena occurring in the star's upper layers.

11.3. Dark matter and dark energy

Dark matter is a hypothetical form of matter composed of (unknown yet) mass particles that would only interact gravitationally; it is presumed to represent about 27% of the total matter in the Universe. This kind of matter has been introduced by astrophysicists to justify the rotation speed of the stars in a galaxy and the gravitational lensing effect of the visible light that passes through galactic regions. Obviously, these two phenomena may also have explanations within this theory:

- The rotation of stars from any galaxy that has a supermassive black hole in its center has been explained in Section 11.2.c.
- The lensing effect can be explained by the reflection of the granular fluxes at galactic levels, on all the stars, gases and cosmic dust existing in interstellar space. All these fluxes create a region of higher granular density around the galaxy,

which will cause the deflection of photons in the same way it was described in Section 11.2.d. On the other hand, it is clear that the same spatial region also contains particles emitted by the stars (as electrons, protons, photons and neutrinos), but they may not be held responsible neither for such a large mass as the dark matter is estimated to have, nor for the limited lensing effect of the galactic region.

- As a part of the incoming fluxes does not return, the granular accretion of the black holes could also create a significant imbalance in the spatial density around galaxies.

D*ark energy* is a hypothetical form of energy that represents approximately 68% of the total matter (equivalent), being introduced to explain the accelerated movement of the galaxies away from each other. This form of energy would have a uniform distribution throughout the Universe, a constant density, and it would exert a repelling force (at intergalactic level) that opposes gravity.

However, the creation process and the accelerated movement of galaxies have been explained in Section 5.2., by the very essence of the gravitational effect. The gradient of granular fluxes, at the universe's scale, will always produce a force that pushes away the galaxies, and this happens simultaneously with the space expansion. The magnitude of this resultant force is dependent on the average granular density of space and on the concrete coordinates within the Universe; however, the acceleration effect it causes will be perpetual.

In other words, using all the data contained in this theory, the dark matter and the dark energy cannot be evaluated as distinct physical entities; they both are parts of the same thing: space.

Seen as matter, through its component granules, space is responsible for all of the existing mass and energy. Gravity, as an intrinsic phenomenon of space, is responsible for all the forces that exist at the stellar and galactic levels, setting their magnitude and direction. Thus, the space characteristics may simply explain all the scientific observations that led to the introduction of these two mysterious dark "elements".

Following these interpretations, two aspects of this theory may be easily correlated with the General Theory of Relativity (Einstein): the variation of the average granular density of space is similar to the space "curvature" produced in the vicinity of big masses, while the rotational component of the granular fluxes around all cosmic bodies is similar to the gravitational effect known as frame-dragging.

One more thing should be added here: if space, seen as a three-dimensional framework, will continue to expand, then its granular density will decrease at the same rate, as well as the intensity of the gravitational fluxes. Besides observing the recession of the galaxies, could we measure this space expansion? Could we analyze this real phenomenon by making some laboratory experiences? It is reasonable to think that space has a profoundly *relative character*, and thus we are not able to measure its dilation by other means. We have seen that the granular fluxes interact with matter and generate forces at any scale, from the surface of elementary particles up to stars and galaxies. The intensity of these fluxes keeps the shape and proportion of all elementary particles, determines the dynamic equilibrium with the other forces existing at their scale, and all these things are directly reflected at the macroscopic level in how the objects interact and move (also in their dimensions).

If a calibrated bar of 1 meter would expand by one percent of its length, for example, we are not able to realize this (or to measure the length difference) if all the other things around us would expand by exactly the same percentage. All the velocities would change, and therefore the waves of constant frequencies would change their wavelength by the same percentage. One mention here: the dilation would be infinitely small at the quantum scale, as the mass of all elementary particles depends on the number of component granules (presuming that the size and the other granular properties do not change over time - Chapter 3).

In conclusion, the dilation of space (considering space as a three-dimensional framework), in conjunction with the presumed simultaneous decrease in intensity of all gravitational fluxes, gives space a relative character and does not modify the functionality of its material component. The granular structures, from particles up to cosmic bodies, and their laws of interaction are not affected by this phenomenon. This fact naturally extends the relativity of space as a fundamental and general principle, because it now may exhaustively describe our Universe. Theoretically, a new physical quantity might be introduced, invariant over time, whose formula would contain the volume of space multiplied by the intensity of gravitational fluxes.

12. THE UNIVERSE

12.1. Extinction

Since its birth, our Universe is space, space is matter, and matter is energy. It all began with a singularity, whose entire energy was concentrated in a single "point"; this point suddenly fluctuated and "exploded", turning into a vast, ever-expanding three-dimensional space that contains the same amount of energy, now distributed in a virtually infinite number of granular quanta. All the granules obeyed a few simple laws of kinematics; over an extended period of time, these laws have forced the granules to organize themselves into elementary particles and also determined the complex interactions between particles at a small, quantum scale. Later on, these particles formed the first atoms and the concentration process of all primordial matter shortly begins.

We have shown that the gravitational fluxes determined the star formation process, the evolution of the first galaxies and their movement throughout the Universe. They all continued to move and transform according to the laws of physics that were active since the time zero of the Big Bang. *All* means grains, particles, atoms, planets, stars, galaxies; matter, in any form and at any scale, mechanically interacts, transfers impulses and conserves the global energy. As a result of gravity, we may notice at the cosmic level that larger quantities of colder matter are concentrated into smaller volumes, i.e. into black holes. It does not necessarily mean that the Universe is going to end in this way, called "heat death". This theory has introduced an average granular density of space, which decreases with the expansion of space. In this context, another scenario would also be possible, and it could happen even before the heat death. The average density might reach an extremely low value and the structural integrity of elementary particles can no longer be held. At that time, all the matter would decompose into granules and dissipate in the global granular fluid of very low density. Anyway, gravity will set the ultimate fate of our Universe, over a limited duration of time.

12.2. Rebirth

If we are to corroborate that possible extinction variant (described in Section 12.1) with the granular absorption process in all black holes (described in Section 11.2.e), we could simply figure out a logical explanation for the existence of the primordial singularity and for its "explosion". But to this end, some new hypotheses should be added:

1) This is not the only universe that ever existed; tens or hundreds of billions of years ago, there was a similar universe, simply called U1. No one can state with certainty that it was the first one, or that there is a cyclicality in the birth and extinction of the universes.

2) U1 and our Universe have had exactly the same granular composition, with the same characteristics, and their physical laws were identical. However, the constants of physics at similar ages were different; U1 had a much greater mass, and therefore its granular density was higher.

3) Space, seen as a three-dimensional framework, might already exist or it was created through the expansion of U1; anyway, it was not generated at the birth of our Universe, and this does not change my version of inflationary theory. On the contrary, we may now easily explain those granular reflections on the edge of

the Universe; instead, we may presume that there were collisions with the granular matter from the first universe. Basically, the explosion of that singularity and the inflation that followed might have happened in a space region of U1 where the granular density was extremely small.

4) The evolution of U1 was similar to that of our Universe. First, the elementary particles were created, then the stars and galaxies. During all this time, U1 continuously expanded, its matter cooled down and the granular fluxes increased the masses of its black holes.

After tens of billions of years, U1 got into an extinction phase, following a scenario that was already described in Section 12.1. Now it only contains very distant black holes in a space of very small granular density (which continues to decrease). These supermassive black holes absorbed all of the ordinary matter; thus, the internal pressure has increased substantially and transformed their superdense granular "fluid" into a superdense solid. All the granules in this solid type of stellar core are fused together, occupying an extremely small volume (the Granular Postulate #2 is no longer valid here, nor the fundamental laws). The incident gravitational fluxes determine the existence of a pressure gradient, which is still able to maintain the balance between the internal layers of the black hole. With the decrease of the average granular density of space, some smaller black holes simply dissolved into the spatial fluid. When a certain threshold of granular density is reached, the incident fluxes can no longer maintain the integrity of these supermassive black holes with solidified cores. While their outer layers slowly dissolve, their solid cores (whose stability was ensured by the pressure of the external layers) expand and suddenly explode. This simplified model might explain in principle how the primordial singularity was created and why it exploded, giving birth to our Universe.

As several singularities of U1 might have exploded, some other universes could exist at this very moment; however, they would be so far away that any observation would be impossible.

We found how U1, at the end of its existence, might create a baby universe (or several universes, a Multiverse); the mass of these "child" universes would be smaller, as would be the mass of the "child" singularities they could eventually produce. Therefore, this cyclic extinction-rebirth phenomenon could stop at this stage.

Anyway, this model should be seriously improved in order to answer some other fundamental questions, such as: how did the primordial universe come into existence, and what its substance was made of? My new hypothesis regarding the birth of the Universe follows the trend of modern science and offers an "out of nothing"-like scenario, which is widely described in Appendix 7.

13. THE STABILITY OF ELEMENTARY PARTICLES

13.1. Introduction

The structure of an elementary particle may be directly inferred from the specific properties of the granular medium and from its related postulates (see Chapters 3 and 6). To analyze the stability of this kind of particle, let's now consider a simplified cross-section of a free electron, as depicted in Figure 35. The granular fluid surrounds this electron and exerts continuous and constant pressure on it (the omnidirectional force **F** per unit area); this pressure is caused by the continuous transfer of impulse between the spatial granules and the electron. We will try to show how this action of the granular fluid ensures the shape and stability of that particle (this explanation may be extended and easily applied to any other elementary particle).

We should recall now that all the constituent granules of electrons (whose internal structure is assumed to have the maximum possible density and where all granules are bonded to each other) are constantly moving, rectilinearly, at the absolute speed ***C***. In fact, they are rotating on quasi-circular trajectories due to those internal and external granular collisions. Consequently, the average tangential speed of this rotational movement has a constant value, lower than ***C***, while the angular velocities are different on trajectories of different radii. The quasi-constant number of granules in electrons may be estimated as:

- Above a lower limit, to allow the existence of the electron's distinct shape: a very thin and curved disk;
- Below an upper limit, to allow the stability of the electron's shape during the intrinsic and global movements.

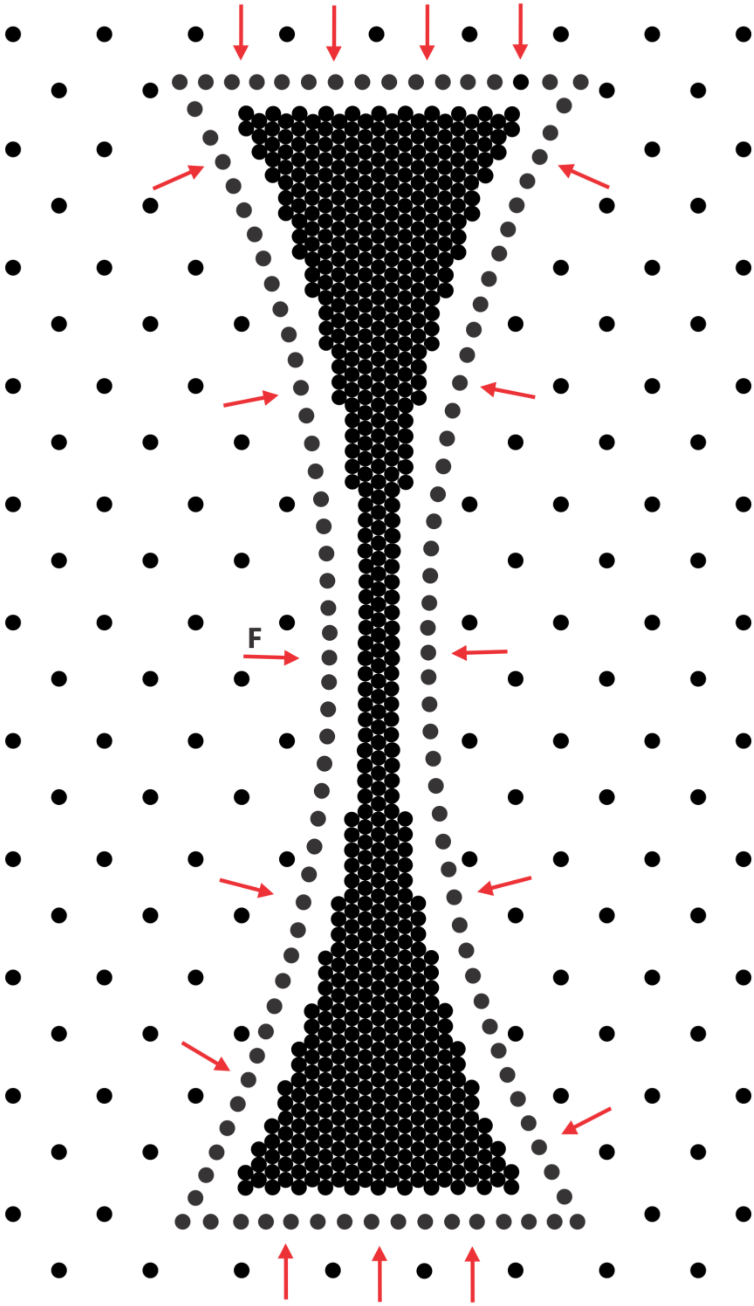

Figure 35 - *An electron at granular scale*

Assuming a dynamic granular structure, the different positions and directions of travel of the constitutive granules may create inside the particle three types of granular aggregations:

A. *Compact* zones (we would call them "clusters"), in which the granules are bonded to each other and, for a short time, they have the same direction of movement (their speed is postulated as constant);

B. *Free* zones, in which the granules are not connected to each other, and where they collide according to the known rules.

