The size of our Universe

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1. The current vision

Let us assume that the current theories regarding the Universe's birth, Big Bang and the related inflation, as well the calculations of the age of various stars/ galaxies, are all true; therefore, we have to deal now with a very large material system, which appeared about **13.7** billion years (current years) ago and which is in a continuous process of expansion. What exactly this scenario hypothesizes? A "singularity", i.e. an infinitely dense point of matter and energy, explodes violently and generates a sort of tridimensional frame - not very well defined - named space, which will be populated immediately by the first elementary particles and their structures. Very interestingly, the expansion process of this newly born space has had at first a superluminal speed - several orders of magnitude above the current speed of light. However, in order to comply with the actual laws of physics, scientists say this is perfectly possible if assume that this is a simple expansion process, an intrinsic increase of space - not a transport of matter, which should have a lower speed than the speed of light in a vacuum. The particles and atoms were uniformly distributed within this space, and here comes a small question. How the space "stretched" differently at the initial and later moments, carrying and not carrying the matter along with it? Anyway, after a few hundreds of millions of years, the stars formed the first galaxies; space is still expanding, but at a much lower rate. It is considered that only the space between galaxies continues to expand, and they shall keep their structure and size due to the gravity. Space, whatever internal consistency it would have, does not actually drags the matter along. The current cosmology claims that the galaxies are not taking part in the expansion process of the universe, where some of them should have been already reach superluminal speeds. No, they are traveling at a few **hundreds** or **thousands** km/s relative to the **CMB**, in their galactic clusters. What actually "moves", justifying the size of the cosmological redshift **z** for distant sources, is only the space itself. The Doppler Effect, mostly relativistic, produces a significant redshift for these sources, but they do not move with those computed speeds for real; it is only the extension of space that determined that shift of the color spectrum for a presumed stationary observer. All the other contributions (gravitational effects, rotational movements, stellar dust and cosmic gases) have been ignored in the redshift calculations.

It may be presented as an example the **ULAS J1342+0928** quasar (black hole), which has the value **z = 7.54** and whose light has been emitted 690 million years after the Big Bang (13.1 billion years ago). It is located at a distance (calculated by considering the expansion of space) of 29.36 billion light-years away. Similarly, it may be mentioned here the oldest and most distant astronomical object, the Galaxy **GN-Z11**, which has a redshift **z = 11.09** and its age is about 13.4 billion years. Its proper distance is also very big, 32 billion light-years.

2. The granular vision

As many of my previous documents have stated, the space is only extending in a geometric manner (by addition), while its granular component will automatically fill any empty zone. Therefore, if we only consider this granular component of space (which is constant in number and dictates in fact all the space properties), we may realize that space undergoes a continuous process of *dilution*, not one of *dilation*. In conclusion, at the time the first galaxies were formed, there was a higher granular density (on average) of space than today's one (but lower than that at the time of the CMB emission). For this reason, some of the so-called constants of physics had different values, while others were identical. In the same way, due to the complete relativization of our Universe, some of the derived physical quantities remained relatively constant along very long periods of time.

2.1. The rate of time

Here are those types of time that were previously defined for different dimensional levels, all depending on the movement of matter and on some fields.

a. The granular time (virtual) is determined by the existence of the granular movement and by its constant speed. It therefore has a constant, absolute rate and is regarded as a source of time for any other dimensional level (see The Universe [2]).

b. Elementary particles' local time. Considering their internal movement (the intrinsic precession, determined by their granular structure), which may be partly distributed into their external, translational movement - the granular time may similarly be distributed into particle's local time, whose variable rate is dictated solely by its absolute speed. Additionally, we may presume that the local time is not significantly affected by the value of local granular density.

c. The quantum time is associated with structures, i.e. composite particles and their formations - atoms and molecules bonded in various systems. This kind of time is also flowing differently, as the movements and oscillations of the system components are having variable frequencies - depending on their interactions through fields. It is relevant in this context the gravitational field, its nonuniformity in fact - that produces a slower rate of the local time. The source of quantum time is the particles' local time, described in the preceding paragraph. Local granular density changes the unitary intensity of the gravitational fluxes (their nonuniformity remains, however, almost constant as ratio), but in this article will be considered as dominant the intercorrelations imposed by the global relativization. Therefore, the quantum time is not significantly affected by the granular density; anyway, its variation would be mostly and indirectly reflected only in the different atomic spectra (which are assumed unchanged here), not affecting the propagation of light.

d. The normal, macroscopic time is associated with a particular macroscopic system and represents the average of quantum time rates for all the component particles. It is therefore dependent on the absolute speed of that system and on the local intensity of the gravitational field (more precisely, on its nonuniformity caused by masses).

