Part 3: Birth and death of Matter

Primo Galletti Aldo Aluigi

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In the graphs previously described [1], further than the events of high intensity, it is also possible to notice less intensity phenomena.

If the signal is amplified by 100 times, it is possible *to notice events that have a time duration lasting from few hundreds to few thousands of seconds and their intensity is up to few mV*. These *low intensity* events appear as "notches" overlapped by the main signal and it is possible to see them only when the signal is relatively quiet. There are no recordings of events showing intermediate time characteristics between the two above mentioned events.

The assembling and implementation of a LED sensor has allowed a further improvement of its time resolution, allowing to record also events having a *very low intensity*: they have a time duration from about 1/100th second up to 1/10th second and their intensity can reach up to $100 \div 200$ μVolts.

The analysis of these phenomena having a lower intensity, as well as the discovery of *Multiple Nucleus Quasars* (MNQ), has led us to deeply revise the mechanisms showing how the Universe works.

1 "Bubbles" of new matter

In carefully analyzing the diagrams produced by the detector when the detected signal is relatively quiet, some "notches" can be easily seen on the crest of the recorded signal [2].

Graphs 1997_N1 and **Graph 1997_N2** show very clearly some of these "notches" (see circles 1, 2, 3 and 4) that appeared on the 21st, 22nd and 23th of September 1997. **Graph 1998_N1** shows quite clearly another "notch" (see circle 1) very similar to the previous ones, which appeared on December 22nd 1998.

These events last about $3,000 \div 4,000$ seconds and have an amplitude of $2 \div 3$ mV. These relatively "small" events can be only sometimes observed as they are

[1] See **Part 2** of *A Detector for Gravitational Waves*.

[2] These phenomena started to become visible during the month of September, a month when the thermal excursion day-night is much lower. The use of the second temperature-controlled enclosure has allowed us to see them well also in other periods of the year.

often masked by the waves of high intensity produced by the collapsing of the MNQs nuclei.

The peculiar shape has made us exclude, since the beginning, that these could be disturbances coming from the outside as, in this latter case, positive peaks should have been easily generated. Furthermore, a rather "long" time duration has made us think of the fact that these events are something quite different [3].

It is regretfully impossible to calculate the redshift of these events as the waves do not show the typical "fork" shape.

What do these "notches" represent? Given their nature and origin, we can try to formulate the following hypothesis: *they can, very likely, be considered as new matter "coming" into the Universe, that is to say matter, made of hydrogen, at its first birth which, after this, condenses and should form the new star clusters.*

The origin of the young star clusters, that are also visible outside the galactic plate as well as the remarkable amount of matter as hydrogen clouds, should be this one [4].

These newborn hydrogen clouds, while expanding, get cold and form young star clusters which, in their turn, are bound to form the small galaxies, which will be then attracted by bigger galaxies, and supply these latter with fresh matter Therefore, galaxies forming the Universe are, very likely, nothing but a continuous aggregation of these young star clusters.

2 Gravitational waves lasting for a short time

In order to explore the field of the events lasting for a shorter time, we have built a detector, very similar to the previous one, which uses LED light instead of a vacuum tube one [5].

Two of these detectors have been assembled and placed in two hermetically sealed tin lined iron boxes, fed by batteries placed into the boxes themselves. It was necessary to use these tricks to get rid of the electromagnetic noise coming from both the electric power grid and electromagnetic waves. This allowed us to amplify the detected signals by 10^4 times without any problem. This advantage was obtained through an amplifier formed by two a.c. coupled stages where the first stage has a gain of 10^3 times while the final stage (having a lower output

[3]Namely, considering how the Wheatstone bridge of the instrument is built, the only possibility to have negative voltage peaks on V_{CD} is either that there are voltage interruptions or sudden reductions through the photoresistor. On the contrary, positive peaks may be caused by voltage interruptions through the variable resistance DVR

[4]These clouds cannot be formed by the explosion of supernovas, as these latter ones contain heavy metals, therefore they are old celestial objects!

[5]The detector with the vacuum tube is also in a position to detect short time duration events very well. It is also very efficient too (instead of a signal of $100 \div 200$ mV, it is capable to give a signal of 1 mV as the vacuum tube emits light on a spectrum that has an amplitude higher than the LED). The use of a LED has allowed us to assemble and to implement it more easily. Furthermore, long term stability problems verified on LEDs are not important here.

impedance) has a 10 time gain. The frequency range goes from a few Hz up to 10 kHz.

