The size of our Universe

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Second Edition, March, 2019

Updated: October 22, 2019

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1. The current vision

Let's assume that the current theories regarding the Universe's birth (the Big Bang theory 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 ago (current years) and which suffers a continuous process of expansion. What exactly is this scenario hypothesizing? A "singularity", i.e. an infinitely dense point of matter and energy, undergoes a sort of explosive process and generates the tridimensional frame named space; this not very well defined void is full of energy and it will be immediately populated by the first elementary particles and their formations. Very interestingly, the initial expansion process of this newly born space had 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 considered it an inflationary process, an intrinsic increase of space in itself - and not a real transport of matter, whose speed should have been lower than the actual speed of light in a vacuum. The particles and atoms were uniformly distributed within this empty space, and here comes a small question. How space did "stretch" differently at the initial and later moments, carrying and, at the same time, 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. Many scientists are considering that only the space between galaxies continues to expand, while these huge stellar formations will keep their structure and size due to the gravity. Space, regardless of its mysterious internal consistency, does not actually drag the matter along with it. The current cosmology claims that the galaxies are not taking part in the global expansion of the universe, a process in which some of them should have already reach superluminal speeds. No, they are traveling in fact at a few **hundreds** or **thousands** km/s relative to the **CMB**, in their galactic clusters. What is actually "moving" out there, 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 to the light of these sources. However, the distant sources do not move with those computed speeds for real; that shift of the color spectrum (seen by a presumed stationary observer) is only due to the expansion of space. All the other contributions (gravitational effects, rotational movements, stellar dust and cosmic gases) have been practically ignored in these calculations of the redshift.

One particular case is the quasar **ULAS J1342+0928** (a black hole); it has a measured redshift of **7.54**, which means its light has been emitted about 690 million years after the Big Bang (13.1 billion years ago). This quasar is therefore located at a distance (the expansion of space was taken into consideration) of 29.36 billion light-years from Earth. 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 automatically fills any empty zone that appears in the process. Therefore, if we consider only this granular component of space (it has a constant number of granules and dictates, in fact, all the 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, the average granular density of space was higher than today (but lower than that existing at the time of CMB emission). For this reason, some of the so-called constants of physics changed their values over time, while others remained unchanged. In the same way, due to the complete relativization of our Universe, some of the derived physical quantities remained relatively constant over very long periods of time.

2.1. The rate of time

Here is a short description of those types of time that were previously defined at each dimensional level of reality and which are connected to the movement of matter and to the propagation of some fields.

a. *The granular time* (virtual) is determined by the existence of the granular movement and by its constant speed. Therefore, this time features a constant, absolute rate of passage, being regarded as a source of time for any higher dimensional level (see The Universe [2]).

b. *The local time* is associated with elementary particles. As their internal movement (the intrinsic precession, determined by their granular structure), may be partly distributed into an external translational movement - the granular time may be similarly distributed into particle's local time, whose variable rate is dictated solely by the particle's absolute speed. Additionally, we may presume that the local time is not significantly affected by the changes of the granular density of space.

c. *The quantum time* is associated with structures, i.e. with the composite particles and their formations - atoms and molecules bonded in various systems. This kind of time has a variable rate of passage, as all the movements and oscillations of the system components are having variable frequencies (which depend on their interactions through fields). It is also relevant in this context how the gravitational field, its nonuniformity in fact, causes a slower rate to the local time. The source of quantum time is the particle's local time, which is exactly the time described in the preceding paragraph. The local granular density changes the intensity of all gravitational fluxes (we presume that their nonuniformity remains almost constant as ratio); however, the quantum time is not significantly affected by this due to the intercorrelations imposed by the global relativization. Even if the rate of this kind of time would change with the granular density, this will be indirectly reflected only in the shift of atomic spectra (which are assumed unchanged here).

d. *The normal time* is associated with a particular macroscopic system and represents the average rate of the quantum time experienced by its component particles. This kind of time is therefore dependent on the absolute speed of that system and on the local gravitational field (more precisely, on its nonuniformity caused by the nearby masses).