In conclusion, all these time definitions are leading to the idea that a unique rate of time may be used globally, for the entire universe (presumed quasi-stationary), including for the moment the first galaxies were formed - when a higher value of the spatial granular is estimated. Moreover, a certain mathematical formula may be used, where the *absolute* distance travelled by the light could be expressed as a product between the speed of light (less than the current one) and time (of constant rate). Estimating that the spatial geometry is "flat" (space is an isotropic continuum), and regardless of the granular density at a given moment, the trajectory of a photon will be perfectly straight and the total distance it has travelled is mathematically expressed as a sum of the distances covered at different speeds. As the photon is a special particle consisting of concentrated granular fluxes, it may only move at the maximum speed allowed by the density of the local space. We will further ignore the gravitational fields that could curve its path or any other abnormalities and gradients of the granular density of space.

2.2. The photon energy

Here is a short analysis on the photons emitted by distant galaxies (sources), which have traveled for several billion years to the observer and which have a significant redshift. We will not include the photons from closer sources - less than a billion years; they are affected by a normal, not relativistic Doppler Effect (at source and destination) that produces either redshifts or blueshifts, according to their recession velocity. The variation in their energy is directly determined by this and it is fully explained by the current laws of physics.

All photons coming from very distant sources have a significant redhift, i.e. an increase in their final wavelengths; this frequency decrease implies an energy decrease, which is not coherently explained in current astrophysics. For example, with all the expansion of the empty space, photons' energy loss could not be simply transferred to space, "heating" it as a direct result!

However, the granular perspective allows us to give a simple explanation for this phenomenon. Let us consider, as shown in **Figure 1**, the **v** photon (which was emitted at the time when first galaxies formed, about 13 billion years ago, and which is observed today from Earth). It has been shown in a previous article ([5], chapter 3) the precise manner the absolute speed of photons depends on the granular density and how this density has continuously decreased over time. The speed formula is:

$$c = C / (1 + \rho \tau C)$$

At the time that photon was emitted, the granular density was $\boldsymbol{\rho_0}$ and the speed was $\mathbf{v_0}$, while now is $\boldsymbol{\rho}$ and the speed value is $\mathbf{v = c}$ (the current speed of light in vacuum). The exact formula of granular density evolution over time is not known yet, but for this more logical argumentation is not even necessary; we will further consider that the speed of light has increased linearly in the past 13 billion years, from about 30,000 km/s up to 300,000 km/s today (prior to this period it varied more abruptly, with significantly lower values).

Using the formula $\mathbf{1 + z = \lambda_{obsv} / \lambda_{emit}}$, values greater than one were obtained for **z**, and even larger for the CMB photons (it is assumed that they have been emitted 379.000 years after Big Bang, having $z = 1089$). These extreme values helped scientists to calculate the "distance" to source, resulting 46 billion light-years for the radius of the observable universe. In other words, they say we can actually see the early galaxies, which are located at proper distances much larger than 13 billion light-years, despite the space has "dilated" meanwhile, and this thing may give the false impression to observers that those galaxies moved at superluminal speeds.