The output signals coming out from the two boxes are sent to an audio card (it is an **AVE 64 GOLD**) for Personal Computers (PCs) and they are recorded through the PC.

The sampling frequency of the audio card is 44 kHz and it uses two 16 bit resolution analogical to digital converters (ADC).

The amplitude of the output signal goes from 10 mV up to about 200 mV therefore, by amplifying 10^4 times, it gives an input signal into the PC's audio card up to about 2 V.

The inserting of a low value resistance (e.g. $100 \div 1000\ \Omega$) at the input of the first stage of amplifier and the further amplifying by 100 times the signal, allowed us to see the noise generated by the amplifier, while after switching off the instrument and further amplifying by 10 times more the signal, it was possible to see the noise generated by the audio card [6].

Therefore, in summarizing the above, we obtain:

- 2 V (peak-to-peak) for the signal from the audio card
- 200 μV (peak-to-peak) for the signal from the detector
- 2 μV (peak-to-peak) for the noise of the amplifier
- 200 nV (peak-to-peak) for the noise of the audio card

Photo 1 and **2** show two traces of the signal recordings coming from only one the two boxes. The total time duration of each of them is 100 milliseconds. The scale amplitude is 2 V, corresponding, therefore, to 200 μV of the sensors signal.

In the first trace it is possible to see waves having an intensity of $100 \div 200\ \mu$V and an average time duration of about 10 milliseconds.

In the second trace, in the central part, it is possible to see some smaller waves with a typical amplitude of about $10 \div 20\ \mu$V and an average time duration of about 2 milliseconds [7].

Photo 3 shows a spectrogram obtained after a recording of 1.5 seconds and same is a confirmation of what above said.

Finally, **Photo 4** and **5** show the three-dimensional spectrograms, of 2 minute recording, corresponding to a file of 10 Mbytes data. The first one refers to the signal coming from only one of the two boxes, while the second one shows a comparison of the signals coming from both boxes.

An important characteristics of these waves that makes them quite different from the previous "notches", it is their shape: *they consist of a positive peak, immediately followed, by a negative one.*

[6] The typical frequency of the noise of the audio card has resulted being at about $1 \div 15$ kHz, therefore it was possible to identify it exactly and, therefore, isolate it.

[7] Hearing through direct audio system these continuous collapses is a terrifying sensation as the sound is very similar to the fall of an avalanche together with strong earthquake.

What do these waves represent? Their rather short time duration let us think that *these events are generated by celestial objects having characteristics that are similar to the Sun's, continuously falling on very massive celestial bodies*. And to be more precise, the waves of higher amplitude should be generated by the fall of stars on supermassive nuclei, such as those forming the MNQ, while the waves of lower intensity should be produced by the fall of stars on less massive celestial bodies such as the *common quasars* that can be found in the centre of some galaxies.

The positive half-wave should, very likely, represent the collapsing of the star during its fall into the gravitational field of the massive object, while the negative half-wave should represent its explosion that occurs when it hits the surface.

When a star falls on one of these supermassive nuclei, the first impact occurs with the high temperature shell that causes the loss of its gas portion. The nucleus of the star continues its fall, until it crashes onto the surface of the nucleus.

3 The life-cycle of matter

We think now advisable to summarize what found out after analyzing the recordings made by the detector during these seven years (about 60 thousand hour recordings without interruption), partly repeating what already mentioned.

1. It seems the Universe is governed by these extramassive MNQs, having a high number of nuclei (a few tens) tightly orbitating one around the other like the stars of a compact globular cluster [8].

   The radius of each nucleus is, very likely, not bigger than $2 \div 3$ day-light while, the overall size of these MNQs, should not have a radius longer than 3 month-light.

2. The internal structure of these MMQs cannot be seen with any instrument detecting electromagnetic waves, as these objects are wrapped by a thick shell of high temperature gas, which does not allow to see their internal structure. Only detectors for gravitational waves can see their internal structure [9].

[8]These MNQs must not be confused with the *common quasar* one can observe at the centre of some large galaxies. The first ones are supermassive objects which can only live at the centre of a cluster of galaxies.

[9]The fall of a star onto the surface of a nucleus might be seen only in case this event happens at one of its poles. In this case, due to the high fall speed, a *burst of highly energetic gamma rays* should be emitted.

3. The nuclei of these MNQs are continuously fed by matter such us stars, planets, dust, gas etc..., forming the galaxies, continuously falling on top of them.

