The formation of elementary particles

- A software simulation of the granular collisions -

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1. Granular characteristics

All the assumptions and postulated stated by the Primary Theory [1] are considered valid in this article, along with all characteristics of the spatial granules and of the special fluid they form. Everything here will be based on the particular granular dynamics, which will be analyzed in an ASR framework (an absolute system of reference, natural to our universe) and which will be widely described as an extension of the corresponding chapters of my first books [1] and [2].

Here is a brief summary of the granular characteristics:

- The free granule has a perfect spherical shape; **D** denotes the diameter of the sphere, which has a constant value, possible to be very close to the Planck length.

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

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

- All granules are made of the *essence*, the primordial substance with *perfect elasticity*.

- The intergranular collisions will therefore be perfectly elastic collisions and the total granular momentum will be conserved.

- No other form of mutual influence or interaction exists between distinct granules, besides the one of mechanical nature that is carried out by the perfectly elastic collisions.

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

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

If we restrict the analysis to the granular scale and to free granules, the theory of relativity may no longer be necessary; we still have a maximal, constant and unique speed (taking or not into account the granular collisions), but we are not able to discriminate between various systems of reference and the rate of the granular time cannot be variable. We may only work with the granular speed ***C*** (as space does not normally contain multi-granular structures) and for short periods of time (while the granular density has not varied significantly) we may work with the speed of light at those moments, denoted **c** (the variation over time of this speed is described quantitatively in [3]).

The answer to the next question may be found very interesting: how was it possible, in the beginning of the universe, that this amorphous fluid of space to generate stable granular structures -

the well-known elementary particles? A single additional hypothesis will be used in this context, stating the decreasing of the granular density in time - (about 13.8 billion years, the article [5] chapter 3) and the *permanency* of all fundamental granular characteristics. In order to figure out all the aspects of this complex phenomenon, a thorough analysis of the granular collisions will be made now, trying to find their fundamental "mechanisms" by using concrete examples and simulations.

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

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

- The physical quantities related to granules (the impossibility to determine their absolute values), the states and time at this level.

- The intrinsic uncertainty of space/time coordinates in a granular medium that is closing to quasi-uniformity.

A *significant part* of this system, large enough, may be virtually separated in order to perform any statistical analysis and to allow any possible evolution in time. We are expecting to see, for example, a self-organization process through creation of new and complex structures - as the elementary particles and their interactions. However, this distinct spatial zone will not be completely separated, it will inherit and propagate all the local granular flows.

2. Granular collisions

The medium presented above can be theoretically described only through the relativization of all the physical quantities (either of individual granules or of their system), yet keeping as fundamental thing the *absolute granular speed.* However, if we assume that a geometric parameter could be considered an *absolute constant*, for example the **granular diameter**, we may now have a uniform scale for any dimension and distance, in a linear metrics. The granular time flows uniformly, being a quantity that derives from the existence of the absolute granular speed and from the existence of the linear, uniform and isotropic empty space. The movement of a granule is therefore uniform, continuous, and it occupies all the intermediate positions on its absolutely straight trajectory. In this system with a huge - but finite - number of granules we may presume absolute "randomness" of the direction distribution (it practically becomes continuous) and the existence of the granular fluxes (groups of granules moving exactly on the same direction). Regardless of the presumed decrease in the granular density over time and of the value of the granular diameter - all granules will continuously collide with each other. These collisions have the following important characteristics:

- They likely occur between two free granules, very rarely between three or more at a time.

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

- Collisions are perfectly elastic, the granular energy/impulse remains unchanged.

- The collision of two granules, regardless of their direction, occurs frontally, on the direction that symmetrically connects their centers (Figure 1, where three individual cases are shown). Any other possible collision type, let us say a tangential one, will not produce any changes in the movement and trajectory of the involved granules (due to their special elasticity property).

