Mass - Energy equivalence

The dynamic directional mass

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

1. The Mass

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

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

The symbolic, the rest and dynamic mass

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The *dynamic mass* could be introduced in the same way, as a quantity that depends on the number of granules and on the *distribution* of the impulse vectors inside the considered structure (therefore on its global speed, which may be relativistic). As all structures in question are not spherical, there will be a certain dependence of the dynamic mass on the spatial orientation (on the global direction), as shown in Figure 3 for electrons and protons. This mass will therefore be expressed as a function of direction (the direction of an ideal flux, uniform and very thin, that acts upon the particle), but in practice we will use some **mean** values, averaged for the duration of the intrinsic motion of precession. *Note*: at small global speeds, the directional dynamic mass tends to get uniform due to the intrinsic precession, its average value becoming constant.

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

2. The Energy

Kinetic energy, the type of energy that will be discussed now, is always associated to an entity, i.e. to a granular structure in motion. If we look at the particle above from the AFR and then analyze the directivity of its granular movement versus the global one, we may discern three possible distributions (as shown in Figure 1) of the elementary kinetic energies:

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

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

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

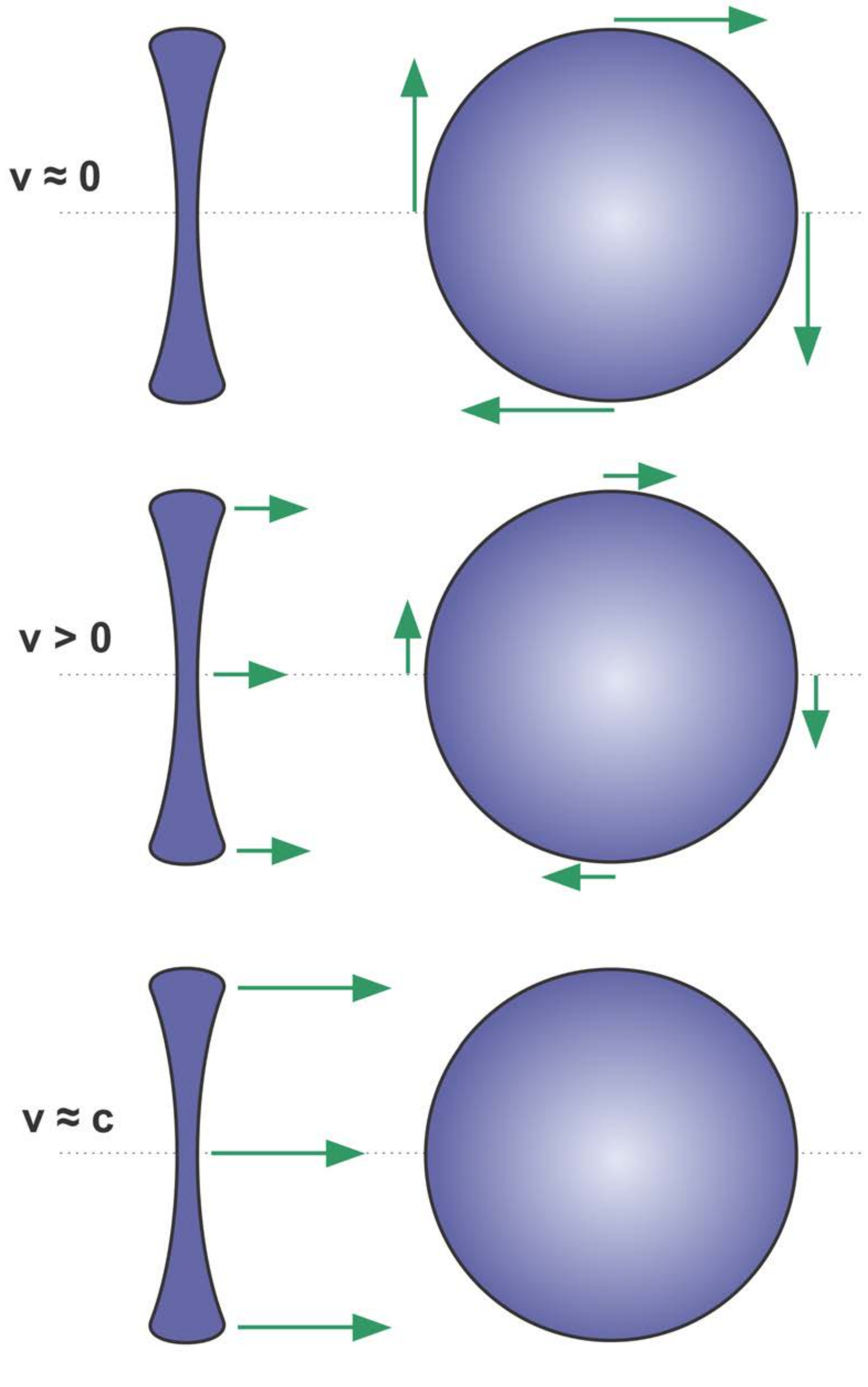

Figure 1 - *The distribution of rotational and translational speeds of an electron*