   All galaxies having a nucleus (namely those having inside them a common quasar) confer their nucleus to the MNQ and the former becomes part of the group of nuclei forming it, thus increasing its capabilities to attract the matter [10].

The phenomenon might be similar to the superluminal beams that have been observed in the nuclei of some galaxies where we can observe only the one directed towards us.

4. These MNQs are as older as higher is the number of the nuclei forming them [11].

5. After a nucleus reaches its critical mass, it collapses within about 3 days and generates locally a high quantity of energy, to be able to "curve" the space around it and, in a very short time, to "exit" from the Universe.

   Once it has gone "out" of the Universe, the nucleus remains as "buried" in the space and its gravitational effects cannot take place at all.

   As the "exit" of the nucleus happens in a very short time, the high temperature gas shell wrapping it, very likely, does not allow it to go out completely and part of it remains in the Universe.

   It is possible that at the end of the total collapse, within the MNQ, one nucleus only remains that eats up leaving no more matter around it in order to collapse.

6. When a nucleus collapses, the gravitational waves generated are so intensive that some of the previously collapsed nuclei, which have then remained "buried" in the space, may re-emerge to become again part of the MNQ, to collapse then very short after.

7. These peculiar MNQs, because of their very high mass, act as *powerful attractors* and suck nearly all matter around them, including galaxies.

   According to the present estimations, the mass of each nucleus should reach about *some billion solar masses.*

8. The gravitational field generated by these objects is so intensive to deflect the light even at hundreds of thousands light-year distance [12].

   The locally generated energy in the form of gravitational waves, during the collapsing of these nuclei is enormous. Its value should be equal to about 10^{29} solar masses. That is to say, a much bigger mass than the total mass present in the visible Universe!

   The explanation of what seems a paradox is the following: *when collapsing, it also collapses part of the space the mass holds around itself.*

9. Further than the above-mentioned phenomena having a high energetic intensity that happen in the MNQs, where matter continuously come in and go out of the Universe, there are also phenomena having a lower intensity represented by "notches".

   These "notches", should only consist of *"new" matter that comes into the Universe*, that is to say matter that is born for the first time [13]. These are

[11] If in a general collapse shows only few "forks", it means that those are young MNQs.

[12] A spectacular example of these MNQs is represented by the cluster of galaxies **Abell 2218**.

[13] For this reason we previously spoke of old recycled matter, in order to distinguish it from those "bubbles" of new matter coming, for the first time, into the Universe.

spontaneous phenomena supplying the Universe with new matter, therefore with energy. These "bubbles" have mass going from *few million up to some tens million solar masses*. Their formation takes place in a few thousands of seconds.

10. It seems these "bubbles" are borne everywhere and continuously. It seems this new matter has its birthplace preferably far from large matter concentrations [14].

    We think these "bubbles" are made of hydrogen clouds that in cooling down condense and then generate young star masses in supplying the galaxies with fresh matter. The smallest "bubbles" cannot easily condense and tend to remain gas clouds.

4 Attempt for a balance of the Universe's matter

We want to try to lay down, hereunder, a preliminary balance about the matter forming the Universe also if some points are still uncertain [15].

Matter present in the visible Universe. For what concerns M_U, the mass that is in the portion of the visible Universe, today's calculations indicate a value of about 10^{23} solar masses ($M_\odot$). Said value, however, does not correspond to the "proper" mass, but to the "gravitational" one, that is to say it also includes the "dark matter" whose quantity is still quite uncertain. Therefore, we have preferred to use a different method to make calculations which, in our opinion, is much more reliable.

Because of the continuous expansion, the energy of the Cosmic Background Radiation (CMB) should represent the whole matter forming the Universe. **Appendix A.2** contains the calculation of M_U using the most recent data concerning the CMB. According to this calculation it comes out that:

$$M_U = 1.7\ 10^{21}\ M_\odot$$

Universe expansion. In order to give the Universe the possibility to expand and at the same time to keep steady on a large scale, it is necessary that *the quantity of new born matter is higher than that disappearing because of collapsing of the MNQ*

[14] The "bubbles" of matter are very "light", therefore they can more easily "enter" where space is less "thick". The nuclei of MNQs instead, as they are very compact and heavy, can "enter" into the Universe only after strong local disturbances, as it happens when there are collapses of the nuclei.