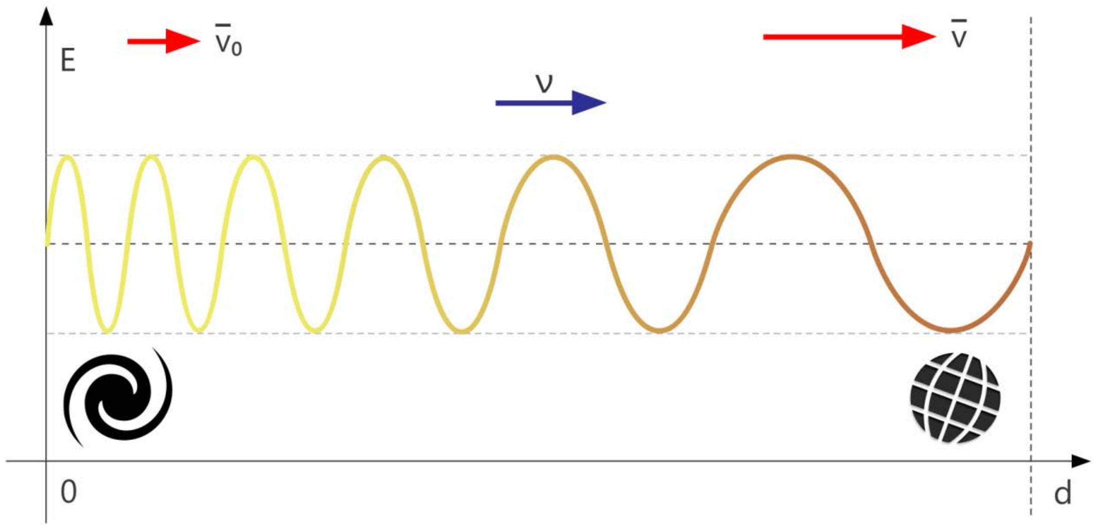

Figure 1 - *The redshift of light*

Coming back to the granular perspective, it has to be mentioned the granular structure of photons, a multilayer spiral of a certain length, whose average density is greater than the local one. A photon from distant galaxies has traveled for billions of years, crossing regions of space with lower and lower density. During this journey, it gradually changed its form (the length in fact) and moved at higher and higher speed, which is presumed to have a quasi-linear increase. If we are seeing these things in an *absolute geometry* and we relate them to the actual physical constants (lengths and speeds), we can realize that the redshift of photons has been only caused by the increase of their absolute propagation speed. Moreover, if we assume as true the value of 13 billion years for the duration of a photon's journey through space, the travelled distance can be simply calculated and averaged to the estimated value of about *8-9 billion light-years* (this kind of reduction is also valid to the closer sources - under one billion years - but in a smaller proportion). In other words, the sphere of the observable universe will have a similar radius value, *much smaller* than the official one. Even so, if these very old galaxies are observed in all cosmic directions, assuming no relativistic speeds for all of them, we may still picture an observable universe (at the beginnings) of very large dimensions - which could be only formed in a superluminal expansionistic process. In order to explain this in granular context (where the granular speed shall not exceed the value ***C*** and the geometric space is not deformable), another model of the universe's birth (a distributed one) was imagined in the First Bangs [5] article.

As this redshift is as a certain phenomenon, we have to find out now what exactly is happening to the photon energy and whether its energy is always conserved within the cosmic system. Simplifying things, let us make a thought experiment and consider only the points of departure and arrival for the photon above, as shown in Figure 2. There are two distinct points that are therefore located at a very great distance one from the other, both in space and in time. Metaphorically speaking, they even belong to different universes, which we may call $\mathbf{U_1}$ and $\mathbf{U_2}$. Although both U_2 and U_1 are part of the same big universe, some of their fundamental physical constants are quite different. The whole universe is a dynamic system, changing over time and extending its space (both components), regardless its "open" or "closed" attribute. We can see all these things in an absolute manner, relative to the current metric, but we must not forget their global relativization. In particular, as time flows, some physical "constants" - such as the granular density or the average granular distance - have changed. The U_1 universe had a greater granular density, and therefore its absolute speed of light was significantly lower in comparison with that of today (U_2). Similarly, the mass of the elementary particles and their electric charge were different; seen in the context of global relativization, without a precise modeling, we cannot say, for example, if the light emitted by the first hydrogen atoms had *exactly* the same frequency as of today. However, for the sake of simplification, let us consider that the structured matter's "physics" was the same in both universes and only the absolute speed of light differs significantly.

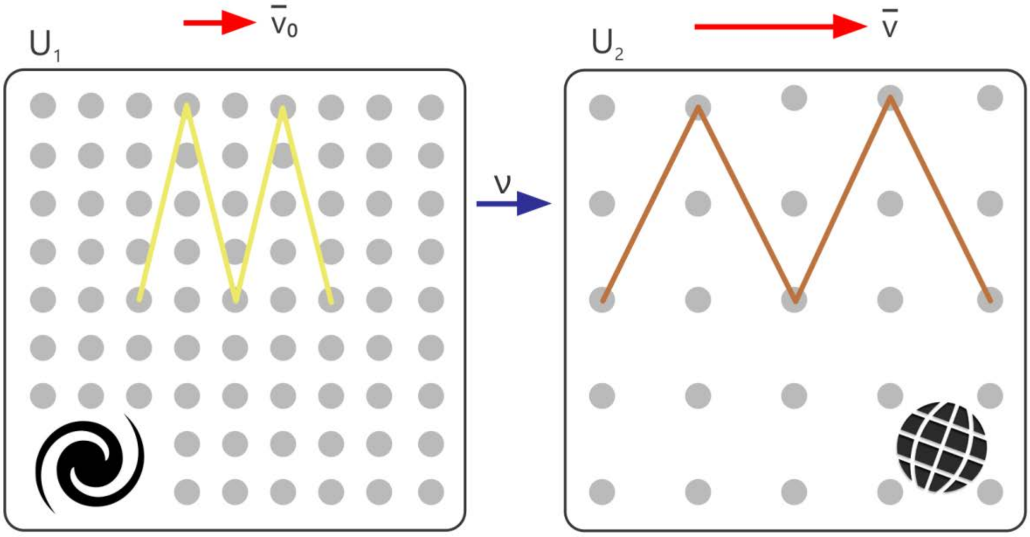

Figure 2 - *A photon in different "universes"*

Once these additional assumptions are made, what can we practically say about the photon energy? A simple idea can be stated now: If we were local observers in those two universes and we relativize the measurements to local physics, we might obtain the *same* amount of energy for that photon. This energy would only change if the photon crosses the "barrier" between the two universes and if we make an *absolute* comparison, considering that the universes are identical. In other words, the energy of the photon does not change in fact, nor its proportionality with the frequency (the Planck "constant"), only the physics of the crossing universe is changing. The difference of energy is zero actually, and the law of energy conservation can be perfectly applied in this case - if it is adapted to the local physics (constants) of certain space-time regions in the universe. No energy is taken or given to space by photons; space is only changing its characteristics over time due the decrease in granular density. It is also relevant the way this transition between different universes is made, gradually and slowly, over billions of years.

Abbreviations and Acronyms

CMB - The Cosmic Microwave Background

Big Bang - A theory on the universe's birth

"Abc" - Figurative language

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