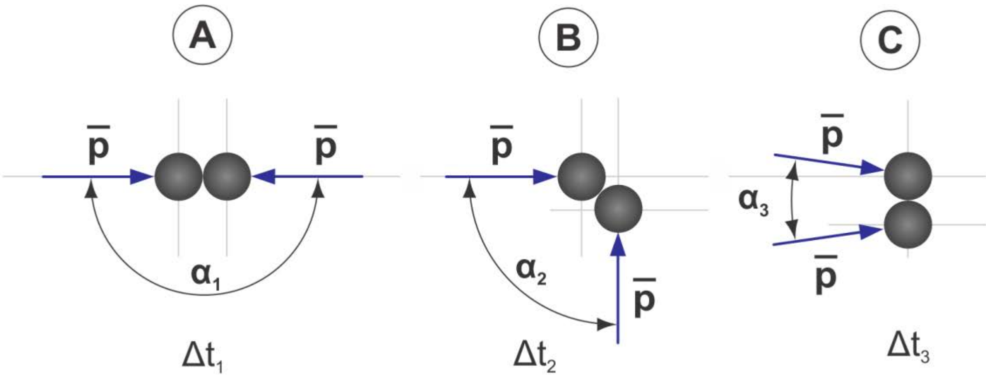


Figure 1 - *General types of granular collisions*

- The collision of two granules is not instantaneous, it takes a certain amount of time; this time interval will significantly depend on the angle formed by the trajectories of the colliding granules (see Figure 3, A).

- The colliding granules are in perfect contact during this time (Figure 2, B) and they create this way a temporary "supergranule", having a shorter or longer lifespan. The normal hypothesis to formulate now is that the granules do not merge in this process, and the supergranule will contain the deformed - but separated granules during its lifetime. Regardless of the type of fusion, the granules will eventually be split up and each of them will take over the impulse of the other one.

- The supergranules may have any absolute velocity during their lifespan, from **0** up to the maximum value ***C***, and a higher speed means a longer lifetime. The existence of *free supergranules* moving close to ***C*** is very unlikely.

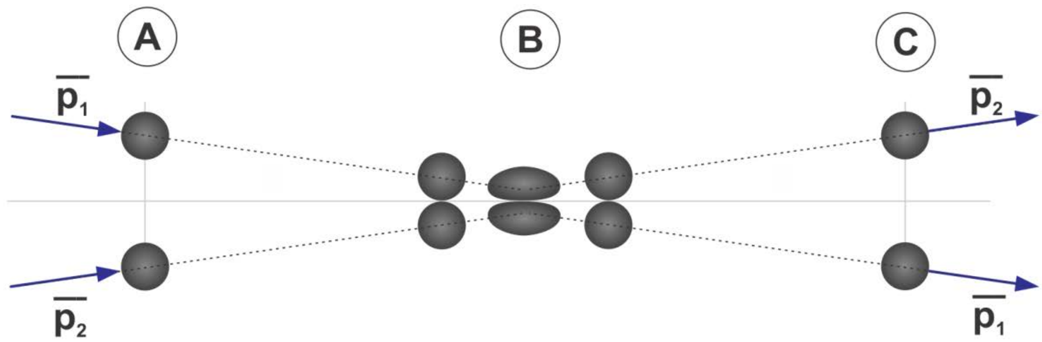


Figure 2 - *Slow granular collision*

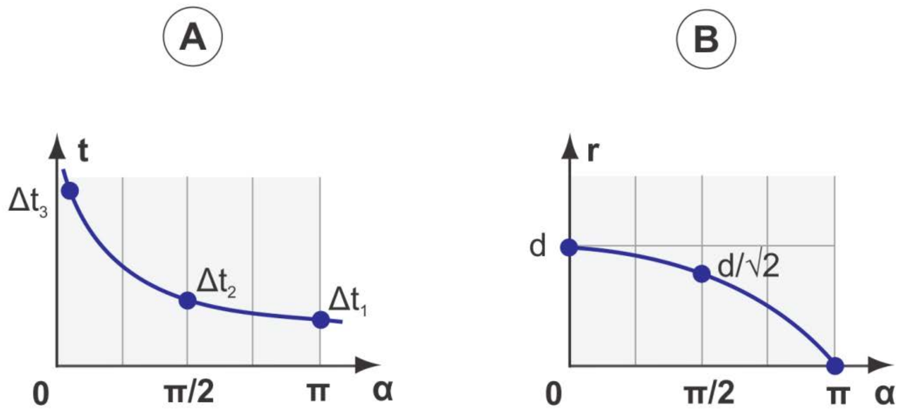


Figure 3 - *The duration and spatial displacement in case of granular collisions*

The **Law of conservation of global momentum** governs the granular collisions, but a few details have to be mentioned here**:**

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

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

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

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

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

b) a displacement of maximum one granular diameter in granule's trajectory (see the case shown in Figure 3, B).

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

Statistically, the most frequent collisions will be the granule-granule ones, followed by the granule-supergranule type (with those supergranules that have a longer lifespan, existing in the early universe). These kinds of supergranules, regardless of their form - filament, cylinder, tube, sphere, torus, irregular group of granules - will eventually disintegrate after multiple collisions with the free spatial granules. We will further describe only this type of collision, being representative for a functional model of the granular space and its evolution.