[15] One of them concerns Hubble's constant which value, still much discussed today, should be between 15 and 30 million km/s per million light-year (that is to say, between 40 and 80 km/s per Mpc).

nuclei. The quantity of matter necessary to meet the above requirements is given by:

$$\frac{\Delta V_U}{V_U}\ M_U = 1.5\ 10^{-10}\ 1.7\ 10^{21}\ M_\odot \approx 250\ 10^9\ M_\odot/year$$

where, the calculation of the term $\Delta V_U/V_U$ can be found in **Appendix A.1**.

Matter collapsing with the MNQs. According to the analyses of the waves lasting for a short time, it was possible to notice that the star like objects falling on the MNQ's nuclei are *an average of* $20 \div 30$ *per second.* In case they have characteristics similar to the Sun, the amount of matter collapsing per year should be corresponding to:

$$\Delta M_{collapses} \approx 25\ (3,600\ 24\ 365)\ M_\odot = 25\ 31.5\ 10^6\ M_\odot \approx 0.8\ 10^9\ M_\odot/year$$

Supposing that the instrument is in a position to see these small intensity waves up to about $1/4\ R_U$, we should multiply said value by 64 and we may not consider the correction for the redshift on the counting. Therefore, the result we obtain is:

$$\Delta M_{collapses} \approx 2\ 64\ 0.8\ 10^9\ M_\odot \approx 100\ 10^9\ M_\odot/year$$

where a factor 2 has been, quite arbitrarily, inserted to take account of matter that is not made of objects having the size of the Sun (like planets, dust, gas, etc...) which falling on the nuclei do not produce gravitational waves having a sufficient intensity to be detected.

(Critical) mass of the nucleus of a MNQ. Sooner or later the matter falling on the MNQ's nuclei will "go out" of the Universe. As the characteristics of the collapsing nuclei are very similar to each other ("standard" nuclei), we can write:

$$\Delta M_{collapses} = \Delta n_N\ M_N$$

where Δn_N is the average quantity of collapsing nuclei per year and M_N is the mass of each nucleus.

Considering the recordings made up to now, it was possible to detect that there are about $1 \div 2$ general collapses per year and that each general collapse causes the disappearing of about $5 \div 10$ nuclei (the difference between the nuclei "going out" and those "coming in").

Furthermore as, through the gravitational waves of high intensity, we can see quite well about $80 \div 90$ % of V_U, and *because of the redshift, the average time of each collapse is 4 times higher than the real one*, we can estimate that *there is the collapse of about fifty nuclei per year.*

From previous relations it is possible to obtain a nucleus mass as:

$$M_N = \frac{\Delta M_{collapses}}{\Delta n_N} \approx \frac{100\ 10^9\ M_\odot}{50} \approx 2\ 10^9\ M_\odot$$

That is to say, we can obtain that the average mass of a nucleus that collapses *should have a mass equal to some billion solar masses.*

Quantity of new matter that "come into" the Universe. The $\Delta M_{notches}$, that is the quantity of matter that yearly comes into the visible Universe in the form of hydrogen "bubbles", must be able to balance both the collapsing matter and the effect of expansion. Therefore:

$$\Delta M_{notches} = 100\ 10^9\ M_\odot + 250\ 10^9\ M_\odot \approx 350\ 10^9\ M_\odot / year$$

The most recent estimating indicate *the hydrogen clouds have a mass going from a few million to few tens million solar masses.* If we indicate these "notches" corresponding to an average mass of *10 million solar masses*, we obtain:

$$\Delta M_{notches} \approx \frac{350\ 10^9\ M_\odot}{250\ 10\ 10^6\ M_\odot} \approx 35\ thousand\ notches/year$$

If we suppose the instrument is only able to see "notches" that are up to $1/3\ R_U$, this can only detect a number 27 times lower, that is to say a little more than 1,000 "notches" per year. Not considering the correction due to the redshift, the number detected *should reach* $3 \div 4$ *"notches" per day.*

Considering the present situation, it has been possible to notice that only during some periods of the year *the instrument records few "notches" per day.* We do consider as satisfactory this first result, especially because of the uncertainties of the calculation. And particularly:

- the estimating of 10 million solar masses could be in defect, that is to say the hydrogen clouds that we see could be "bubbles" of smaller size (that, therefore, remain as they are, being unable to condense in star clusters);
- the counting done up to now are still quite unreliable, especially because of their being masked due to the waves of high intensity.