C. *Filamentary* zones, in which the granules are arranged linearly or irregularly on compact, one-dimensional rows.

All of these granular groups have a short, limited lifespan; however, their shape and size are randomly shifting, while their component granules are continuously "jumping" between groups.

13.2. Special granular collisions

We must describe now two special cases of perfectly elastic collisions: there are collisions between the granules of different compact zones or between them and those of the free zones. Based on their direction of travel, they may be *collinear* (head-on) collisions and *orthogonal* collisions. Both cases shall be subject to the momentum conservation law, applied in the closed system that is formed of all colliding granules.

The first case involves a granule and a compact, linear group that move in opposite directions, as shown in Figure 36. We may see how the solitary granule keeps moving in its initial direction, but as an equivalent granule; the group of granules also keeps moving to the left, maintaining its initial structure. The impulse of a single granule is ***p*,** while the impulse of a group is **n *p*** - where **n** is the number of component granules. In conclusion, this simple type of collision does not affect the global granular motion; it only causes a very small delay, whose value is proportional to the number of granules that belong to those groups.

The second case involves a granule and a compact, linear group that move in perpendicular directions, as shown in Figure 37. We may see how, after the collision, the solitary granule is "reflected" in the opposite direction; moreover, it is very easy to observe that this angle of reflection gets wider as the number of granules increases.

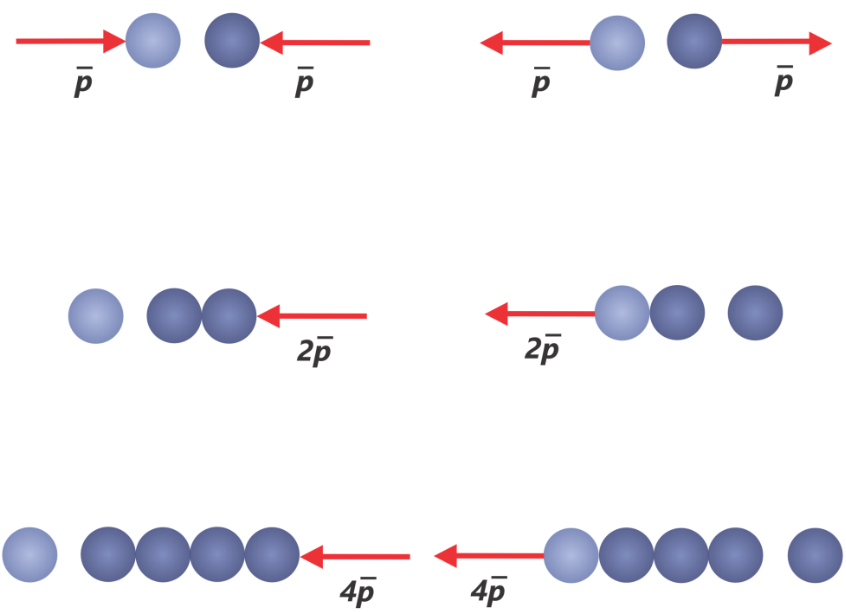

Figure 36 - *Collinear collisions*

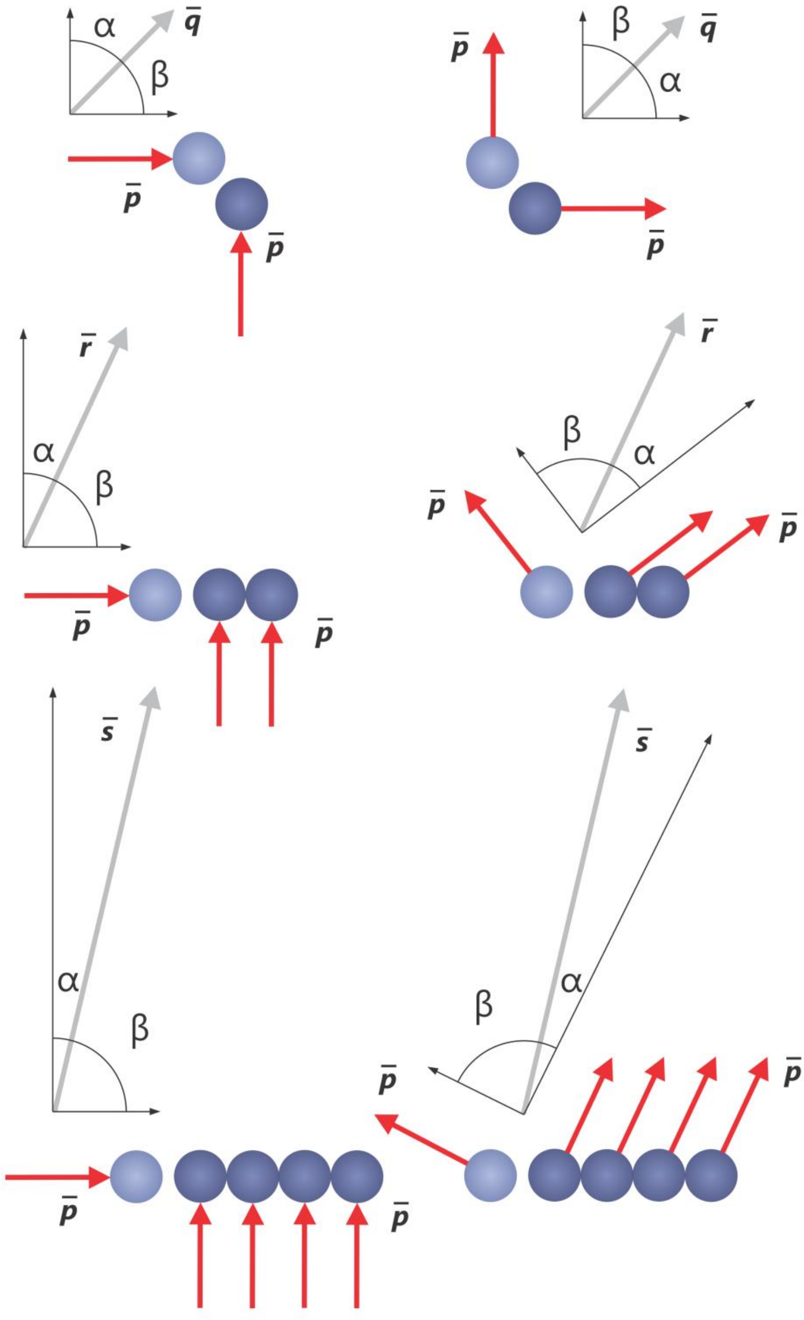

Figure 37 - *Collisions on orthogonal directions*

There are three basic situations to analyze, namely the groups of 1, 2 and 4 granules; the total impulses of these groups are **q**, **r** and **s**, respectively. Applying the law of conservation of momentum to these collisions, we may see how the final impulses of the group and of the granule become reversed in regard to the total impulse vector (the angles **α** and **β** are reversed). The angle **α**, which the group will move by after collision, may be easily calculated from the rectangular triangle formed by the impulse vectors:

$$\tan(\alpha) = p / n p = 1 / n$$

The final direction of the group forms twice the angle, **2α,** with its initial direction (vertical), while **2β** is the angle formed between the reflected granule and the horizontal direction. We may easily notice that, in the case of a very large number **n**, the granular group would suffer a very small deviation of trajectory and the solitary granule would almost go back on its initial direction (practically obeying the laws of reflection).

All collisions between large groups of granules are actually having more complex dynamics and an unknown timing. Their equations might be exactly determined only if some fundamental granular parameters were known, such as the diameter ***d***, the speed ***C*** and the elasticity constant.

13.3. Internal granular kinematics

Regardless of the concrete granular distribution in the aggregation zones, we may assume that all particles have simple internal kinematics, which would consist in a global rotational motion; each granule would move on a quasi-circular trajectory of constant radius, whose center might be right in the geometric center of the particle. This assumption is based on the previous description of the special granular collisions (Section 13.2) and on two other statements:

A. The density of the granular fluid is higher around particles, especially near their edges. In other words, the spatial outline of a particle is fuzzy, not very well defined. However, the boundaries may be dynamically established by the extent of the particle's larger parts, the granular compact zones.
B. Any description of the internal granular kinematics within a circular section through the particle may be generalized for its entire structure, which is in fact a collection of overlapping, circular-shaped layers of different radii.

The variable density described above, bigger near the particle's edges, may be justified only by the presence of the granular compact groups. Thus, any incident granule coming toward the particle's "surface" may behave in two different ways (or in any combination of them):

- If there were only free zones on its path, it would cross the particle as an equivalent granule, with an additional delay due to the very high value of internal density.

- If a compact zone is present on its path, the granule will be reflected back and thus the granular density around the particle will increase. In this case, the most important effect is a small deflection of the compact zone's trajectory, which will be oriented after collision toward the interior of the particle.

Essentially, the "pressure" exerted by the granular fluid on a rotational granular structure continuously "bends" the trajectories of its compact zones, keeping in this way their rotational motion. Therefore, the external granules could either pass through the particle, having no effect on it, or bump into its granular groups, maintaining their rotation - in which case the final effect is the *stability* of its shape and size.

Figure 38 (the upper part) shows a circular section through an electron composed of fixed, linear filamentary groups; all those one granule-wide rows will hold their structure unchanged on very small distances. To keep the analysis simple, we will assume that the particle is only formed of this type of group, tied to each other, and these hypothetical granular "filaments" contain a very small number of constitutive granules (tens). The horizontal group of four granules, which moves in the vertical direction, is bumped at a given time by an external granule. As mentioned in Section 13.2, the group will change its trajectory by the angle **2α**. It will go farther on this new direction and covers the distance **s**, when another external granule will bump into it; this phenomenon repeats similarly, over and over again. The rectangular triangle formed by the small segment **s** and the radius **r** (of a circle circumscribed to all the triangles) allow us to write:

$$\sin (2\alpha) = s / 2r$$

However, **r = n d**, where **d** is the diameter of a granule, and therefore we have the equality:

$$n\,d = s / 2 \sin (2\alpha)$$

But we already know that **tan (α) = 1 / n**, and, by applying the tangent half-angle formula, it yields:

