

Granular collisions

Uniformity and variation

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1. Introduction

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

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

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

2. The theory of the large systems

Regardless of the way it came into existence, as being an infinite given which represents the absolute nothingness or as a finite void resulted from the spread of the primordial essence, the three-dimensional space will be further

considered as a passive framework where our granular Universe simply "floats". Obviously, as it was stated in my first book [1], these things could also be seen inversely, i.e. to consider space as the "full" component and the essence as the "empty" one. However, as the full/empty ratio would have been too high, it seemed natural to consider the essence as being the material part, i.e. the part full of something.

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

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

Let's consider the moment when essence came into existence, which may also be the moment when space appeared as an empty frame, as a volume. My favorite scenario was described in an article named First Bangs [5]: the essence already existed (or it appeared as stationary and contiguous substance) and multiple bangs occurred at a certain moment inside its body. There is an additional assumption, this elastic substance occupies a limited, finite volume and it is subjected to an external pressure, thus being in a compressed state. The distributed process that soon begins is of mechanical nature and it looks more like an extended implosion; it is even possible that it would not have been violent and to have lasted very long time (at cosmic scale). Anyway, this dynamic process has eventually led (through division, internal friction or other mechanical transformation) to a granularized substance (of a certain size) and to the transformation of the elastic energy into kinetic energy. A huge number of infinitesimal granules appeared this way, and each of those granules is moving in a random direction at constant speed. Their number and size were determined by the quantity of essence and by its degree of elasticity, while their speed was given by the initial elastic energy. A simple representation of the essence is shown in Figure 1A; 1B shows its granular state at a later moment (it is not drawn to scale).

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

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

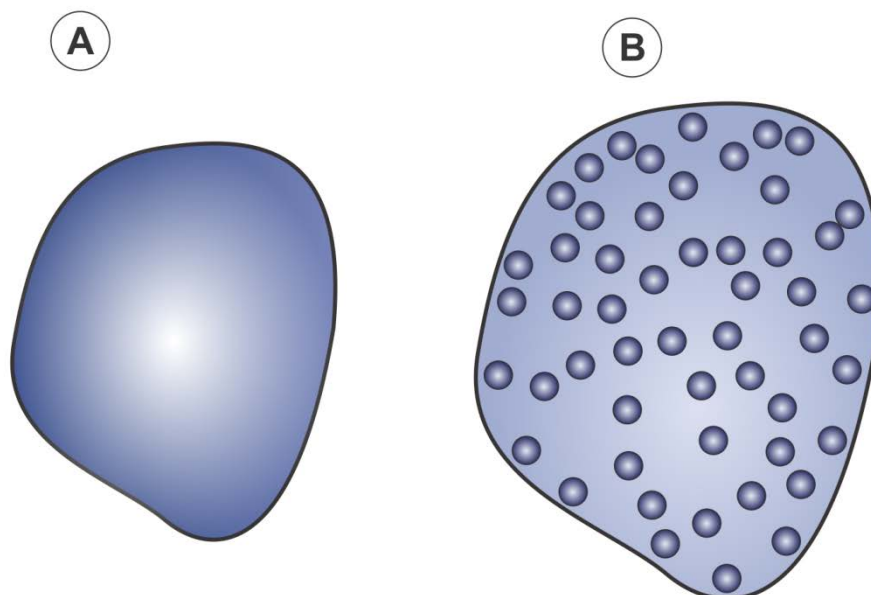


Figure 1 - *The essence and its granular state*

All of the granules are moving freely inside that framework we described above. As their initial density was huge, most of the granules were bonded together in large groups, for large time intervals; all collisions between individual granules and those groups were chaotic, but they allowed a fast leveling of the granular speed. Collision between two identical granules only means an exchange of speeds, but there was a very high probability (due to the huge density) of simultaneous collisions between three or more granules

(grouped or not). This latter process, infinitely repeated, could have averaged the speed of all granules to the final value C . Anyway, a special granular fluid was made in this way, similar to a gas; it can exert pressure on the external membrane (via the transfer of granular impulses) and thus trigger the geometric expansion of the frame described above.

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

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

- a) If we only look at its geometric component, there is nothing we may say about the size of the space (no marks for measurements or estimates, nothing that might be compared). The same thing can be said about the periods when its material component had a quasi-uniform granular distribution.
- b) *The really huge number of identical components*, i.e. granules, which may be simply estimated to several googols (10^{100}) - due to the new number of galaxies [6] and due to my assumption that there is a minimum number of 10^{15} granules inside an electron (a ratio of about one-to-one was considered between the number of free granules and those contained in the material structures of any kind).
- c) Seen at the granular level, space seems to be amorphous and dynamic; all granules continuously move and collide in a chaotic way. However, if we change the perspective and extend the angle of observation, space is gradually turning into a *fluid with special properties, uniform and isotropic*, which has a certain granular density.
- d) The components of this system are mobile, they all move with a constant speed and collide perfectly elastic. Their really huge number makes possible the existence, any direction and any moment of time we would consider, of a *flux of granules that have parallel trajectories*. Taking into consideration the way all material parts of space emerged, out of a unique chunk of essence, a postulate was issued in [1] telling

that an equal number of granules moves on each possible direction in space (their total impulse is quasi-null).

- e) If we admit that this system is closed and its volume is continuously expanding, then the density of the granular fluid will decrease over time. It seems normal to assume that there were many initial irregularities in the local granular distributions, as of directions and of density, but they all have diminished and space became uniform in time.
- f) The fluid made of free granules (those generating in fact the directional granular fluxes, constituting the intrinsic gravitational field of this large system) underwent significant changes in density during the initial stages of the universe (fractions of a second, as in the Big Bang theory), for example at the time when the majority of the elementary (quarks) and composite particles were formed. Once the density got low enough, the formation of electrons and positrons and their immediate annihilation have also led to rapid oscillations of the granular density.
- g) The granular spatial system cannot be divided and analyzed as separate regions; both the nature and the dynamics of its granular fluxes show us that any area we would consider, it is "connected" with all the adjacent and more distant ones, mutually influencing each other in a continuous manner. However, this influence is transmitted at a limited speed, the speed of light at that time and place.
- h) The granular space seems to be a stable automatic system, behaving in a *linear and predictable* fashion; this means it could remain in a steady state for ever, just its density will be decreasing over time... Therefore, all its physical quantities could be described by equations and statistics similar to those of the ideal gas. We may even introduce the concepts of *granular time* and *granular entropy* (seen as a measure of the chaos at this level), which both could be included in a law where the value of global entropy will only increase in time.

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

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

3. Linearity and evolution

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

There was some nonuniformity in the granular distribution of space during its initial stages and, consequently, all the granular fluxes were warped in the regions with high density gradients. Everything has happened because these primary fluxes were very dense and therefore they behaved as larger granular groups (as bigger granules, see [4] and the *Elementary Particles* application). Once a flux gets curved and turns into a vortex of the right size, its regular discoidal shape is maintained due to the uniform pressure exerted by the omnidirectional fluxes that flow in any spatial region. The presence of denser granular fluxes and their aggregation in stable formations practically represents the nonlinearity that is superposed over the granular uniformity of space and which changes all dynamics of the system... In addition, this process has triggered important drops in the local entropy, as the above theory of space described. This self-organized system now contains larger components, granular structures of several types. The omnidirectional fluxes, i.e. the gravitational ones, will provide support for the fields that allow these granular formations to interact. The charged particles will speed up or slow down in these fields, creating in this way other granular structures, *the photons*.

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

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

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

4. References

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- [6] Christopher J. Conselice and others, 2016, *The evolution of galaxy number density at $z < 8$ and its implications*