In conclusion, all these definitions of time are leading to this idea: a unique rate of time may be used globally, for our entire universe (presumed quasi-stationary); this includes the moments when the first galaxies were formed -

and when a higher value of the spatial granular density must be considered. Moreover, a certain mathematical formula may be used, in which the *absolute* distance travelled by light could be expressed as a product between the speed of light (lower than the current one) and time (of constant rate). Estimating a "flat" geometry of space (seen as an isotropic continuum) and ignoring its variable granular density, we may have perfectly straight trajectories for all photons; therefore, the total distance they have traveled could be mathematically expressed as sum of the distances covered at different speeds. As a special particle that consists of concentrated granular fluxes, a photon may only move at the maximum speed allowed by the density of the local space. For now, the gravitational fields that could curve its path or any other abnormalities and gradients of the granular density of space will not be taken into consideration.

2.2. The photon energy

Here are a few considerations on those photons that have originated from distant galaxies (sources). These "old" photons have traveled for several billion years to an Earth-based observer and most of them show a significant redshift. We are not including in this analysis the photons emitted by closer sources (let's say less than a billion light-years away); the majority of them underwent a normal, not relativistic Doppler Effect (at source and destination) that produces either redshifts or blueshifts, according to the recession velocity. Their variation in energy is directly determined by this phenomenon and it is fully explained by the current laws of physics. As we already know, all photons coming from very distant sources have a significant redshift, i.e. an increase in their final wavelength; this frequency decrease implies an energy decrease, which is not coherently explained by the current theories of astrophysics. For example, with all the presumed expansion of the empty space, the loss in photon energy could not be simply transferred to space, "heating" it in some way as a direct result!

However, the granular perspective allows us to give a simple explanation for this phenomenon. Let's consider, as shown in Figure 1, a photon denoted by **ν** (which was emitted when the first galaxies were formed, about 13 billion years ago, and which is observed today on Earth). The precise manner in which the absolute speed of photons depends on the granular density and how this density has continuously decreased over time were previously described in [5], Chapter 3. Thus, the formula for speed is:

$$v = C / (1 + \rho\, \tau\, C)$$

At the time that photon was emitted, the granular density was $\boldsymbol{\rho_0}$ and the speed was $\mathbf{v_0}$, while now the density is $\boldsymbol{\rho}$ and the speed is $\mathbf{v = c}$ (the current speed of light in a vacuum). How exactly the granular density evolved over time is not known yet, but for this 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 (it varied more abruptly prior to this period, and from significantly lower values).

Using this formula $\mathbf{1 + z = \lambda_{obsv} / \lambda_{emit}}$, values greater than one were obtained for **z**; for example, the CMB photons (they have been emitted 379,000 years after Big Bang) have a very big value, z = 1089). These extreme values helped scientists to calculate the "distance" to source: a mind-blowing value of 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 continuous dilation of space during that period. As a remark, this thing may give the false impression that those galaxies moved at superluminal speeds.