$$4\,d = s\,(1 + 1/n^2)$$

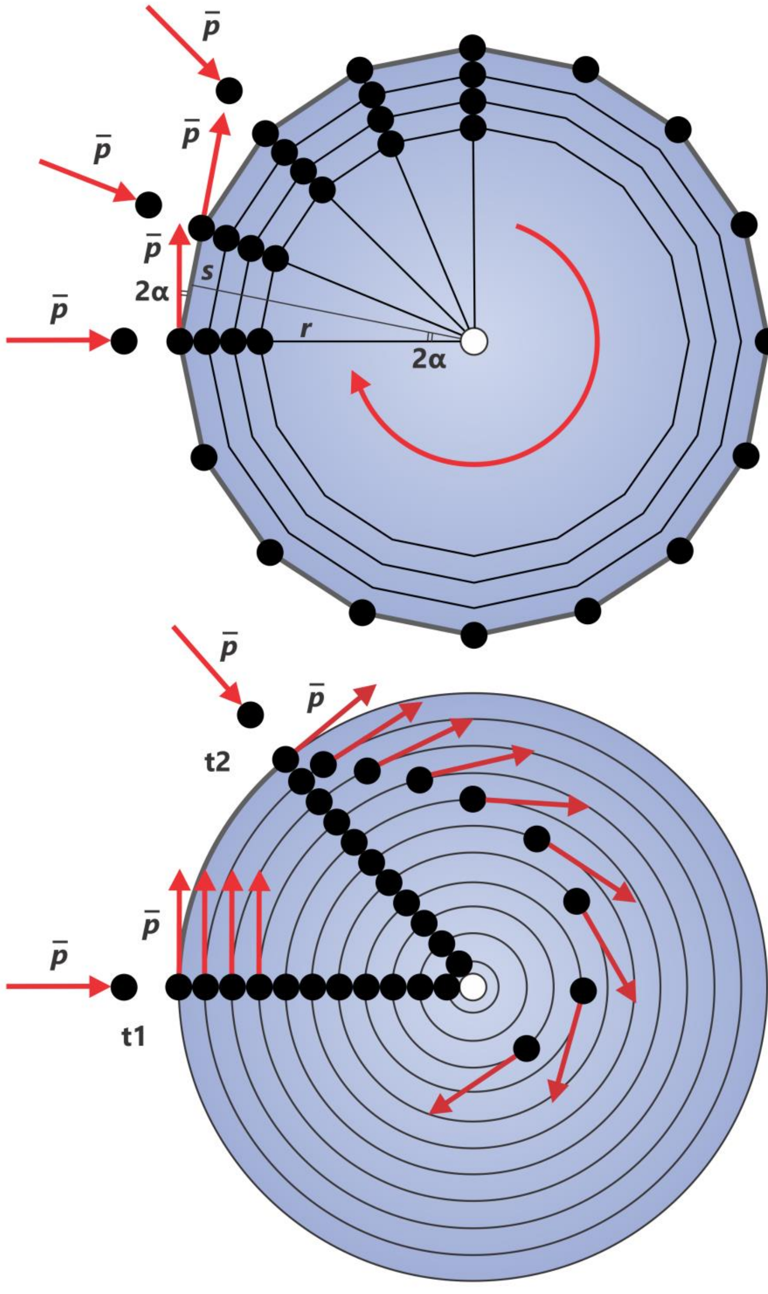

Figure 38 - *Circular sections through an electron*

Previous equality may be approximated, in case of a large **n**, by:

$$\mathbf{s \approx 4\ d}$$

This final formula says that, for a rotational structure composed of filamentary areas, the closed circular trajectories of these areas may be maintained for an indefinite time only if the compact areas continuously receive external impulses at a constant rate. This period has an approximate value equal to the time required for a granule to get through the space **s** (which is four times its diameter):

$$\mathbf{\Delta t = 4\ d\ /\ \mathit{C}}$$

The granular fluid around the particle may simply allow this because its density increases closer to the particle's "surface" and because the global impulse vector is always perpendicular to the surface where momentum is transferred.

The general conclusion is this: once a rotational granular structure is formed (a discoid that is symmetric around a central axis and has the size within certain limits), the granular fluid of space can ensure the stability of its shape and its specific size for an indefinite time period.

Figure 38 (the lower part) shows how, between two quite different moments of time **t1** and **t2**, a linear filament may "dissolve" itself (as its component granules rotate at different angular velocities, on pseudo-circular trajectories of different radii). However, these areas are permanently rebuilt by the addition of some new granules that are detached from other compact areas. All this granular dynamics, apparently of a chaotic nature, keeps in fact the integrity, the shape and the initial size of the elementary particles. The different angular velocities of the internal layers generate, on average, global angular momentum for the particle as a whole, and this is immediately reflected in the existence of its intrinsic precession motion (spin). It has to be mentioned that all velocities and impulses above have been seen from the particle's rest frame.

13.4. The size of elementary particles

All the previous estimations were made only for disc-shaped particles, electrons in fact. It is clear that the electrons have almost constant dimensions, and even more, their physical form does not change during the global rotation and intrinsic precession movements. Nevertheless, are we able to determine their radius or their thickness in absolute values? Alternatively, could we calculate them as multiples of granular diameters?

Intuitively, an elementary particle cannot have however small dimensions, for example, the width of ten granular diameters. Its thickness, which is by far the particle's smallest dimension, may not have this particular value; a particle should not be affected by the granular collisions that could move the compact groups by one granular diameter to any direction. These groups, which in fact give "hardness" to particles (even if they continuously change in shape and size), are present anywhere, at any distance from the center. They are so numerous that, if some would dissolve or disappear, the structure as a whole will not be affected at all.

How could we find at least the upper limit, i.e. the maximum radius a particle can have? First, this secret might be hidden in the size of compact groups. At a relatively large distance from the center, the rotation velocities (on trajectories that are considered circular) of the granules from adjacent layers vary much less than those of the granules closer to the center. As a consequence of this thing, we may say that the compact groups are bigger if they are located at a greater distance from the particle's center (considering all dimensions of a compact group, i.e. length, width and height, relative to the centerline of the particle). We may logically assume that they also have a longer lifespan, as the distances on which they move rectilinearly are greater.

Let's imagine such a compact group in a position of extreme eccentricity, where it interacts directly with the granular fluid that surrounds the particle. For the sake of simplification, we may think of a rectangular parallelepiped whose upper side is the interface with the outside, as shown in Figure 39. The average impulse transferred through this side, within a certain period of time, is directly proportional to the area of this surface. As we have seen above, this impulse will curve the group's trajectory with an angle inversely proportional to the number of its component granules, i.e. with its volume. However, this volume is a quantity that results from the multiplication of the exposed area by the height **h** of the group. The temporary direction taken by the compact group has an angle of inclination given by this simple mathematical relation:

$$\tan(\alpha) = 1 / h$$ (h is expressed in number of granules)

In order to ensure the stability of the entire granular structure of an electron (or another particle), we have already shown that certain proportionality must exist between this number **h** and the radius **r** of the orbit on which the compact group is rotating. However, we may intuitively infer that the height of a group increases if all angular velocities of the component layers have closer values. The angular velocities of two successive granular layers are:

$$\boldsymbol{\omega 1 = C / r} \quad \text{and} \quad \boldsymbol{\omega 2 = C / (r + d)}$$

where **d** is the diameter of a granule. Their difference is:

$$\boldsymbol{\Delta\omega = C\,(1 / r - 1 / (r + d)) = C\,d / r\,(r + d)}$$

As **d** is assumed to be much smaller than **r**, we may write:

$$\boldsymbol{\Delta\omega = C\,d / r^2}$$

$$\boldsymbol{h \sim 1 / \Delta\omega \sim r^2 / C\,d}$$

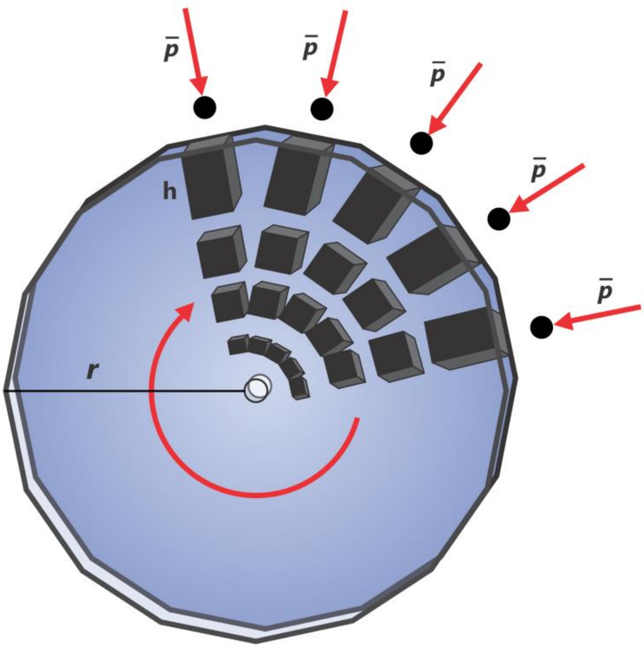

Figure 39 - *Compact granular groups*

This alleged proportionality of **h** with $\mathbf{r}^2$ instead of **r** (as for the filamentary groups of small radii) implies that, at big radii, the average impulse transferred by the granular fluid is no longer strong enough to deflect the trajectories of those groups from the peripheral zones of the particle. It is possible to establish in this way an upper limit for the diameter of elementary particles, which will finally depend only on the granular diameter and on the density of the granular fluid.

Another important feature of the disc is its thickness. The lowest value of the thickness was analyzed above. Assuming maximum granular compaction in the axial direction of the particles, this thickness may also be expressed as a multiple of granular diameters - being virtually equal to the number of circular overlapping layers that form the disc. As shown in Chapter 6, all particles have a continuous motion of precession (so a helical trajectory) that is caused by the granular rotation. The global rotation of a particle (considered a solid body) makes its inner layers (also considered solids, of circular shapes) to synchronically rotate on orbits of slightly different radii. This tends to displace the layers relative to one another, more as their rotation radii are more different. The effects of such different angular momenta are compensated by the pressure of the granular fluid and by the rotation of the compact groups; also, there are many radial filaments that contribute, by their continuous oscillation, to the global dimensional stability. In other words, the thickness of a particle shall be established as a result of this dynamic balance, the major role being played by the local granular density.

The compact groups, of different sizes and shapes, may thus form *solid and stable* discoidal structures, whose radius and thickness stay within fixed limits. These stable structures (we have seen that they can also take toroidal shapes) are the elementary particles that make up ordinary matter. They might also be viewed as special vortexes that can freely move in the spatial fluid, keeping their rotational motion indefinitely by the simple action of the granular mechanics.

Note: check this website www.1theory.com for more info and for new software models of the elementary particles.

13.5. Irregular granular fluxes

Everything in the sections above was based on these simple assumptions: the elementary particles are immersed in a uniform granular fluid and the intensity of granular fluxes is constant in any direction. Let's now consider two special cases, in which some other directional fluxes also act on a particle, and see if they can modify its internal structure.

13.5.1. Photonic fluxes

This case involves a photon of any frequency in a head-on collision with an electron. Figure 40 shows only three successive layers of the photon, a small part of the supplemental flux that flows toward the electron.

The resultant action of this supplemental flux (considered uniform for a short time) is an additional impulse transmitted to the electron's compact groups; consequently, their trajectories will slightly incline to the right.

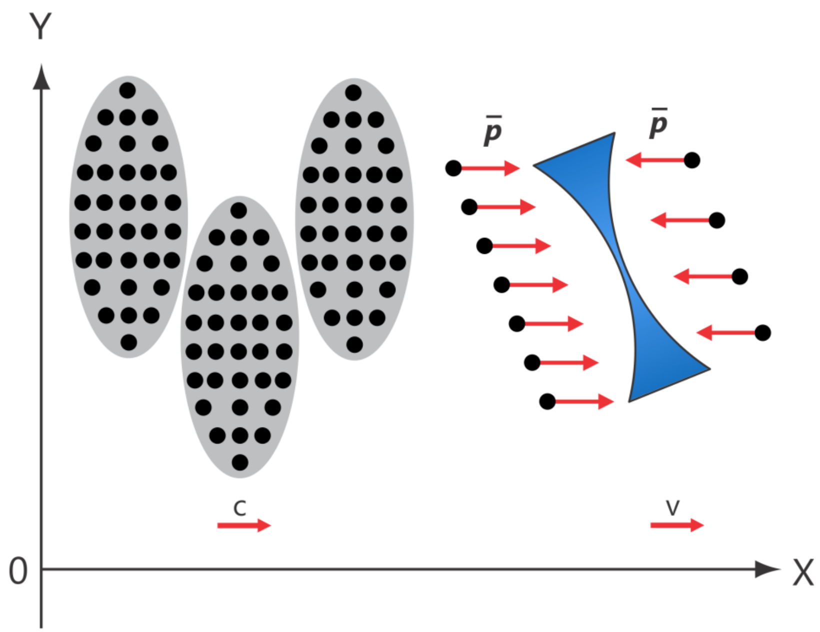

Figure 40 - *Photon-electron collision*

As this interaction is evenly distributed throughout the whole granular structure, all the electron's internal impulses are reoriented on a different angle and the particle's speed will increase a little. The effect accumulates each time a new photon layer comes into contact with the electron's surface (**c > v**), causing a uniformly accelerated motion to the particle. If this phenomenon ceases, the electron continues to travel at the maximum speed it has gained in the process. In the same way, the layers of lower density may slow down (decelerate) the particle. As these uniform photonic fluxes are wider than the diameter of the electron, the particle's shape and size are not affected at all. Anyway, the real photonic fluxes will act alternatively on both sides of the particle during their longer collision intervals.