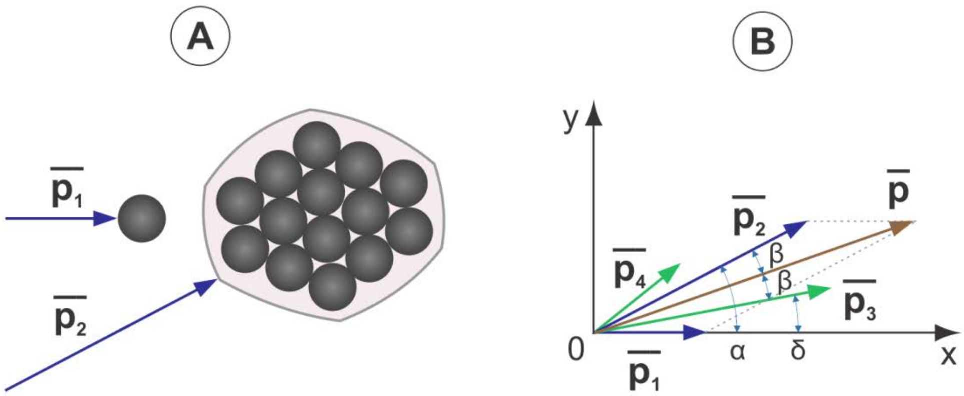


Figure 4 - *Granule-supergranule collision*

The general case that is shown in Figure 4 (collision between a granule and a long lifespan supergranule) allows you to observe the conservation of total impulse ***p*** (which is the sum of the initial ones, multiples of the elementary impulse). The final impulses are, in principle, of the same values, but their new direction is symmetrical relative to the total impulse vector. The supergranule might break apart during the transition interval, or it may include the free granule and eject another - things that depend on the initial impulse directions. Whichever situation would be, the final impulses are multiples of the elementary impulse and their vector sum will always be equal to the total impulse. In our concrete case, impulse $\mathbf{p_1}$ changes to $\mathbf{p_4}$, while $\mathbf{p_2}$ changes to $\mathbf{p_3}$.

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

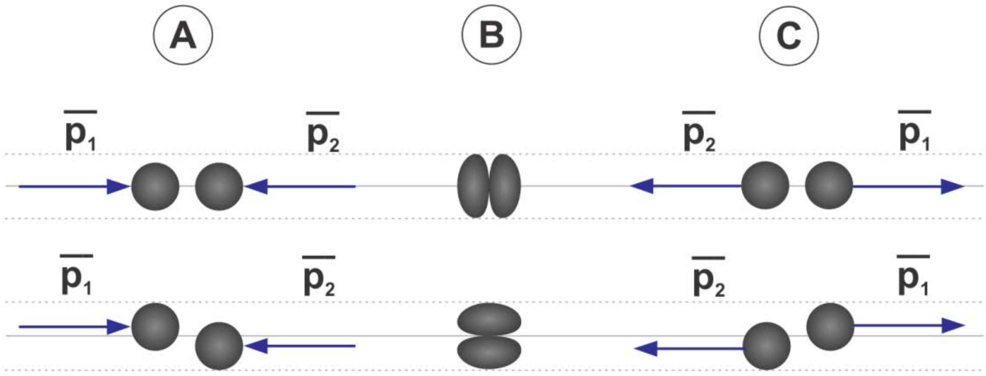


Figure 5 - *The frontal and tangential collisions*

Figure 5, the upper part, shows a frontal collision between two granules (A), the moment when they are "flattened" (B) and the final moment when they have done the impulse exchange (C), continuing to move on the same directions as equivalent granules. In the lower part of the figure we may see what happens in case of tangential collision: the granules are flattened on longitudinal direction (B), *slipping* past each other and then continuing to move on the same directions.

Knowing these specifics of the granular collisions, we may now try to make a global picture on how various fluxes behave when they are crossing other flows, uniform or not (considering the lack of uniformity in the early universe, as well its high, variable granular density).

Let us now presume that a short flux passes through an area where an intense flux is flowing in a particular direction; depending on this granular flux density, two distinct cases may exist:

a) if the short flux is not so dense, a few tens of granular diameters as average distance between the component granules, it will move toward the source of the strong one (due to the granular displacements), *on its reversed direction*.