Average life of matter in the Universe. All born matter, sooner or later, will have to collapse. Therefore, if we indicate as τ_U the average life of matter in the Universe, we have:

$$\frac{M_U}{\tau_U}\ \Delta M_{collapses} \approx 100\ 10^9\ M_\odot$$

From which it is possible to obtain for the average life τ_U:

$$\tau_U \approx \frac{M_U}{\Delta M_{collapses}} \approx \frac{1.7\ 10^{21}\ M_\odot}{100\ 10^9\ M_\odot} = 17\ billion\ of\ years$$

which corresponds, quite well, to the data that today are at our disposal.

Number of MNQs present in the visible Universe. What is the average life of a MNQ's nucleus? We can write down that:

$$\Delta n_N \ M_N = \frac{M_{MNQ}}{\tau_{MNQ}}$$

Where M_{MNQ} is the matter forming the MNQs, and τ_{MNQ} is its average life.

If we take 1/10 of the whole quantity of matter present in the visible Universe, and divide it by the quantity of collapsing matter per year, we obtain:

$$\tau_{MNQ} = \frac{M_{MNQ}}{\Delta_N \ M_N} = \frac{1.7 \ 10^{21} \ M_\odot}{10 \ 100 \ 10^9 \ M_\odot} \approx 1.7 \ 10^9 \ years$$

That is to say, we obtain that the nucleus inside a MNQ has a very short life!

It is reasonable to suppose that in the portion of visible Universe there are, very likely, not many MNQs. Namely, as soon as a nucleus that is at the centre of a large galaxy becomes part of a MNQ, it immediately takes advantage of the enormous attraction possibilities of this latter in remarkable increasing its growth rate. Furthermore, a massive presence of MNQs, should not be consistent with an average life of matter of $15 \div 20$ billion years!

5 A new framework for the Universe

All information we receive about the Universe through the *gravitational waves, shows us that the Universe works in a quite different way than it is suggested today*, which solely bases on the information reaching us through *electromagnetic waves*. We report hereunder how all this might change.

1. The Universe should be continuously expanding in compliance with *Hubble's Law*, but for these local dishomogeneities in motion, due to the thickening or the rarefaction of matter forming during the evolution of these MNQs.

2. *It does not seem the Universe has any boundary.* It should have an endless extension and respect to any observer it should expand to infinity at an infinity speed.

   From any point of observation, the observer will always be situated at the centre of it and will always see a radius of more or less the same value. There are no preferred observation points. Therefore, if an observer might see the galaxy behaviour during time, he would see them continuously expanding and accelerating.

   In respect with space, *galaxies and MNQs are still at rest* but for local motions due to gravitational effects.

3. Theoretically, we can see the Universe around us, up to a distance where the expansion velocity, respect to us, reaches the speed of light, after that limit

we cannot see anything else. Such distance has been defined as the *Radius of the visible Universe*, which namely represents our horizon line.

Gravitational waves allow us to see quite well as far as about 9/10th of the radius of the visible Universe, after which the gravitational waves reaching us, are distorted due to *movements of space* that take place in all directions.

Electromagnetic waves allow a satisfactory sight to a much shorter distances, as these waves are more easily diverted and attenuated during their propagation throughout space.

4. *The "redshift" analysis of gravitational waves, shows us that the Universe is much older than indicated by the present theories.* Events happened about $40 \div 50$ billion years ago can be observed very clearly, and the main actors of these facts (that is to say the MNQ nuclei) were by then already very old!

5. *It seems no any Big Bang has ever taken place.* Therefore, there has never been a beginning of the Universe, which very likely has always been, more or less, as we see it now, apart from the local dishomogeneities produced during the evolution of the MNQs.

6. All this leads us to conclude that a continuous supply of new matter (and, as we will see, also new space!) is needed in order to allow the Universe to expand. If there is no supply of fresh matter in the form of "bubbles" of hydrogen, the Universe could not remain steady (on a large scale), therefore collapses would completely deplete it in about a few tens of billion years.

7. MNQs act, through the mechanism of collapsing, as true regulators in keeping the Universe steady and homogeneous, and do not allow continuous and dangerous piling up of matter. They act as real safety valves! Without them, the Universe would not be steady any more and, dangerously, tend to concentrate or rarefy.

8. While these MNQs eat up the galaxies, they also "spit out" of the Universe nuclei, thus *cleaning it from the "old" matter and keeping the Universe always young.* They act as true "dusters" of the Universe.

9. The general collapses of these MNQs *create in the Universe "empty" matter areas*, which remain like that for a long time. They will be then filled with "bubbles" of new matter.

10. There is no reason for the existence of the problem concerning the *"missing matter" in the Universe*, and therefore, the "dark matter" problem exists no more. This apparent lack of mass should be caused by the fact that in very massive celestial bodies such as these MNQs, the quantity of space they attract on themselves causes an increase in the (gravitational) mass by several orders of magnitude.