13.5.2. Gluonic fluxes

This case involves the concentrated granular flux that flows inside a composite particle. For instance, let's consider the field created between the quarks of a neutron (Figure 41). As it has been shown, the flux of the gluonic field is not uniform, its density is higher in the axial zone of these two particles. The **d** quark is in a state of relative equilibrium, i.e. the total flux received from the left is equal to that received from the right. However, the flux from the right side is not uniform; the compact groups in the quark's central region receive a more intense impulse and they will slightly shift along the OX axis, to the left.

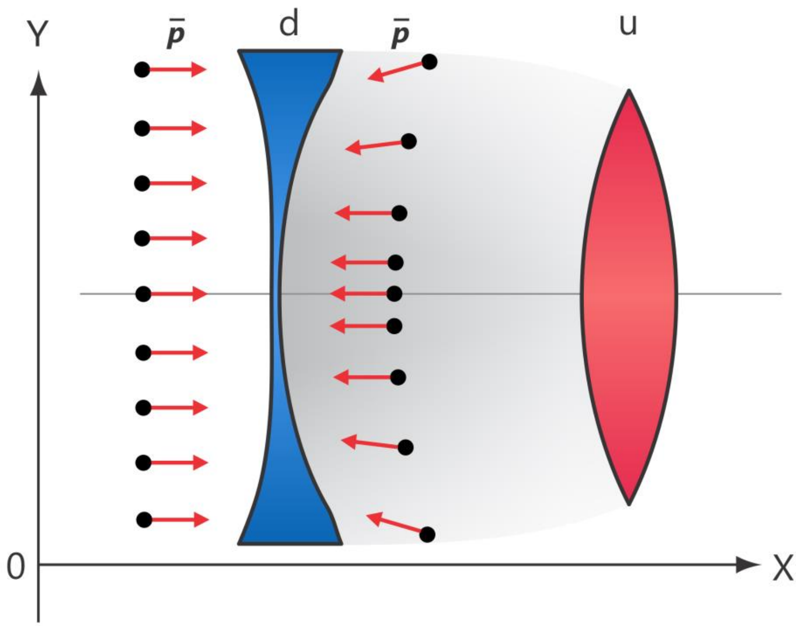

Figure 41 - *The gluonic flux*

This force is balanced out, within certain limits, by the internal granular dynamics of the quark; anyway, it will produce a certain deformation, changing the geometric shape of the particle (see the color component) and therefore its electric charge. If these presumed limits are exceeded, the left quark (**d**) may divide and its central part will turn into an electron.

13.5.3. The annihilation of elementary particles

An electron and a positron may annihilate each other if they got close enough. Their electrical fields can accelerate them up to a relativistic speed and each particle emits one gamma photon during this process. In the end, these two particles will collide and disintegrate themselves; in any case, the total energy and the total momentum are conserved in a closed system like this.

If we assume that both particles were initially at rest, the mass-energy equivalence leads to this formula:

$$\mathbf{m_0\, c^2 = h\, \nu}$$

where $\mathbf{m_0}$ is the rest mass of the electron (or of the positron) and $\boldsymbol{\nu}$ is the frequency of the incomplete gamma photon. We have shown in Section 6.2 that this mass is in fact a relativistic one (due to the perpetual rotation of particles), proportional to the absolute rest mass $\mathbf{m_{00}}$ - whose value is given only by the number of granules. With regard to the real origin of mass, which is based on the "effort" required to change the direction of the granular impulses, we may draw the following conclusions:

- The mass of a particle, originating from its state of motion and from its number of granules, is not directly converted into the energy of the emitted photon. During its accelerated motion, the charged particle creates all the granular layers of the photon; however, at the time of the collision, the particle disintegrates and loses the compact structure that generated its rest mass.

Simply put, the granules of the emitted photon are not emanated from inside the particle. There are in fact two separated processes: the re-orientation (concentration) of the spatial granules into a directional flux that constitutes the new photon, and the annihilation of both particles, which means they are spreading their constitutive granules throughout the surrounding space.

- The mechanical collision between these particles is more like a "plastic" one, as they temporarily create a new body that contains both their structures joined together. The new structure is unstable; it will immediately dissolve into space and its component granules will be thrown in random directions. The energy consumed to concentrate a number of granules and to create the structures of these two particles (and therefore their mass) is entirely lost in the annihilation process. This is not about the granular energy, which remains unchanged (as postulated in [1]) whether the granules belong to a structure or not; this is about energy seen as a flux, as a granular concentration. The process of annihilation is practically yet another confirmation of the mass-energy equivalence (Einstein), because both these physical quantities represent the same thing - a structured combination of elementary, granular energies in the form of directional fluxes or particles.

13.6. The granular pressure

It has been shown in Section 13.4 that the size of elementary particles is finally determined by the properties of their constitutive granules (diameter, impulse, perfect elasticity) and by the local granular density. This density, which is a characteristic of the spatial fluid, can vary significantly from the average value of the Universe. And the simplest example is the inside of a superdense star, i.e. of a black hole. As estimated in Chapter 12, this type of star, due to its huge internal pressure, can "dissolve" the elementary particles (quarks) into their component granules, forming in this way a "solid" core. We also know that these stars are spinning very quickly, with relativistic peripheral velocities.

The high density of the granular fluid in the deeper layers of the star shrinks the composite particles (but their mass will increase); the electric field tries to compensate for this, but all quarks will eventually collapse and merge into that amorphous granular fluid. The first level of the core is similar to the structure of a particle, being composed of big, compact granular groups; also, all these groups rotate at speed ***C*** around the stellar center.

You may see in Figure 42 (a section through the star center) how the gravitational force **F** pushes on the outer layer and creates a certain pressure on surface **S1**. As a result of the geometric concentration, the granular impulse that propagates into the star's depths creates higher pressure on the surface **S2**; on the surface **S3,** at the nucleus level, this pressure becomes extremely large and allows the solidification of all granular fluid within zone **Z1**. In other words, this region is perfectly similar to the internal structure of an elementary particle, in which the granules are practically glued together into compact groups; also, these thick layers and big granular groups may rotate at different angular velocities.

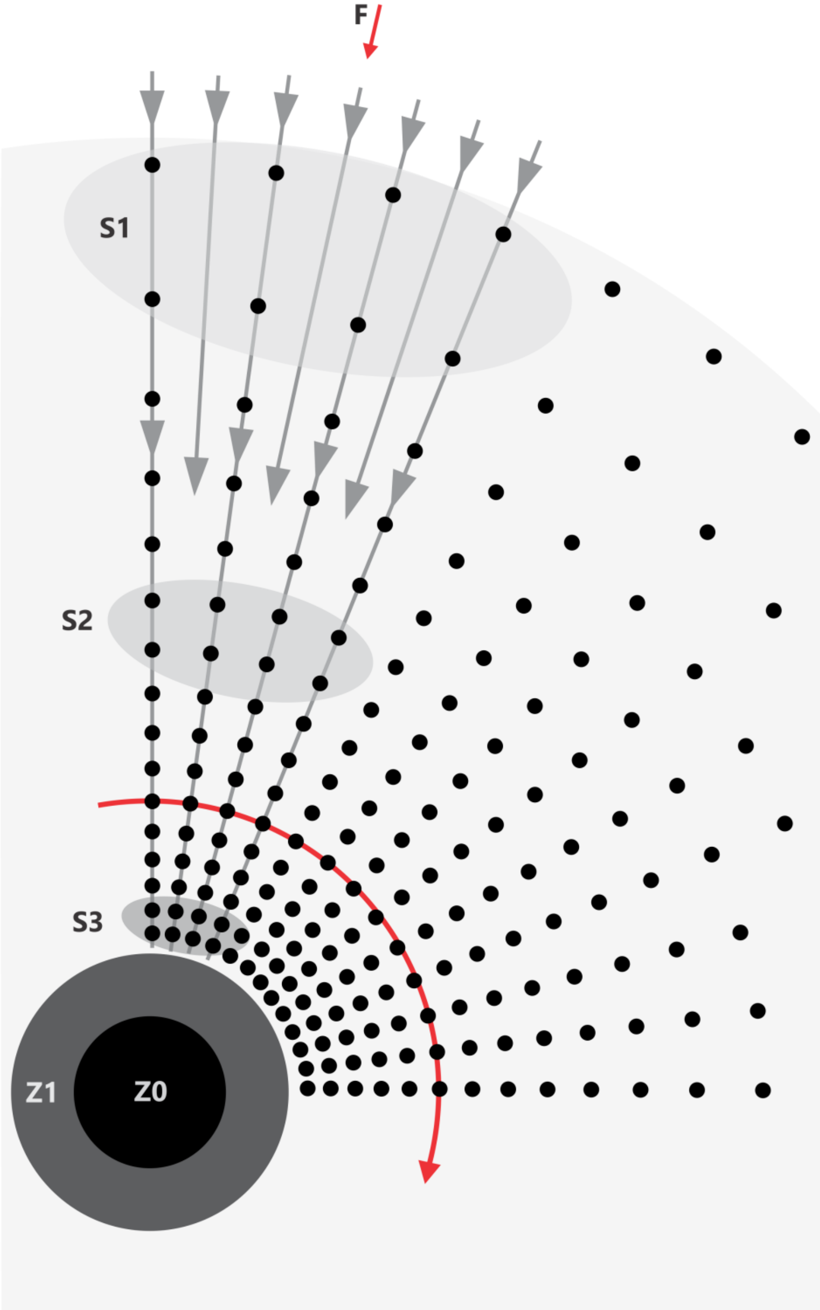

Figure 42 - *Section through a black hole*

We have shown that the gravitational fluxes cannot pass through this type of star; they either reflect on its surface or remain captive inside it, leading to continuous mass growth. This mass supplement causes an increase of the internal granular pressure and thus the outer zone of the solid nucleus, **Z1**, will exert a higher and higher pressure on the central region **Z0**. This central zone of the nucleus is the place where the pressure reaches a maximum possible value. In the case of supermassive black holes (having masses of billions of solar masses), we may consider that the pressure within the region **Z0** exceeded a critical value and the granular solid entered into a highly *compressed* state. What are the special features this compressed granular solid might have?

1. All compact groups have joined each other in region **Z0**, forming a completely solidified spheroid; its internal layers have the same rotation speed (lower than ***C***), regardless of the radius of their trajectory. Here is the place where the granular postulates are no longer applicable, as well as some laws of physics. All granules of this zone have different dynamics, and, by their huge number, they virtually transform zone **Z0** into an accumulator of *kinetic energy*.
2. Spatial granules were described in Chapter 3 as some discrete, minimal, identical, ball-shaped elements that have a perfectly elastic behavior in all collision processes. This behavior suggests the elastic nature of the primary "material" these granules are made of. Therefore, it is possible (at least theoretically) that a sufficiently high pressure might shrink, distort and finally turn them all into a special, compressed state. In other words, zone **Z0** may also be considered a high-capacity accumulator of *elastic potential energy*.

3. Regardless of their rotation velocity (even relativistic), the outer layers of the black hole (formed by quarks) are in a steady state of dynamic equilibrium, in which the centrifugal forces equalize the gravitational ones.

Now, let's consider the latter phenomenon along with the perpetual mass accretion (from granular fluxes, interstellar gases and dust, from incident photons and particles, or even through the assimilation of other stars) and with the decrease of average granular density all over the Universe (the star evaporation is negligible). We must also emphasize the fact that the mass of all quarks from the outer layers of the star relativistically increases with the peripheral velocity. Could the stability of this supermassive star change over time? When its mass reaches a certain threshold value, could the star undergo a gravitational collapse due to the high compression of zone **Z0**? Could this collapse immediately determine the star explosion?

We would answer "yes" to all these questions, and this can be logically justified. The granular model of this kind of supermassive star specifies that the necessary conditions for explosion might be fulfilled in a distant future, over tens of billions of years, when:

- The average granular density of space will drop below a critical threshold, as well as the intensity of the gravitational fluxes that maintain the stellar structure. As a result, the size of the star will increase a little.
- The mass of the star will exceed a critical value, and therefore the solid region **Z0** will fail to the immense pressure and it will abruptly compress, reaching the minimum possible size, of extremely low value.

In fact, this is a well-known scenario, perfectly similar to a supernova explosion. While other regions of the star are also collapsing, the total angular moment is conserved. As a result, the peripheral speed of the outer layers increases, and thus the centrifugal force may become greater than the gravitational one. The moment these outer layers are expelled into space is the moment when the star explosion is triggered. All the internal layers quit the state of dynamic balance, allowing the enormous energy stored inside the stellar core to be dispersed throughout the space. This event of truly cosmic magnitude has all the characteristics of a Big Bang, and it might validate the hypothesis of a primordial explosion through which our Universe was formed, as described in Appendix 7. The region **Z0** (consisting of compressed granules), which has reached a minimum size during the collapse, would correspond to that singularity introduced by the current cosmogonic theories. Moreover, the normal stellar matter (the already existing quarks) will evenly spread through space, being supplementary accelerated by the granular fluxes generated in this explosion.