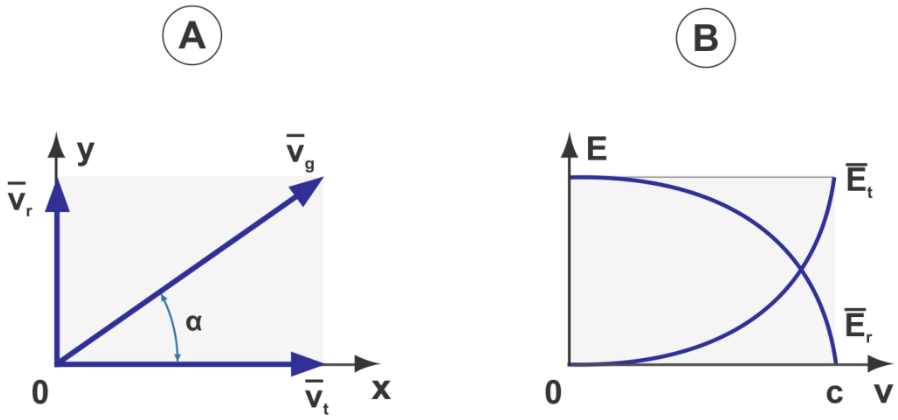

Figure 2 - *The distribution of speed and kinetic energy*

Figure 2 shows (on the left) the (normal) decomposition of the particle's global velocity $\mathbf{v_g}$ into its rotational and translational components, $\mathbf{v_t}$ and respectively $\mathbf{v_r}$, their values being included in this formula:

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

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

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

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

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

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

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

This function is graphically represented in Figure 2, on the right side.

3. The Time

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

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

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

4. Photons

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

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

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

Note: The mass of electrophotons could have a similar description, regardless their variable and unstable structures (see the article [3], Chapter 4.2).