The "dark matter" is nothing but this thickened space around the celestial bodies produced by their gravitational field. Therefore, the more a celestial body collapses, the more its (gravitational) mass increases for what concerns its gravitational field. All this happens also if the (proper) mass itself has had no increase.

11. It seems that *black holes* are not the celestial objects concerning phenomena after which they have been named! *These objects are not in a position to collapse and "go out" of the Universe as the MNQs do.* Their modest mass (which is about a few tens of solar masses), does not allow them to concentrate the enormous quantities of energy that is needed to "curve" the space!

    Therefore, it seems these celestial objects are in a position to collect only very small quantities of matter that falling on their surface, produce electromagnetic radiations having higher frequency than the visible spectrum (X rays, etc...) because of the contraction they have had, reach a speed close to the speed of light.

12. Owing to the huge gravitational field generated by these MNQs, the matter falling on the nuclei at the moment of the impact with the surface (nearly completely) looses all its *electromagnetic energy*, which strays through the space and forms the *Cosmic Microwave Background (CMB) radiation*. This energy should, therefore, *represent all matter forming the Universe*.

13. The *fluctuations of the CMB*, recently discovered, are a further proof of the existence of these MNQs. More exact measurements of these fluctuations could supply useful information on the *real number of the MNQs* existing in the Universe and, therefore, of their *average life*.

6 Considerations on the energy of these events

The area of a gravitational wave is proportional to the energy produced during the event, therefore it could be proportional to the mass of the celestial object. Therefore, the energy associated with the short time duration waves should result as proportional to:

$$U \propto Area\ of\ wave \approx \frac{1}{2}\ (100\ 10^{-6})\ (10\ 10^{-3}) \approx 0.5\ 10^{-6}\ V\ s$$

Taking as a reference the series of collapses of 1994, the average characteristics of the high intensity gravitational waves are the following:

$Amplitude \approx 0.5\ Volt$

$Distance\ between\ peaks \approx 4\ days$

$$Time\ duration \approx 16\ days$$

An estimate of the area associated with these waves can be done as follows (supposing a trapezoidal shape of the "fork"):

$$Area \approx \frac{1}{2}\ 0.5\ (16+4)\ 86,400 \approx 500\ 10^3\ V\ s$$

Therefore, the energy associated with these waves results as follows:

$$U \propto Area\ of\ the\ wave \propto 500\ 10^3\ V\ s$$

If we take the ratio between these two energies, we obtain:

$$\frac{500\ 10^3}{0.5\ 10^{-6}} \approx 10^{12}$$

In this case, *there is no matching* in value (it is, in fact, a higher value by a few thousand times) with previously calculated masses.

The nucleus mass too, does not match even with the observations made on the "notches". In fact, if we take as reference the "notch" shown in **Graph 1997_N2**, we notice an average amplitude of $2 \div 3$ mV with a time duration of 4,200 seconds. The energy associated with this wave has therefore a value of:

$$U \propto 4,200\ 3\ 10^{-3} \approx 10\ V\ s$$

If compared with waves of high intensity, the ratio results as:

$$\frac{500\ 10^3}{10} \approx 50\ 10^3$$

Which, also in this case, *does not match* with the respective masses (it is, namely, a value a few hundred times higher) previously calculated.

Why do we find these inconsistencies between energies and masses? We will see later on, that this problem can be solved in keeping conceptually well separate the followings:

- proper (or particle) mass
- gravitational mass
- inertial mass

Thus, in the first situation the *inertial mass* of the star, at the moment of the impact, has been compared with the *gravitational mass* of the nucleus at the moment of collapse, while in the second situation, the same gravitational mass has, very likely, compared with the *"proper" (or particle) mass* of the "bubble".

7 Discussion

There are still many questions that have received no satisfactory reply. Some of them are indicated hereunder.

1. What is the mechanism underlying the expansion of the Universe?

   The existence of a *"physical" space* allows us to give to this question a more satisfactory reply. More exactly, it would result that *the expansion of the Universe is due to a continuous generating of new space*. That is to say, *along with the birth of new matter there is also the birth of new space* [16]!

   This new space, however, will not born along with the "bubbles" of new matter, but it does exist a new mechanism that is capable to generate the enormous quantities of space needed by the Universe to expand.