14. GRANULAR INFORMATION

14.1. Information features

First, what does the concept of information generally mean? From a technical and scientific point of view, information means a representation or a reflection of reality, which, by using a set of symbols accessible to humans, may quantify some parameters of material or virtual objects. If the specific characteristics of that object are encoded using those symbols, information gets a deeply *abstract* character - but it will allow *concrete* processes of analysis, comparison, compression, storage or transmission. The information associated to a generic object may thus describe one or more of its properties to a certain degree.

Informational postulate #1

A finite amount of information may be associated to a physical object, and this information may describe it exhaustively.

This means: if we had this amount of information, we could create an identical copy of the object, a clone that would not differ a bit from the original. In addition, this idea leads us toward other important features of information:

A. The information has a *universal* character, and it exists within any physical entity, as an *intrinsic quantity* of the material objects.

B. As an object has a certain shape or a certain value of mass, it also *contains* a finite amount of information. Therefore, as a direct consequence of this first postulate, only a *finite amount* of information may be added to a physical object (due to the discrete nature of its constitutive matter).

C. The other form of energy, i.e. the photons, may also contain information; thus, it is possible to transmit any information at a distance by such means.

D. As the information contained by any material object has a finite value, we may introduce a new physical quantity, namely the information density.

In this context, at least two new questions arise:

Q1: Can we retrieve *all the information* of a material object?

Q2: Which is the *maximum value* of the information density?

To answer these questions, we have to establish first the basic unit of information, its representation and whether this unit allows information to be read, written, duplicated or transmitted at any scale of matter. We may easily infer from above that the information is automatically associated with energy, no matter of its form. As there is a minimum amount of energy, we may intuitively assume that this amount could be associated to a minimal information value. However, a complete definition of information, in the Prime Theory's perspective, may only be given if all particularities of this concept are thoroughly analyzed.

A unit of measurement for information can be easily identified and represented at the macroscopic level. Here, all things are quite clear, as they are dominated by certainty, and it comes naturally to establish a binary association (a minimal system) as a basis of this measure. Two complementary attributes of a simple object may constitute a minimal characterization system, such as up-down, black-white, yes-no, open-closed, present-absent, fixed-mobile, positive-negative and even-odd. These attributes can provide an absolute, precise, general and univocal representation, a minimal encoding method of the basic macroscopic information.

We have seen that an object may only contain a finite amount of information, as it consists of a finite number of atoms (molecules), in a finite number of quantum states, with a finite number of atomic bonds. Regardless of the dimension, position, energy or time uncertainties that are present at the quantum scale, the macroscopic information contained within an object can be *complete* and *certain*. This simply results from the finite energy (mass) contained in an object and from our capacity to determine all its macroscopic parameters (the measuring devices do not affect them significantly). And there is another explanation, based on the "reduction" of information near the atomic scale, which directly results from the properties of matter.

How could we find out the minimum amount of pure and uncorrelated information contained in a particle, a photon or a system of particles? And how could we measure it?

- The isotropy of the three-dimensional space automatically implies certain *symmetry* of the information carried by an object; therefore, this information is redundant and may be further reduced. More, the global directions of movement are no longer representing primary information in the object description, nor its relative position in space.
- Near the atomic level, we are getting closer to a physical limit of information, as atoms are the basic constituents of any material object. This is in fact another level of information (it will be described below), which also includes a certain redundancy and a specific correlation. We will further assume that all elementary particles are identical throughout the

universe and they have the same fundamental parameters; consequently, their only specific features may be the state of motion and the relative energy.

- The temperature of an object, as a reflection of its internal kinetic energy, also adds a certain degree of informational entropy, and therefore it should be eliminated from this search of the "pure" information.

Upon its creation, a material object stores some intrinsic information, which may change in time if its state changes; this information may even disappear, totally or partially, when that object disappears. In conclusion, we may identify three layers of information within any physical object:

1. The *macroscopic information*, which usually has averaged values, describes a global characteristic of an object, such as its size, shape, speed or color. The minimum amount of information at the macroscopic scale is one ***bit***, and this unit can have two basic states - concrete binary representations like open-closed, yes-no, high-low, zero-one, plus-minus, etc.

2. The *quantum information*, which is dominated by uncertainty and probability, describes the state of an atom, the spin of an electron or the polarization state of photons. At this level, the primary information can be measured using a special bit, the ***qubit***, given by the superposition of two quantum states, 0 and 1:

$$|\psi\rangle = \alpha\ |0\rangle + \beta\ |1\rangle$$

where α and β are the probabilities of the two states and

$$\alpha^2 + \beta^2 = 1$$

This type of information is directly linked to the number of distinct states the particles and photons may have and of their degrees of freedom.

3. The *granular information* is stored in the building blocks of matter (the elementary particles and photons). An elementary particle, which emerged from rotational fluxes, may have a set of special, implicit features such as mass, electric charge or intrinsic spin. All the same, a photon (as directional flux) may have some proper features, such as completeness, frequency, shape or polarization. But all these data are directly associated to that particular structure, and they should no longer be described. At the granular level of space, the primary information is exactly the existence of a rotational or directional granular flux at specific space-time coordinates, in a reference frame.

These granular structures become relevant in this way, and therefore we suggest that the granular information might be given by *the probability of the existence* of an elementary particle or photon (of a specific ensemble of granular energy quanta). The granular bit could be given, in the relativized context of a presumed closed space, only by the global probability of the existence of a certain granular structure inside a system, at a given time, not being related to any spatial parameters.

In the case of the largest known system - our Universe, these bits would globally reflect the concentration of granular energy, a sort of granular entropy; thus, the value of **0** would mean that the system is completely amorphous (maximum entropy), and **1** would mean that all of its granules would be constituted in structures. The granular bit would actually show the distribution of granular energy in that system, its capacity to be the primary medium for information, and therefore the possibility to be used as a base for the next informational level (quantum information).

Numerically, this bit would be given by the number of structured granules reported to the total number of granules. However, it cannot be used to work with information, because it only provides the necessary support for the two higher levels of information. There is no other type of information below the granular one, as long as we can only talk about the free granules that form a uniform spatial fluid. More, this homogenous granular medium (regardless of its density) "dissolves" any kind of information, because the information is in fact, as well as the energy, only a temporary granular concentration. For the sake of simplification, the granular bit might be graphically represented as a sphere circumscribed to particles or to photons (Figure 43); these spheres are moving along with them, setting in this way the boundaries of the closed regions of space that may contain or carry information.

These bits correspond to zones **A** and **B**, where the granular density varies from the average value $\tilde{\mathbf{d}}$. Their minimal spheres will only give binary information, namely if that zone is an informational medium or not. The higher levels of information may be spatially marked as larger, shape-shifting regions, which may include one or more minimal spheres.

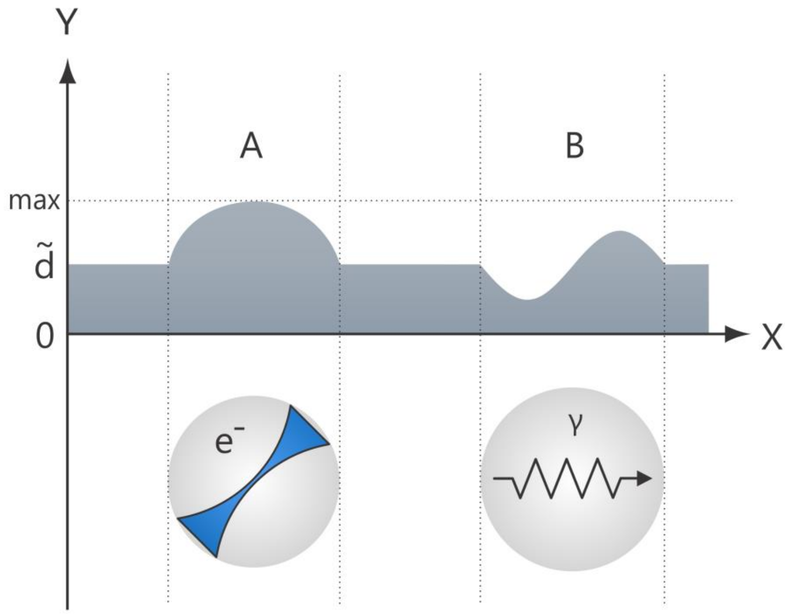

Figure 43 - *Granular information*

14.2. A definition of information

All types of information - macroscopic, quantum or granular - express the concentration of the granular fluxes (elementary energies) at different dimensional scales. Information has a static, intrinsic aspect, representing the proper energy of a granular structure, and a dynamic one, measuring the state, organization and energy transfers related to that structure.

In other words, information is a "pattern" of energy, the form in which the granular energy is aggregated, describing the ratio of *concentration* to *uniformity* in a certain region of the spatial fluid. Information cannot exist independently, without the base of a granular flux (i.e. a concentration of energy), and it simply disappears once that flux "dissolves" into space. At the granular level, the base of information consists of spatial regions with higher or variable granular density, like particles and photons. When some amount of energy is transferred to other structures, the associated information is transferred at the same time, partially or completely. Those three levels of information **L0...L2**, i.e. granular, quantum and macroscopic, are all represented in the upper part of Figure 44. At the bottom, we can see an example of informational "fields"; due to their dynamic shapes, they may overlap the other space regions, where ordinary matter and energy are both located. These three-dimensional fields are the only regions of space that may contain information.

And the answer to Q1 is that we cannot find all the information contained by an object, because at least its quantum part has some inaccessible components, while the other ones may only be read through destructive interactions.

We may effectively work with information up to the quantum level, the lowest possible one, and this sets up in fact the upper limit of the information density (Q2).

How can we work with information? To create and store information means to build or modify a structure, and this process implies the use of a certain amount of energy. In order to read the information, we need to interact with that structure in a specific way, producing a measurable response; the reading interaction also requires a transfer of energy. At the macroscopic level, this minimal interaction does not change the current state of the object. On the other hand, the quantum information may only be recovered through fundamental interactions, and these will change the states of particles or of their different systems.

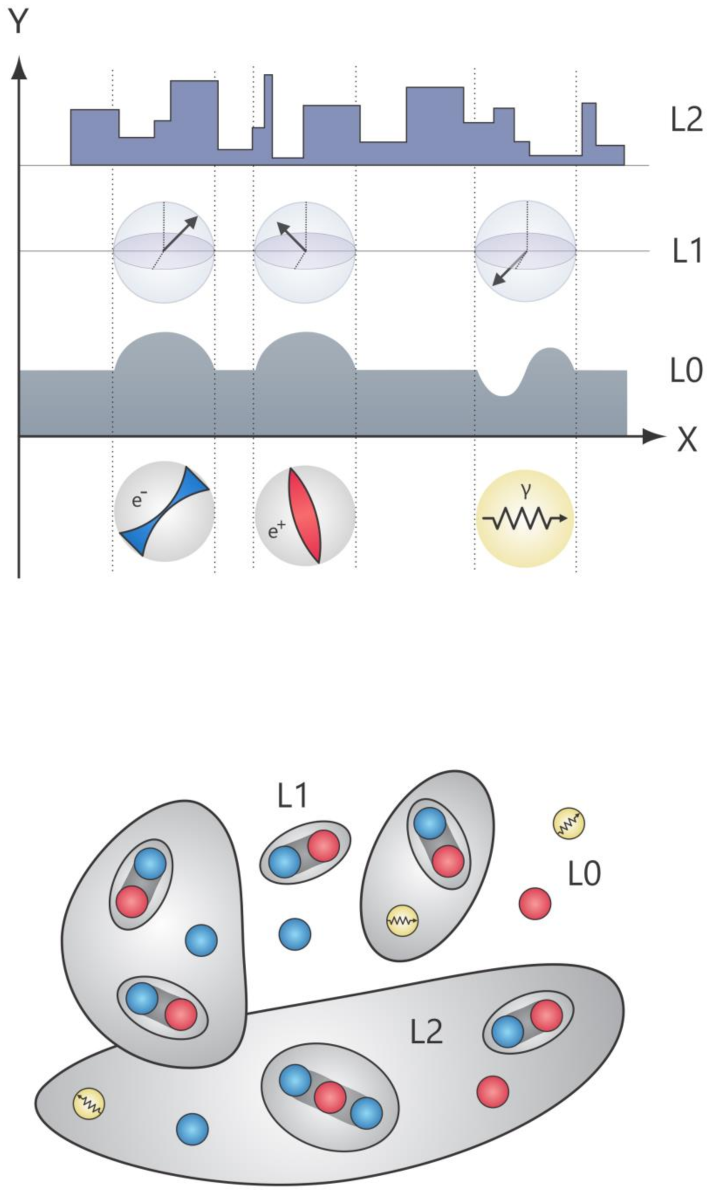

Figure 44 - *Levels and fields of information*

14.3. Destroying the information

Once created, information may be copied, modified, or transmitted at a distance. All the granular information is lost when the granular structures are destroyed; as this type of information is the basis for those two higher levels, the entire amount of information will automatically be lost.