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

The situation of case b. may be applied to the photons that passes through an intense gravitational field (near a star), when the gravitational lensing effect becomes visible. The photon's successive granular layers are compact on radial directions, and these structures will change its trajectory in the more intense flux' direction. The case a. applies to the photons moving along the gradient of a gravitational field, when they are "seen" as low-density fluxes and therefore will undergo a change in frequency (redshift or blueshift, depending on the gradient direction).

3. Formation of the elementary particles

The early universe had all the necessary conditions for the formation and then combination of the elementary particles, namely:

- High initial granular density, decreasing over time.

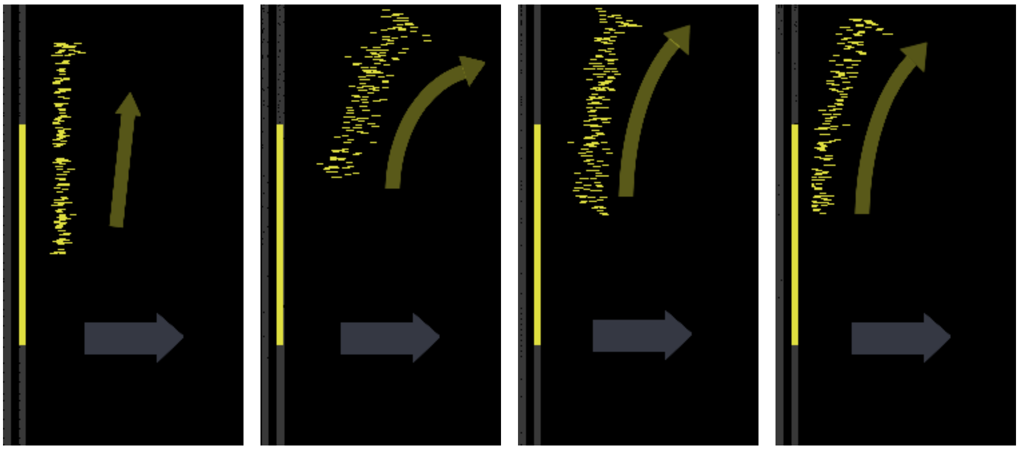
- Uniform and nonuniform granular fluxes, omnidirectional.

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

Any straight granular structure would be formed in there, it got the chance to cross many areas of variable fluxes; the geometry of these structures has been therefore modified, becoming curved-type, concentrated flows. The "Elementary Particles" application tries to simulate the behavior of a compact granular structure (group, filament, supergranule) while crosses through a nonuniform additional flux (with variable density). In order to reduce the number of mathematical calculations, this simulation will be confined to a "two-dimensional" area of 10x10 units, where the omnidirectional local flux is no longer included. This will not distort the results, the compact structures and their combinations will just lose the internal cohesion. All of the functional aspects of this software are widely described on this web page (there are also the download links):

http://www.1theory.com/software.htm#2

Four images (screen captures) from this program are available at their original resolution (click on the pictures A...D), corresponding to a constant flow and to three different vertical gradients.



A B C D

Figure 6 - *Granular structures moving within nonuniform fluxes*

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

If we are to analyze the Figure 4, it can be easily inferred a formula for the angle of the supergranule's impulse ($\mathbf{p_2}$ -> $\mathbf{p_3}$); the initial angle **α** will turn into angle **δ**, whose formula is:

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

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

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

As it is stated in [5], nonuniform granular fluxes were generated in the beginning of the universe on all possible directions. Any area of the primordial space has been crossed by such flows and they may have been produced, according to this simulation, huge numbers of these curved embryonic formations. These clusters remained in compact form long enough to join each other in larger formations, creating this way small granular vortexes that are rotating in random, but unique directions. These discoidal formations proved to be very stable as definite structures (concave or convex in equal measure) and they moved freely (linear and *precession* movements*)* through the spatial fluid. Their geometric shape also remained stable over time, either they were free or bound in larger structures by different fields. Notice here the huge number of granules contained in such particles, number that could decrease significantly once the granular pressure dropped over time. During this process of particle formation (a ***self-organization*** process that generated heavy electron and positron-type particles), the chance has determined the curvature of their side surfaces, so their electrical charge type. The value of their mass, as number of component granules, has been *dynamically* set when the pressure of the granular flows (gravity) equilibrated the sum of their internal granular momenta. After the end of this process of *generic particle* creation*,* once the granular density dropped significantly, two distinct phenomena occurred shortly, determining the future matter form in our universe:

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

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

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

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

4. Conclusions

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

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

5. References

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