2. What mechanism causes the "bubbles" of new matter to be born?

   At the moment, there are some ideas concerning the mechanisms underlying the birth of new space, on the contrary, we are in a position to say very little about of the birth of this new matter.

   We can imagine this new matter can be found as "spread" bubbles buried into the space being in a precarious equilibrium with it. Therefore, a disturbance such as it can be the one generated by a gravitational wave of high intensity passing through, might break that equilibrium and allow matter to "come into" the Universe.

   Furthermore, *the birth of this new matter is, very likely, easier where there are no clusters of matter* in the form of celestial bodies which, with their gravitational field, make "thicker" the surrounding space, thus strongly hindering this matter to "emerge".

   This hypothesis makes still stronger the idea of a *steady and homogeneous Universe on a wide scale*, where the density of the matter is regulated by these peculiar MNQs, through the mechanism of collapses.

3. What kind of matter is the one continuously supplied to the Universe?

   We are not in a position to indicate what kind of matter forms these "bubbles" coming into our Universe. That is to say, we cannot say if *it is neutral hydrogen* or *neutrons*, the latter ones of which in decaying become protons and electrons that would form hydrogen atoms [17].

4. Why do the MNQs nuclei suddenly collapse?

   Why is the fall of a single star sufficient to make it collapse? The key to explain this phenomenon might be the following: *The kinetic energy (inertial*

[16] In that case, the intensity of "notches" should be much higher.

[17] In case these are neutrons, during their decaying gamma rays with a specific energy would certainly be emitted.

mass) the star has accumulated during its fall onto the nucleus is very high due to the very intense gravitational field generated by a MNQ. In other words, in its falling, that happens at the (local) speed of light, the star carries with itself large quantity of space too!

A APPENDICES

A.1 Dimensions of the visible Universe

Let's consider the visible portion of the Universe, V_U:

$$V_U = \frac{4}{3}\ \pi\ {R_U}^3 \tag{1}$$

with R_U as radius of the visible Universe. As,

$$R_U = \frac{c}{H_0} \tag{2}$$

where H_0 is the *Hubble constant*. If as value for H_0 we take:

$$H_0 = 15\ km/s\ per\ million\ of\ light-year$$

we will obtain:

$$R_U = \frac{c}{H_0} = \frac{300,000}{15\ 10^{-6}} = 20\ billion\ of\ light-year$$

or,

$$R_U = 20\ 10^9\ 3\ 10^8\ 31.5\ 10^6 = 1.89\ 10^{26}\ m$$

therefore, the volume of the visible Universe is:

$$V_U = \frac{4}{3}\ \pi\ {R_U}^3 = \frac{4}{3}\ \pi\ \left(1.89\ 10^{26}\right)^3 = 2.83\ 10^{79}\ m^3$$

Due to the expansion, the increase of the volume ΔV_U, in time Δt, corresponds to (see **Figure 1**):

$$\Delta V_U = 4\ \pi\ {R_U}^2\ c\ \Delta t \tag{3}$$

that is,

$$\frac{\Delta V_U}{V_U} = \frac{3}{R_U}\ c\ \Delta t = 3\ H_0\ \Delta t \tag{4}$$

If the time interval Δt considered is 1 year and if we use as measure for the distance the light-year, the previous expression becomes:

$$\frac{\Delta V_U}{V_U} = \frac{3}{R_U} \tag{5}$$

therefore, due to the expansion, in 1 year said volume increases by a fraction:

$$\frac{\Delta V_U}{V_U} = \frac{3}{20\ 10^9} = 1.5\ 10^{-10}$$

We also know that the time, t_{2U}, to double the radius R_U is given by:

$$t_{2U} = \frac{c\ \ln 2}{H_0} = \frac{300,000\ 0.693}{15\ 10^{-6}} = 13.9\ billion\ of\ years \tag{6}$$

therefore, after such at time, the volume V_U will be increased 8 times (v. **Figura 2**).