For example, upon the annihilation of an elementary particle or the absorption of a photon, their component granules will spread throughout the surrounding granular fluid of space. If these concentrations of energy are destructured, all the contained information is lost; consequently, a more appropriate and precise term to use for this process is *dissolution*. As the granular energy is conserved, the granular information will also be preserved. However, due to the specific granular characteristics, the dissolution process transforms and distributes the structured support on the surface of some virtual spheres, centered on the source of information, and whose radius increases at the speed of light, **c**. This projection of granular information on a sphere is an ideal process, which can only happen in the empty space. If the ordinary matter is present, the spherical informational "shadow" is randomly scattered due to the multiple granular reflections on the particles of matter. In both these cases, information *is not lost*, but it cannot be *recovered* from its diluted form (which will continuously expand across the spatial fluid). Therefore, the semantics of the term "lost" as an attribute of information is different, the true meaning is now "impossible to retrieve" instead of "disappeared".

Informational postulate #2

In the closed granular space of our Universe, all the information (as support) is conserved over time.

Explanation: the granular postulates ensure the rectilinear propagation of all granular fluxes, however small they would be. Therefore, even the one-granule fluxes follow a linear trajectory if they are not reflected by the material structures. Thus, the informational shadow extends continuously through the spatial fluid, maintaining all the fragments of the original information, until it reaches an almost zero density (equal to that of the empty space). The informational postulate #2, applied to that support of information called **L0**, is a direct consequence of the constant number of granules in our Universe (Granular postulate #2).

We may put this in a different way: the Universe may contain, at the granular level, all the existing information - whose average density would consequently be very low. At a certain moment, a concentration of granular energy is formed somewhere - for example, an elementary particle is created; at the same time, some granular information appears in the same place, as shown above. This new piece of information, extracted from the spatial "ocean" of information, reaches the maximum value of density (and it will always go along with the host particle). When that particle is annihilated, all the information it contains (as well as the energy) splits into pieces, dissipates and goes back into the spatial fluid.

The example above could be generalized to include the case of more complex systems, and therefore this informational postulate may apply to all levels of information.

Informational postulate #3

*The maximum propagation speed of any kind of information is equal to the speed of light in a vacuum, **c**.*

This is an automatic consequence of the granular kinematics postulates, corroborated with the fact that the informational support, i.e. the granular structures, also has an upper limit of speed. However, this postulate assigns a *relativistic* character to the transport of any kind of information, which will depend on the observer's reference frame as well.

Informational postulate #4

Within the closed space of our Universe, at the current value of granular density, the probability of any granular information to appear spontaneously is quasi-null.

The granular information (the concentration of granular energy into structures) can no longer appear spontaneously; the current value of granular density, which is much lower now than it was in the early ages of the Universe, drastically reduced the odds of a granular structure to emerge by chance. On the other hand, the current value of density is high enough to ensure that all existing structures (and the future ones) cannot spontaneously disintegrate.

14.4. Information and black holes

If we consider a macroscopic object that falls into a supermassive black hole, passing beyond the event horizon, we may notice how its information is lost, on every level. The first one to disappear is the macroscopic information, once the object is torn apart and transformed into elementary particles (they are assimilated into the top layer of the star). The quantum level of information also disappears, as the bonds between particles are destroyed in the deeper layers of the star (those formed by very close quarks). In addition, the granular information is lost if the object's quarks pass through the granular horizon and the solid core of the star assimilates them. Globally, all the energy of the object will be stored in some different layers of the star, increasing the total energy accumulated in the stellar core. However, all three types of information stored in this object, meaning the particular way its internal energy was structured, will be completely and irreversibly lost at the time of granular disintegration. This is similar to the dissolution of information into the spatial fluid, as the empty space and the stellar core are both amorphous regions of quasi-uniform granular distribution - from which the information cannot be retrieved anymore. The only difference may be the speed of the process; in the case of the star, it could happen quasi-instantly at the core level.

Practically, every black hole absorbs all the surrounding information and then dissolves it into its body. Inside a black hole, there is structured matter between the two horizons, the event horizon (outside) and the granular horizon (inside), and this matter could constitute informational support. However, any information would be added to this region will be immediately lost into the very dense matter of the star, which does not actually allow any kind of complex structural organization.

15. EPILOGUE

We analyzed the history of our Universe from the initial moment up to the present time, we launched a hypothesis on its birth and we described a possible scenario for its extinction. In my opinion, all the above explanations for the emergence of matter, for its transformations and interactions are rational, coherent, being based on laws and principles of physics that are valid at any moment, in any place. The entire process of creation and evolution has been completely natural, and therefore it may be easily explained and understood in every detail. Chance and randomness, which must be definitively considered in regard to such a big space, such a long time and such a large number of extremely small particles, have played a special role during this process. However, they should never be confused with some divine intervention, not even when the first alive cell has emerged in this Universe.

There are two different models of the birth of our Universe, the First Bang (described in Appendix 7) and the Big Bang. Either way, our Universe is not a virtual structure; it does exist, it evolves, it is as real as possible. If the idea of a closed Universe is accepted, as in this theory, we will have to fight a gnoseological limitation that stops us from getting complete knowledge about it. However, it is our duty to explore and expand our scientific understanding until we reach that limit.

We have shown that the three-dimensional Universe is bordered by the two-dimensional surface of the primordial "bubble", which encloses it completely inside a dimensionless "nothing". Seen as such, from the outside, the Universe does not exist; with all its continuous expansion, the apparent increase can only be perceived from the inside, where space does really exist. This thing automatically implies ephemerality, and therefore it adds a bit of virtuality to the nature of our Universe.

It was previously described the manner in which space keeps its duality during expansion, even if one of its components "dilutes" in the process. In conclusion, both components of space will always remain separated (they certainly can no longer merge back and form something like the primordial "nothingness"). As there is no logical reason for this expansion process to stop, we may consider that the spatial expansion is perpetual; all granular structures, from particles to galaxies, created over billions of years, will therefore cease to exist at a future moment, when a major cosmic cycle will come to an end.

***

APPENDIX 1

Let's consider a half-integer spin particle in a state of absolute rest; as it was already postulated, this particle keeps moving and follows the particular trajectory that is displayed in Figure A1.1 (graphic representation [4]). This curve should be seen in a 3D perspective, where the black arrows are more distant than the gray ones. As shown above, the intrinsic precession of a particle is due to the continuous rotation of its granular layers. However, this precession is constrained by an extra condition: the instantaneous velocity vector can be neither collinear with the velocity vector $\bar{\mathbf{v}}$, nor perpendicular to it. Therefore, that particle executes a global rotation; it will return to the initial point, having the same direction of spin, after two complete revolutions.

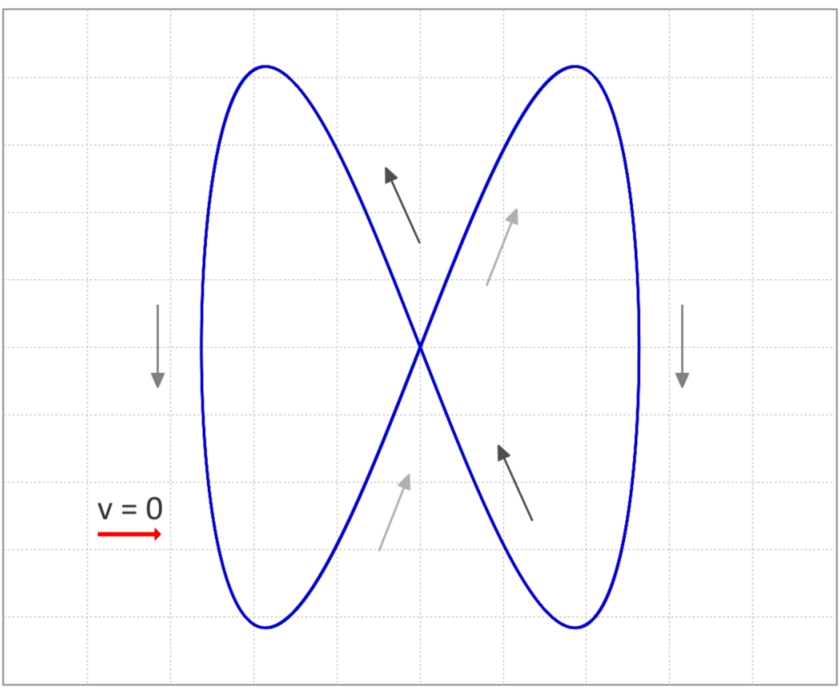

Figure A1.1 - *The trajectory of a free particle at rest*

If our particle moves along the horizontal axis at a speed **v > 0**, its trajectory will change a little (as shown in Figure A1.2). The frequency of this precession is constant, depending on the particle's shape (its moment of inertia in relation to the axis of rotation) and on its granular angular speed; however, the wavelength is variable, it also depends on the global speed **v**. As we considered a free particle, the eventual axis oscillation (wobbling) will not be added to this intrinsic precession.

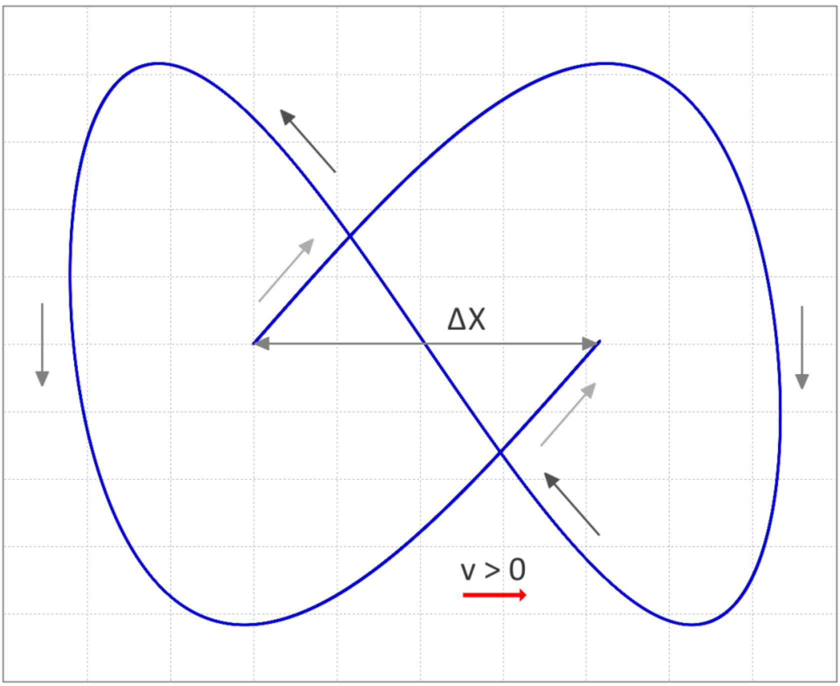

Figure A1.2 - *The trajectory of a low-speed particle*

Figure A1.3 shows the trajectory followed by a particle moving at a very high, relativistic speed. In this case, the possible directions of the instantaneous velocity vector (as of its spin axis) are confined to the space between two cones, being oriented only to the right, as the global velocity vector (see Figure A1.4).

