The formation of elementary particles

A software simulation of the granular collisions

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1. Granular characteristics

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

Here is a brief summary of the fundamental granular characteristics:

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

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

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

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

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

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

- Any free granule can move in any direction inside the three-dimensional space and its trajectory will be further considered an 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 the possible directions of travel, a continuous medium.

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

If we restrict the analysis to the granular scale and to free granules only, the theory of relativity may no longer be necessary; we still have a maximal, constant and unique speed (whether we are taking into account the granular collisions or not), but we cannot discriminate between various systems of reference and we cannot have a variable rate of time. We may only work with the granular speed ***C*** (as space does not normally contain multi-granular structures) and, for short periods of time (while the granular density has not varied significantly), we may use the speed of light at those moments, **c** (the variation of this speed over time is described quantitatively in article [5]).

In the beginning of the universe, this amorphous fluid of space generated countless stable granular structures, the well-known elementary particles. How was it possible? To answer this important question, two additional hypotheses will be used in the current context, namely the continuous decrease of the granular density in time (about 13.8 billion years, see Chapter 3 of [5]) and the *constancy* of all fundamental granular characteristics over the ages. In order to figure out all the aspects of this complex phenomenon, the granular collisions will be thoroughly analyzed now in an attempt to discover their fundamental working "mechanisms", by using some concrete examples and simulations.

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

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

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

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

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

2. Granular collisions

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

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

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

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

- Regardless of their direction, the collision of two granules is frontal, in that direction connecting symmetrically their centers (see Figure 1, where three individual cases are shown). Any other type of collision, let's say a tangential one, does not produce any changes in the movement and trajectory of the granules (due to their special elasticity property).

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

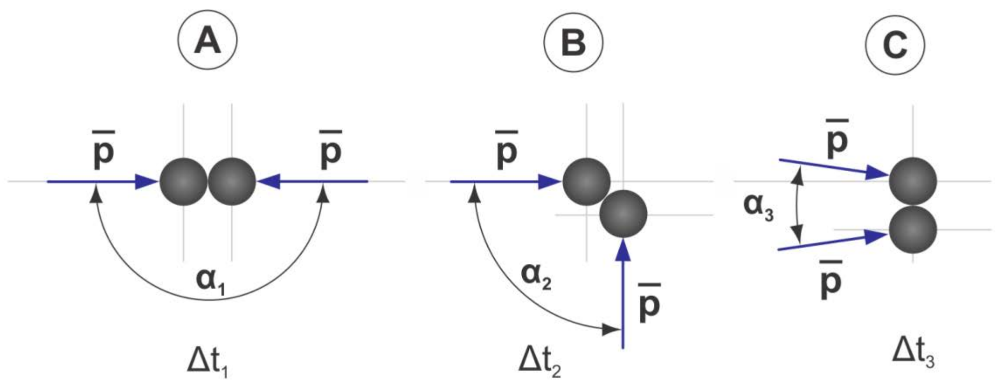


Figure 1 - *General types of granular collisions*

- The colliding granules are in perfect contact during this period of time (Figure 2, B), creating a temporary "supergranule" that has a shorter or longer lifespan. A new hypothesis may be formulated now, namely the granules do not merge in this process; the supergranule will contain both deformed granules, but they remain separated the whole time. Regardless of the fusion type, the granules will eventually split up and each of them will take over the impulse of the other.