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

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

5. Composite particles

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

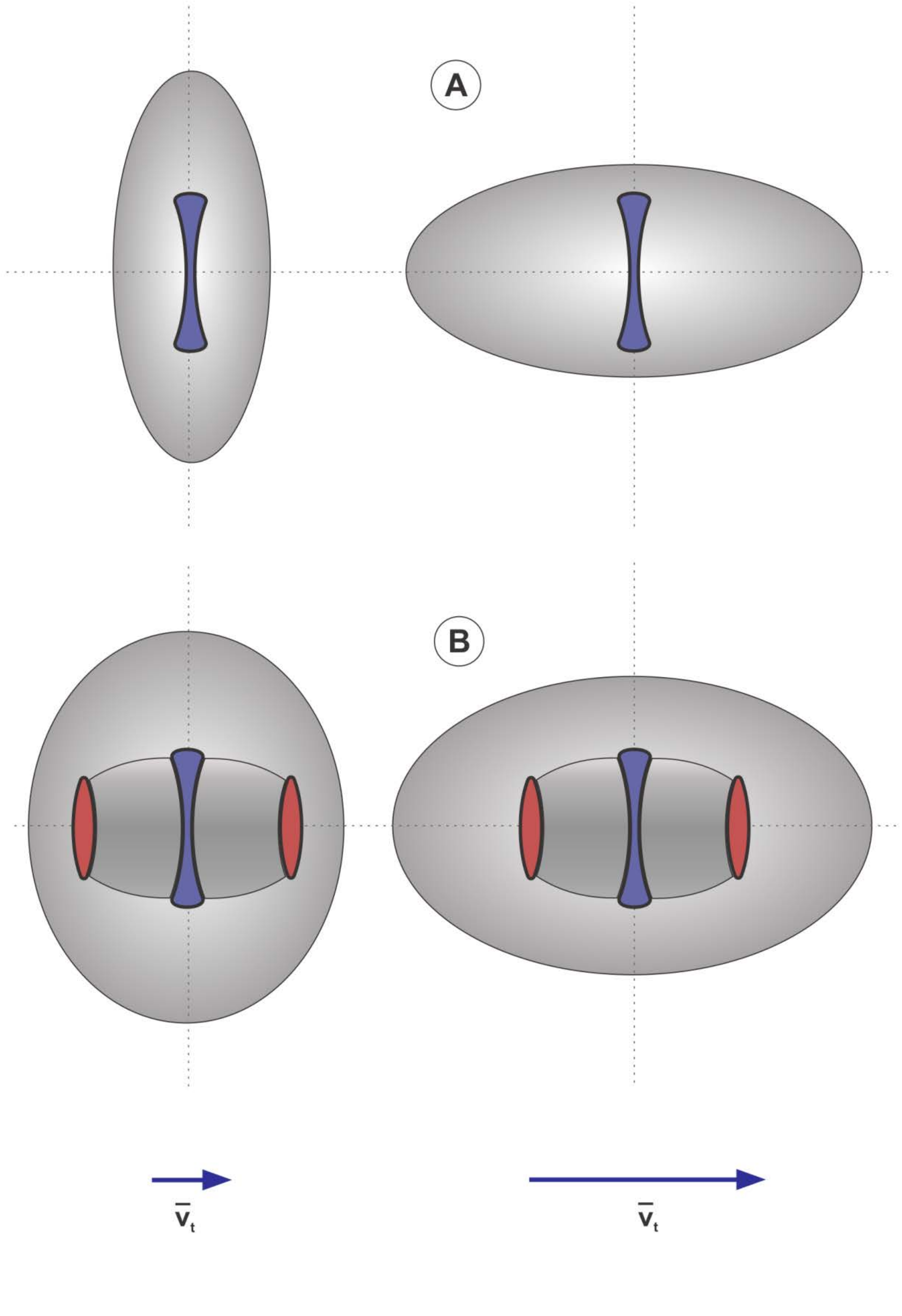

Figure 3 - *The distribution of the dynamic mass in electrons and protons*

6. Conclusion

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

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

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

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

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

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

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

7. Annex 1

Let's now consider an *ideal* elementary particle whose internal granular impulses (or velocity vectors) form the angle $\boldsymbol{\alpha}$ with the global direction of travel. As the granular speed can be assumed to be **c**, the particle's global speed will be $\mathbf{v = c \cos (\alpha)}$. The internal impulse is denoted by $\mathbf{p_1}$ and the value of an external impulse that acts at a given time is $\mathbf{p_2}$, $\mathbf{p_2 <= p_1}$. As a result of this event, the angle $\boldsymbol{\alpha}$ will become $\boldsymbol{\alpha'}$; this is equivalent to a new global speed $\mathbf{v' = c \cos (\alpha')}$. The final angle has been already calculated ([4], Chapter 3) and it has this formula:

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

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

Figure 4 shows on the horizontal axis the normalized external impulse (to the internal one) and, on the vertical axis, the absolute velocity (of values in the range 0...c), both being linearly represented.

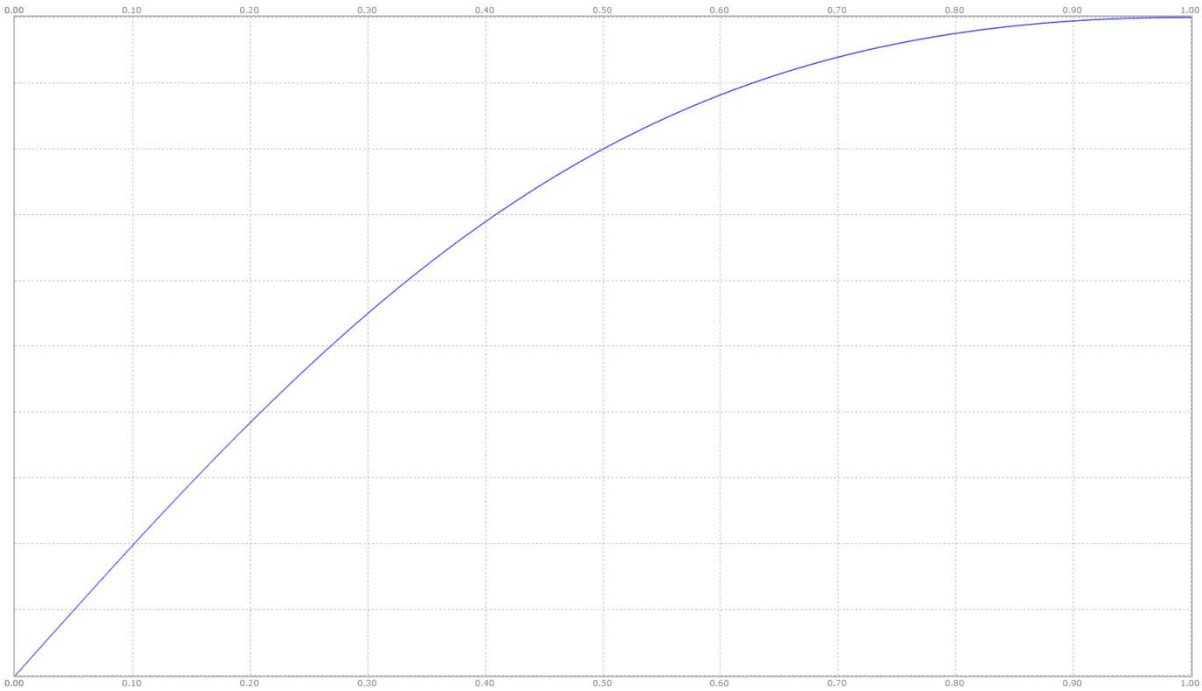

Figure 4 - *The dependence of translational speed on impulse*

8. Annex 2

Let be this distribution of particle's speed (as in Figure 2, on the left), where the speed of rotation $\mathbf{v_r}$ is assumed to fix the rate of interaction through the precession motion and through the value it induced to the dynamic mass. The time is therefore inversely proportional to $\mathbf{v_r}$:

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

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

$$\mathbf{\Delta t = k / c}$$

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

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

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

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

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

9. References

[1] Laurentiu Mihaescu, 2014. *Prime Theory*, Premius Publishing House

[2] Laurentiu Mihaescu, 2016. *The Universe*, Premius Publishing House

[3] Laurentiu Mihaescu, 2016, *The Theory of granular gravity*, article

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