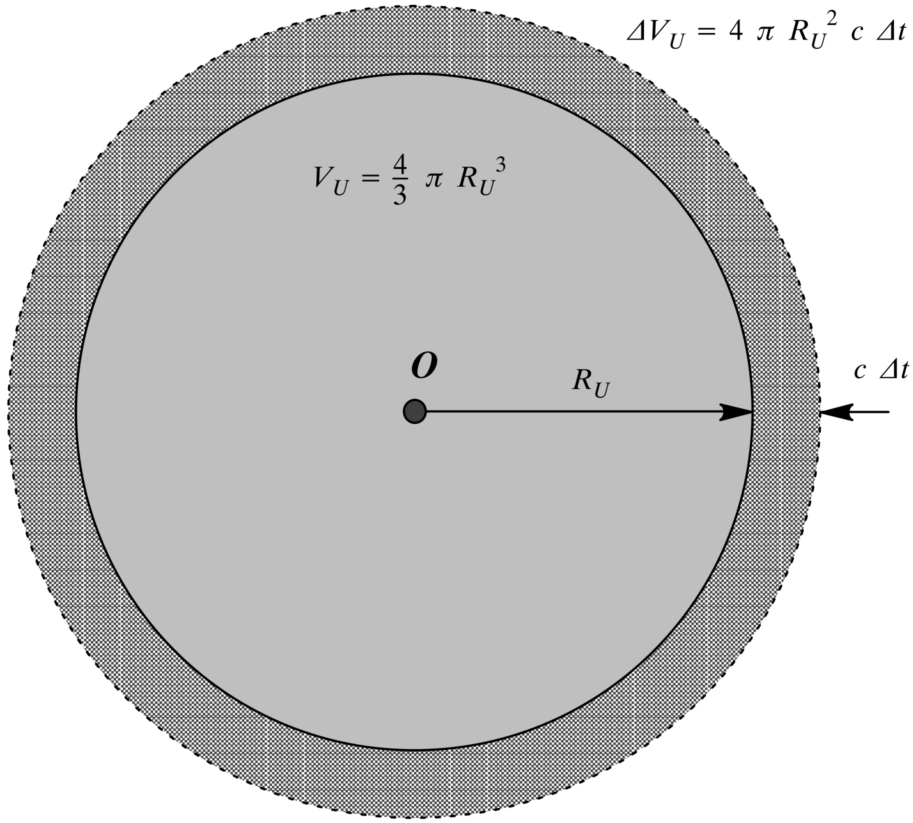

Figure 1: Expansion of the Universe

A.2 Calculation of the ("proper") mass of the visible Universe

The energy density of the radiation produced by a black body is given by:

$$u(T) = a\ T^4 \tag{7}$$

which is Stefan-Boltzmann formula. Where the a constant is:

$$a = 7.57\ 10^{-16}\ J\ m^3\ {}^oK^{-4}$$

Therefore, the energy of the cosmic background radiation (CMB), whose measured temperature is 2.73 ${}^oK$, results as:

$$E_U = a\ T^4\ V_U = 7.57\ 10^{-16}\ 2.73^4\ 2.83\ 10^{79} = 1.2\ 10^{66}\ J$$

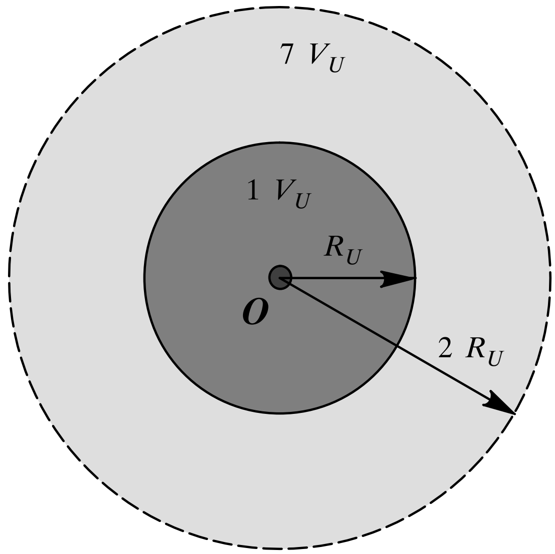

Figure 2: The doubling of the visible Universe radius

and this expressed in units of solar mass gives:

$$M_U = \frac{E_U}{M_\odot\ c^2} = \frac{1.2\ 10^{66}}{2\ 10^{30}\ \left(3\ 10^8\right)^2} = 6.6\ 10^{18}\ M_\odot$$

It is necessary to correct said value according to the redshift, whose effect is an *average lowering by 4 times of the frequency of the measured radiation.*

Wien's displacement law tells us that the frequency of the measured radiation is directly proportional to the temperature of said radiation. The result is, therefore:

$$M_U = 6.6\ 10^{18}\ 4^4 = 1.7\ 10^{21}\ M_\odot$$

The only doubt about this method is represented by the value given to the radius, R_U, of the visible Universe, that is to say by the Hubble constant. In case this is reduced by half, the mass M_U would result 8 times higher and, therefore the value resulting would be about 10^{22} solar masses.