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

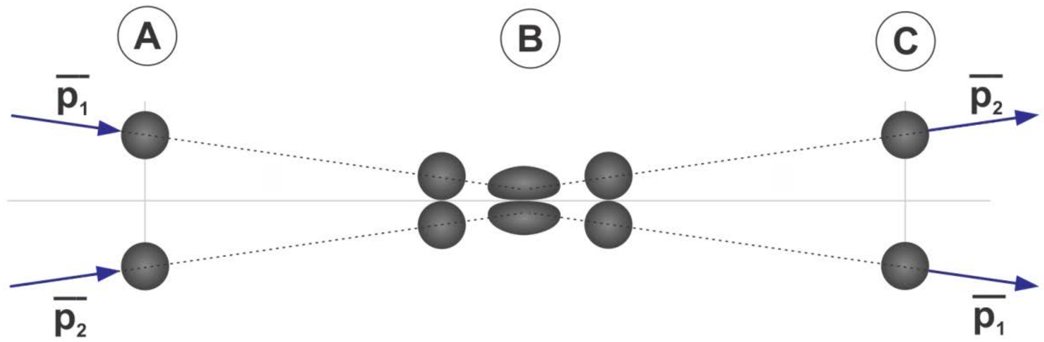


Figure 2 - *Slow granular collision*

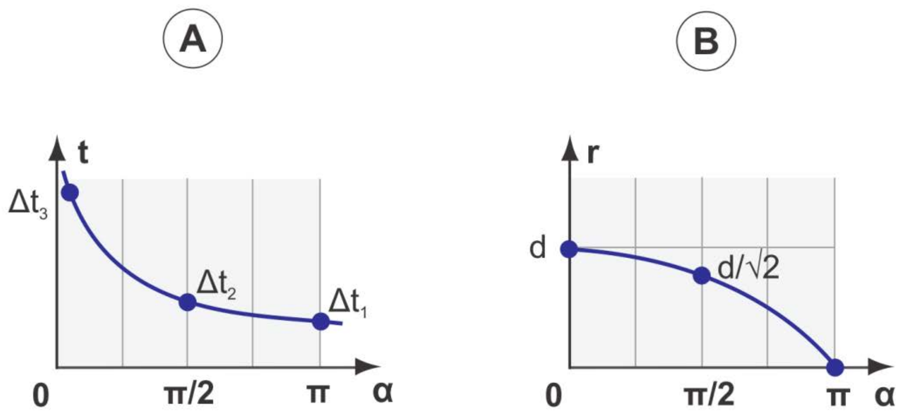


Figure 3 - *The duration and spatial displacement*

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

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

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

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

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

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

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

The effects of these phenomena are time averaged after a large number of collisions and their final result will be an actual lower granular speed **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, which existed in the early universe). These kinds of supergranules, regardless of their form - filament, cylinder, tube, sphere, torus, irregular groups - will eventually disintegrate after multiple collisions with the free spatial granules. We will describe now these ordinary collision types, as they are representative for a functional model of the granular space and of its evolution over time.

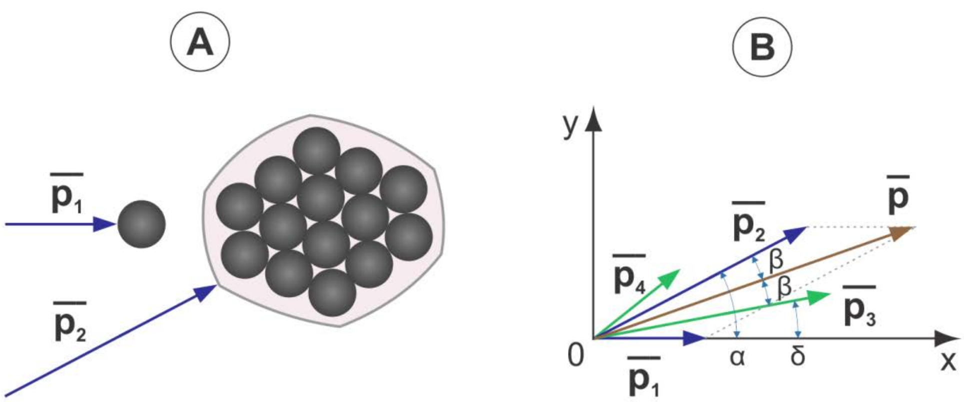


Figure 4 - *Granule-supergranule collision*

Figure 4 shows a general case (the collision between a granule and a long lifespan supergranule) where you may observe the conservation of total impulse ***p*** (which is the sum of the initial ones, a multiple of the elementary impulse). The final impulses are, in principle, of the same values, but their new direction is symmetrical relative to the total impulse vector.