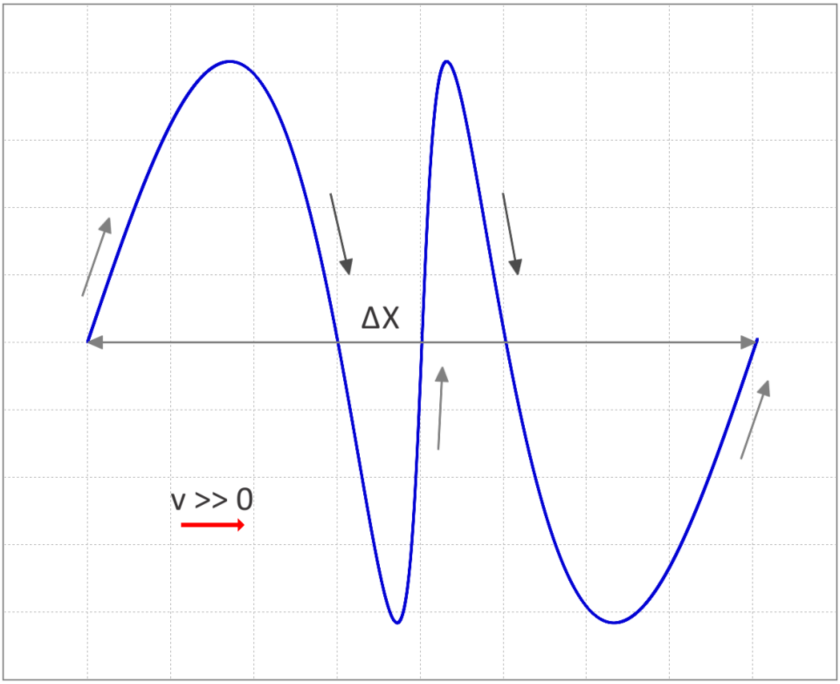

Figure A1.3 - *The trajectory of a high-speed particle*

Some parameters of the intrinsic rotation and precession have already been estimated [1], leading to the following results:

- The circular movement (revolution) has a relativistic speed, approximately equal to **95% c.**
- The diameter of the circle is equal to **105%** of the Compton wavelength (**h / m_0 c**).
- The rest mass is in fact a relativistic one; in the case of a truly "fixed" particle, the mass would be **30.6%** of **m_0.**

All these data, in conjunction with the related statements of Section 6.2 and Granular Postulate #1, give a clear meaning and a concrete value to the absolute rest mass of an elementary particle (**m_{00}**), which only depends on the number of its granules.

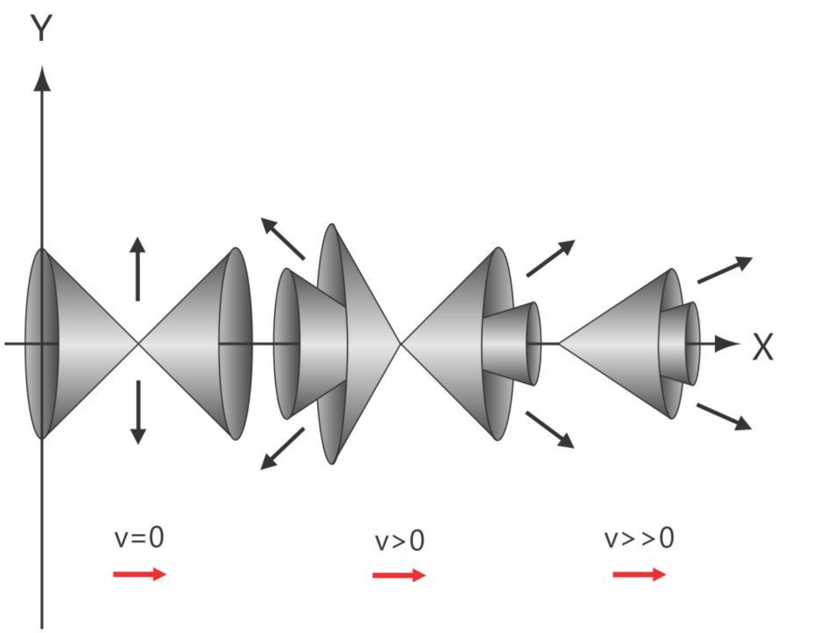

Figure A1.4 - *Spatial distribution of the instantaneous velocity*

Now we may calculate the upper limit of the granular speed by the simple composition of those two perpendicular vectors, tangential and longitudinal velocities:

$$\boxed{C \approx \sqrt{2}\,c}$$

APPENDIX 2

The force **F12** has a spatial component, **F1**, and an electric one, **F2**. The first component is therefore analogous to the gravitational pull (because they have the same origin, the local fluxes), having this simple formula (where **x** is the distance):

$$\mathbf{F1 = k / (x + x0)^2, \quad x \geq 0}$$

The second force, of electric nature, increases linearly on short distances and decreases quadratically on long distances:

$$\mathbf{F2 = k2\ x / (x^3 + k3), \quad x \geq 0}$$

As the force generated by the gluonic field is similar to the pressure exerted by an ideal gas (equation of state p V = constant) on a surface of constant area, we may write:

$$\mathbf{F3 = k4 / (x + k5), \quad x \geq 0}$$

A stable state will be reached when:

$$\mathbf{F1 + F2 = F12 = F3}$$

Figure A2 shows the attraction force **F12** (in blue), the repelling force **F3** (in red) and their resultant **F = F12 - F3** (in green), following the distance **x** [5]. Point **A** is a point of stable equilibrium; if the distance increases, **F12** will increase too, and also **F3** (on short distances). The entire gray area, up to point **B**, is, therefore, a zone of relative stability, in which the ensemble of the two quarks will act "elastically". Beyond point **B**, the attraction force will no longer be dominant and the system will lose its balance.

The amount of energy required to get the particle out of its stable state is equal to the mechanical work of the force between points **A** and **B** (the hatched area):

$$\mathbf{E = \int_A^B (F1 + F2 - F3)\, dx}$$

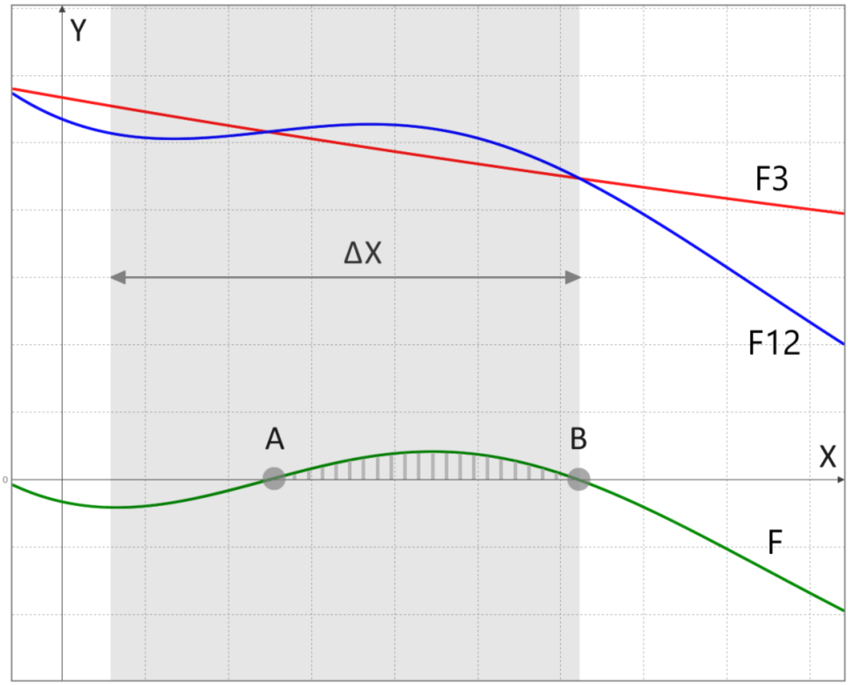

Figure A2 - *The inter-quark forces*

APPENDIX 3

Let's now consider a mobile frame of reference that moves at speed **v** along the OX axis. A beam of light **γ** is emitted in this frame (it forms angle **ϕ** to the same axis), but in the opposite direction. From the laboratory's frame of reference, that beam will be seen at the angle **α**, which can be simply calculated using this formula (it may be obtained by projecting the velocity vectors onto axes and by their relativistic transformation):

$$\mathbf{tg}\ \alpha = \sin\phi / \gamma (\cos\phi - v / c) = \sin\phi \sqrt{1 - \beta^2} / (\cos\phi - \beta)$$

where $\beta = v / c$. For $\phi = 45^\circ$ and $\beta = 0.5$ we get $\alpha = 69^\circ$, i.e. the real angle significantly increases with speed.

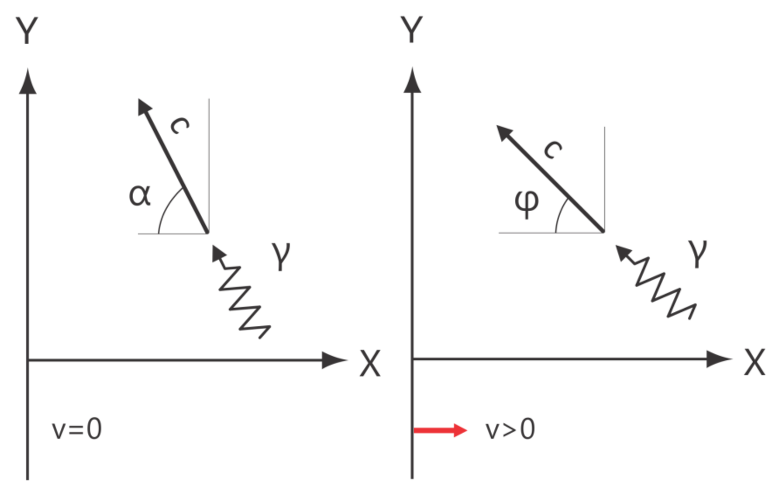

Figure A3 - *The change of angles with speed*

APPENDIX 4

The one-dimensional model of the accelerated relativistic motion of charged particles has a simple equation, which may be expressed by the equality between the Coulomb's force and the acceleration force plus the one required to create the photon's granular flux (presuming its proportionality with the acceleration), where mass will have a relativistic value. Let **x** be the spatial coordinate of the particle and **r** the distance to the source of the electric field (considered as fixed).

$$F_e = e^2 / 4\,\pi\,\varepsilon_0\, r^2 \;=\; e_0^2 / r^2$$

is the electric force, where $r = x_0 - x$.

$$F_a = a\, m_0 / \sqrt{1 - v^2/c^2}$$

is the acceleration force, **a** being the acceleration value and **v** the speed of the particle.

$$F_g = (1 - k)\, a\, m_0 / \sqrt{1 - v^2/c^2}$$

is the deceleration force, with $k < 1$ as a constant. By equating these forces, we get:

$$F_e = F_a - F_g$$

$$e_0^2 / r^2 = k\, a\, m_0 / \sqrt{1 - v^2/c^2}$$

where $a = \ddot{x} = -\ddot{r}$ and $v = \dot{x} = -\dot{r}$, which yields:

$$e_0^2 / r^2 = -k\, \ddot{r} / \sqrt{1 - \dot{r}^2/c^2}$$

We may obtain from this equation the exact evolution of the distance **r** with time, as well as the instantaneous speed and the time elapsed until the particle reaches a certain speed.

APPENDIX 5

The calculation of the alpha angle

This calculation can be simply done if we apply the law of conservation of momentum and of energy in that system, considering speed **v** as having a relativistic value:

$$\mathbf{m\ c^2 + m_0\ c^2 = 2\ h\ \nu} \quad \text{energy conservation and}$$

$$\mathbf{m\ v = 2\ h\ \nu\ \cos\alpha} \quad \text{momentum conservation}$$

By replacing $\boldsymbol{\beta = v / c}$ and $\mathbf{m = m_0 / \sqrt{1 - \beta^2}}$ we get

$$\cos\alpha = \beta / (1 + \sqrt{1 - \beta^2}\ )$$

which shows that at **v = 0** photons are emitted in opposite directions, while at speed **v ≈ c** those photons are collinear.

The energy of photons emitted by orbital electrons:

In the case of a simple atom (classically treated), if the electron's orbital angular momentum is quantized, the speed and the orbital radius will depend on the quantum number **n**:

$$\mathbf{v = 2\ \pi\ e_0^2 / n\ h} \quad \text{and} \quad \mathbf{r = n^2\ h^2 / 4\ \pi^2\ m_0\ e_0^2}$$

and the total amount of electron's kinetic and potential energy may be written:

$$\mathbf{E = E_c + E_p = -\ 2\ \pi^2\ m_0\ e_0^4 / h^2\ (1 / n^2)}$$

The energy difference between the two orbitals with quantum numbers **n** and **m** gives the energy, and therefore the frequency of the emitted photon:

$$\mathbf{\nu = \pi^2\, m_0\, e_0^4 \,/\, h^3 \left(\frac{1}{n^2} - \frac{1}{m^2}\right)}$$

where $\mathbf{m_0}$ is the rest mass of the electron, $\mathbf{e_0^2 = e^2 / 4\, \pi\, \varepsilon_0}$ and **e** denotes the electron charge.