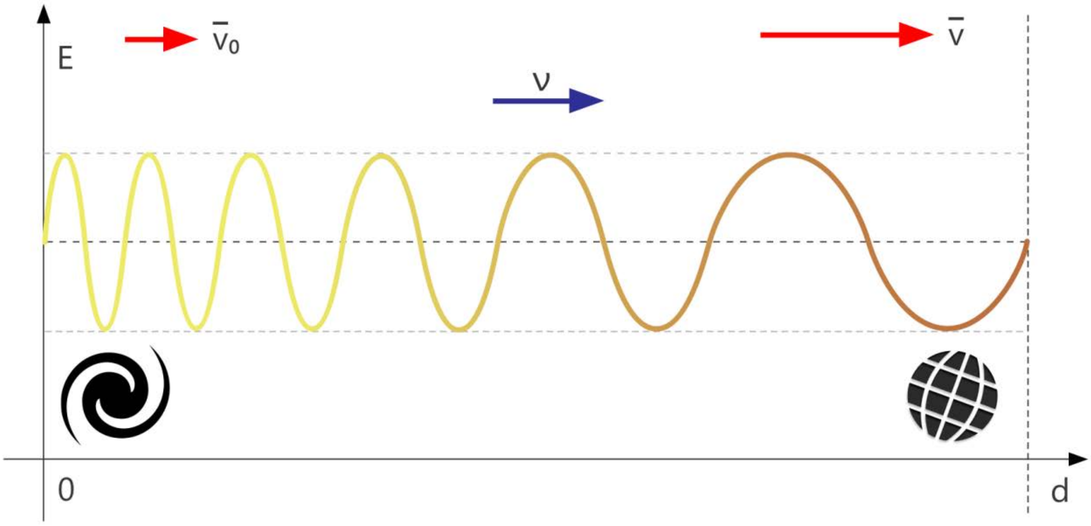

Figure 1 - *The redshift of light*

Returning to the granular perspective, we have to remember the specific granular structure of photons, which is a multilayer double spiral of a certain length and whose average density is greater than the local one. A photon emitted by a distant galaxy has traveled for billions of years, crossing regions of space with decreasing density. During this journey, its form gradually changed (the length in fact) and its speed became higher and higher (a quasi-linear increase is considered for now). If we presume an *absolute geometry* of space and we relate these things 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 that the duration of one photon's journey through space is 13 billion years, the travelled distance can be simply calculated and we can make an estimation 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 has to have a similar radius value, *much smaller* than the official one. Even so, as 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 (in the beginning) 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 [5], Chapter 1. Anyway, even if this new radius value is correctly estimated, our Universe will always be bigger than the observable one and it will likely continue its expansion.

As the redshift is a certain phenomenon, we have to find out now what exactly is happening to the photon energy and whether this energy is always conserved within the cosmic system. Simplifying all these things, let's now make a thought experiment and focus only on the points of departure and arrival of the photon above, as shown in Figure 2. These are two separate points that are very distant in space and in time. Metaphorically speaking, they even belong to different universes (whose short names could be $\mathbf{U_1}$ and $\mathbf{U_2}$, for example). Although both U_2 and U_1 are included in the same big universe, some of their fundamental physical constants are quite different. The whole universe is in fact a dynamic system that changes over time and extends spatially, regardless of its "open" or "closed" attribute. We can see all these things in an absolute manner and relate them to the current metric, but we must not forget about the global relativization. In particular, as time goes by, some physical "constants" - such as the granular density or the average granular distance - are changing. The universe U_1 had a greater granular density in the beginning, and therefore its absolute speed of light was significantly lower in comparison with that of today (in U_2). Similarly, the mass of the elementary particles and their electric charge were different; seen in the context of the global relativization and 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.

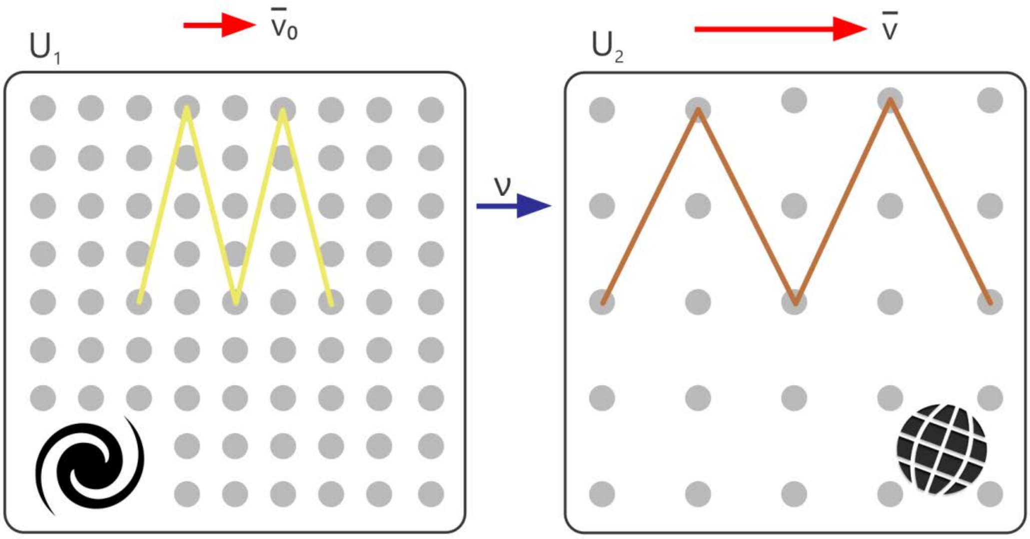

Figure 2 - *A photon in different "universes"*

Once these additional assumptions were made, what can we say now about the photon energy? A simple conclusion may be drawn at this point: if we were local observers in those two universes and we would relativize all the measurements to the local physics, we might practically obtain as a result the *same* amount of energy for that photon. This amount of energy would only change if the photon crosses the "barrier" between the two universes and if we make an *absolute* comparison, considering that these universes are identical. In other words, the energy of our photon (and its proportionality with the frequency - the Planck "constant") does not change in fact; only the physics of the universe is changing. The difference in energy is actually zero 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. 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 in our case the way this transition between different universes is made, gradually and slowly, over billions of years.

3. References

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