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

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

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

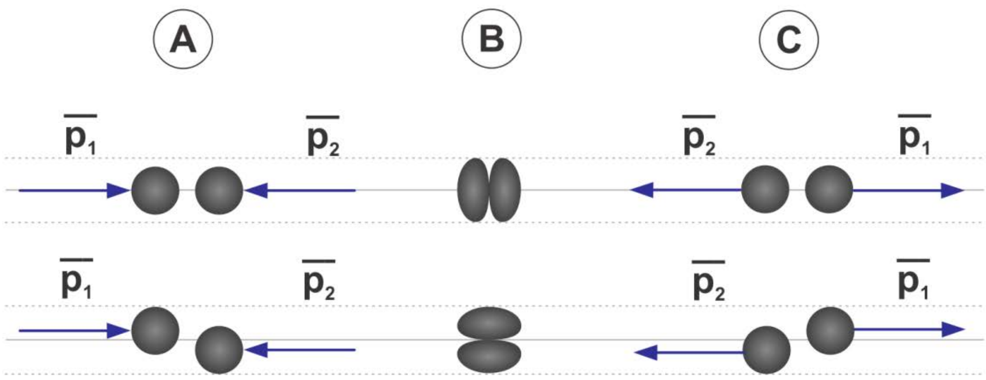


Figure 5 - *The frontal and tangential collisions*

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 granular nonuniformity and the variable density of the early universe).

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

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

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

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

3. The formation of elementary particles

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

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

- Omnidirectional, uniform and nonuniform granular fluxes.

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

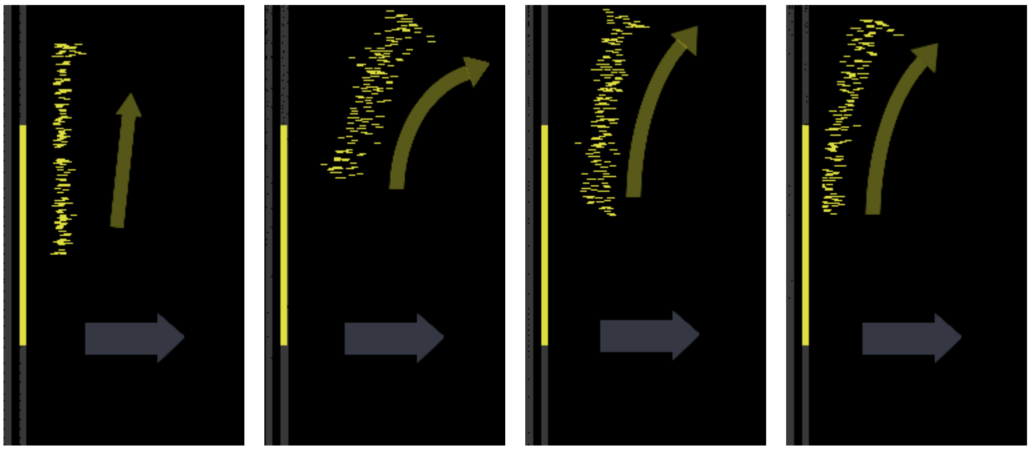
All granular structures formed in this medium have crossed many areas of variable fluxes; the geometry of these structures has been therefore modified and they eventually became curved-type, concentrated flows. The "Elementary

Particles" application tries to simulate the behavior of a compact granular structure (group, filament, supergranule) while it crosses through a nonuniform additional flux (of variable density). In order to reduce the number of mathematical calculations, this simulation will be confined to a two-dimensional "box" of 10x10 units, a place where the omnidirectional local flux is no longer included. This thing does not distort the results, the compact structures and their combinations will just lose the internal cohesion. All of the functional aspects of this software are widely described on its web page (the download links are also there):

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

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

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



A B C D

Figure 6 - *Granular structures moving within nonuniform fluxes*

Figure 4 shows us a simple way to write a formula for the angle of the granular impulse (**p_2** -> **p_3**); the initial angle **α** will turn into angle **δ**, whose formula is:

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

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

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

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

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

2. The mass of the remaining particles (the *free* ones) decreased significantly in a short cosmic time and their annihilation process became possible (the

matter-antimatter reaction, which has generated photons and has led to the success of matter, i.e. of the electrons - they were in greater number).

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

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

4. Conclusion

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

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

5. References

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[6] "*Elementary Particles*", software, Microsys Com, 2017

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