APPENDIX 6

The spectrum of dimensions

Objects (distances)	Usual units	Meters [SI]
Observable universe	46 billion light-years	4.4×10^{26}
Virgo cluster	54 million light-years	5.1×10^{23}
Andromeda galaxy	2.5 million light-years	2.4×10^{22}
Milky Way galaxy	120 thousand light-years	1.1×10^{21}
Proxima Centauri	4.2 light-years	3.9×10^{16}
Earth - Sun	8.3 light-minutes	1.5×10^{11}
Earth - Moon	1.3 light-seconds	3.8×10^{8}
Earth	12.7 thousand kilometers	1.3×10^{7}
Eiffel tower	324 meters	3.2×10^{2}
Adult male	1.75 meters	1.8×10^{0}
Coffee beans	0.5 centimeters	5.4×10^{-3}
Paper width	0.2 millimeters	2.0×10^{-4}
Red light	700 nanometers	7.0×10^{-7}
Hydrogen atom (Bohr)	52.9 picometers	5.3×10^{-11}
Gamma rays	5 picometers	5.0×10^{-12}
Proton	1.7 femtometers	1.7×10^{-15}
Planck length		1.6×10^{-35}
Space granularity [3]		$\sim 10^{-48}$

This table offers a perspective on the size of some important structures in our Universe and on some relevant distances. We may notice that all starts from the quantum estimation of the space granularity - of a value about 10^{-35}m, while the structured matter covers a very wide dimensional spectrum within an observable universe of about 10^{26} m.

Note: Regardless of the modifications caused by the space granularity [3] to the polarization of photons during propagation, the effects are uniformly averaged on long distances; consequently, such a small granularity value may be eventually justified. Anyway, this value is not exactly the granular size taken into consideration by the Prime Theory.

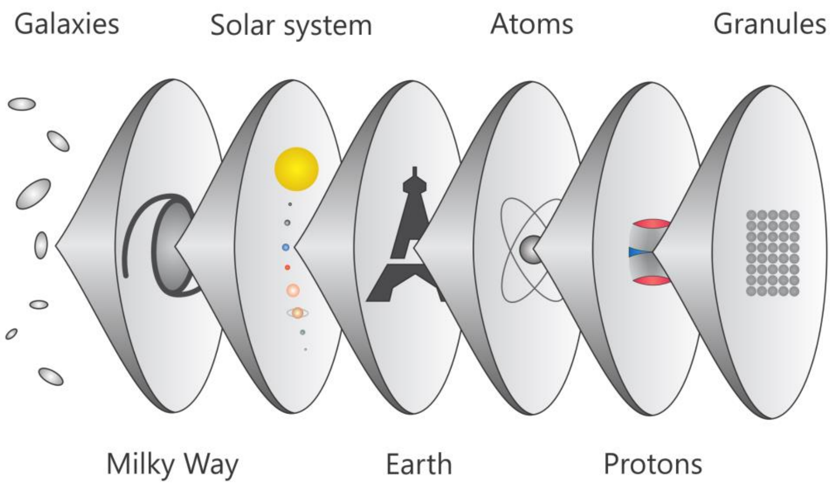

Figure A6 - *Structures in our Universe*

We may notice (see Figure A6) the elegance of our Universe: a quasi-infinite number of tiny granules has built and shaped over the ages a huge number of complex structures, such as elementary particles, atoms, stars and galaxies. In fact, all the fundamental forces described by this theory concurred to create these material structures. These forces have in common the same granular mechanics, but each one of them had a specific contribution, depending on its intensity or range.

Thus, the strong and the weak interactions act at the smallest scale, in the femtometer range. They ensure the inter-quark bonds and keep the internal cohesion of the atomic nuclei.

The electromagnetic interaction determines the formation of atoms, keeps them stable and allows their chemical bonds; its value becomes significant at picometer-range distances.

The photonic interaction was treated separately because of its special nature (it was described in Chapter 8). Photons propagate through space and therefore they can transport energy at any distance; these energy quanta may be transferred to another structure or they may be converted into electron-positron pairs.

The gravitational interaction is the primary force that shapes things at any scale, on any distance. It lies behind of all the other forces, providing the granular fluxes they use to exert their specific actions. In this way, gravity is solely responsible for the configuration, movement, stability and evolution of any material structure in our Universe.

APPENDIX 7

We learned how a certain universe, during its extinction phase, might give rise to a new one - as a possible explanation for the birth of our own Universe. But how did the primary universe come out, and from what exactly? In line with the current hypotheses that include the words "from nothing" (having some logical reasoning), my mechanistic model does explain the genesis of both space and matter. In fact, according to the initial presumptions of this theory, it will be about the three-dimensional space and about its component granules. If we could explain how they emerged and from what, this theory would become truly complete; the universe will predictably continue its evolution, simply following the current laws of physics.

To begin this new model, let's assume the existence of a primal "nothing" - which cannot be defined accurately due to the lack of any perceptible properties (stage 0 in Figure A7). Anyway, it has no spatial dimensions, and therefore no shape and no precise location. The normal time does not yet exist, as it can only be associated to some material systems that move at a certain speed through space. All the same, the energy does not yet exist, in any form; it will appear at a later moment, and therefore we may assign it the value *zero* at this stage.

At a given moment, which could be considered the absolute origin of time, this undefined "nothing" fluctuates and splits into two separate parts, perfectly alike but complementary, which will be further designated as space and anti-space (stage 1).

These components have three spatial dimensions, a well-defined shape (which may vary in time), and they can move relative to each other. We could imagine them as two distinct entities of approximately half-spherical form, which both are lying inside a primordial three-dimensional "bubble" that floats within the presumed non-dimensional "nothingness".

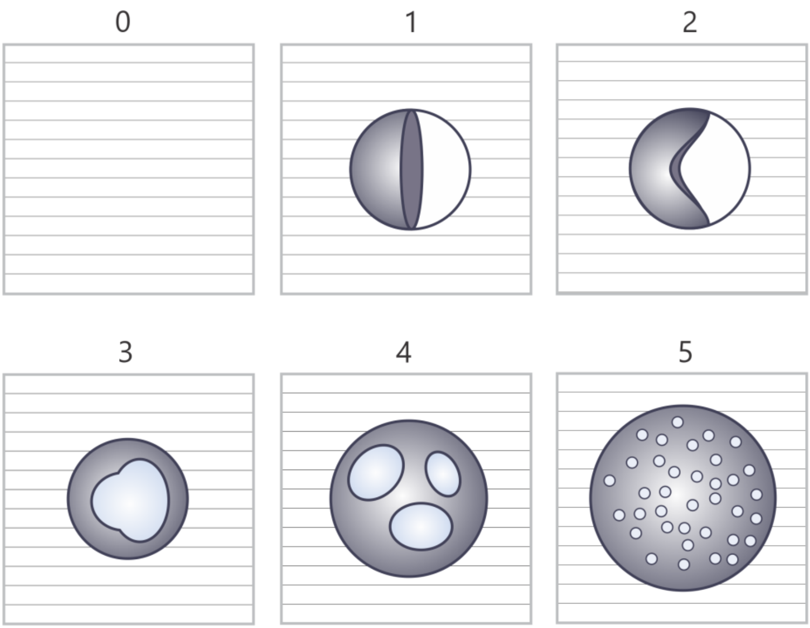

Figure A7 - *Six stages of the primary universe*

We may assign to each of these components some special characteristics, similar to those of ordinary matter, such as density and energy. Therefore, if one of them has a parameter of a certain value, the other one will have that parameter of the same value, but negative. As these two components are mobile, the energy they possess is of mechanical nature. Their initial amounts of energy will be denoted by ***+E*** and respectively ***-E***. Any movement performed by one of these components will be perfectly "reflected" into the other, which will move exactly the reverse way. The energy will not be transferred from one to the other, only the internal distribution will change over time. However, regardless of the internal movement, the total energy of this system will be conserved in time, as well as the energy of each component (stage 2).

The next significant step in the evolution of space and anti-space is the moment when, due to the internal (presumed random) motion, one of the components fully incorporates the other one, geometrically speaking (stage 3). Both entities remain separated, but one of them, supposedly the space, surrounds the other on all three spatial dimensions. For the plasticity of this description, we could add two new attributes: one of the components becomes "full", while the other becomes "empty".

At a later moment, the "empty" component (located on the inside) will divide into two halves that have the same amount of energy, ***E***. These "empty" parts will continue to move within the "full" component, sometimes colliding with each other or bumping against the edges of the primordial "bubble". With each collision, the splitting process repeats faster and faster and the size of the new "empty" parts will decrease exponentially (stages 4 and 5). Each elastic collision of the empty parts against the walls extends the bubble's surface, which will significantly increase in volume. This phenomenon has happened very quickly in fact, producing the following important results:

1. The normal, three-dimensional space was created as a geometric framework that undergoes a continuous expansion process; it emerged from the "full" component described above, initially called *space*.
2. The spatial granules emerged from the component called *anti-space*, the "empty" one. Their division process continued up to a certain limit, when all the "empty" granules got to the

smallest possible size; at the same time, they reached the highest possible speed, while their total energy is conserved. It should be noted that the movement of these granules through space happens without any loss of energy, at a constant speed; also, all the inter-granular collisions are perfectly elastic, and thus they do not change the value of the granular energy quantum.

3. The process by which a fluctuation of "nothingness" produces those two spatial components, followed by the rapid division of one of them, constitutes a global phenomenon that happens simultaneously within a quite large volume (as it represents the absolute beginning, we might simply call it the "First Bang"). This makes it fundamentally distinct from the explosion of a singularity (the "Big Bang"), because that singularity would be a massive concentration of already existing granules. On the other hand, if we accept the hypothesis of the "First Bang", the geometrical expansion of space will happen at a lower speed.

   A singularity, which may form in a long time, will thus "explode" within an already existing space; its granules will no longer bump directly into the edges of a primordial bubble - they will just collide with the other granules. In this case, the spreading speed becomes virtually equal to the maximum granular speed (Chapter 3).

   Therefore, several singularities might form several universes inside that primordial "bubble", but their granular density will have a slightly different evolution over time, decreasing at a lower rate.

This hypothesis on the birth of the primary universe naturally raises a few questions:

A. What has limited the division of the "empty" space?
B. Why do all the granules have the same size?
C. Moreover, is their size variable over time?

In order to answer questions A and B, we must first consider that those components of space are made of a perfectly elastic "raw material". Considering the macroscopic effect of surface tension and internal pressure in fluids, we may think that all granules are perfect spheroids (the shape of minimal area), and their minimum size is established by the special "fluidity" of those two spatial components. For the same reason, the "pressure" exerted by the "full" component has eventually equalized the size of all granules.

The answer to question C is affirmative. As it was already shown, the "full" component of space is continuously expanding; it increases in volume, and thus its "density" is getting lower. This may decrease the "pressure" exerted on granules, which may thus increase in diameter evenly. However, this fact is impossible to prove, it cannot be confirmed by any physical experiment. We are at the very scale of the matter constituents, and there are no measurements to be performed. On the other hand, whatever hypothetical measurement we would do, it will be relative to other presumed constant quantities of the universe, which would also have variable values.

If things were seen in the new perspective offered by the granularity of space, the natural unit of measurement for length should be exactly one granular diameter, and thus all spatial dimensions would get an absolute character. Obviously, this unit is practically impossible to use; however, its possible invariance is further induced to the level of the granular structures, to all elementary particles. These particles, being granular collections of constant shapes, could be used instead as absolute dimensional references. Unfortunately, there still is a variable parameter, namely the granular density of space, which finally determines the exact number of granules in any particle. This dimensional (and mass) variation would be further transferred to any macroscopic structure.

All these aspects lead to the simple idea (already stated in Section 11.3) that all fundamental physical quantities associated to a granular type of universe have a *relative*, uncertain and unquantifiable nature. Therefore, inside this kind of universe, we may only work with a set of basic physical quantities that are just presumed to be constant over time.

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Notes

General assumptions in this theory:

- The term *relativistic speed* means at least a few percent of the speed of light (c);
- The term *electromagnetic waves* generally means photons;
- The term *absolute*, used to describe the speed, mass or the kinetic energy, means that the physical quantities are measured (or things are observed) from a special frame of reference, considered fixed in relation to our Universe.
- The words between quotation marks have a figurative sense.

New term proposal:

For granules, as minimal elements of space whose dimension and kinematics were described within this theory, we propose a new, special English term:

granulon (-pl. *granuli*)