On a Static, Flat and Infinite Universe

February 16, 2017.

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Abstract

In this very elementary article, we try to show that the universe would be static, flat and infinite.

Key words: Redshift, CMBR; static, flat and infinite universe.

1. Introduction.

The Big Bang (BB, or "Great Explosion") theory is the prevailing cosmological model for the universe (that is, the standard model). In this model, the universe -its space- is expanding, which produces a redshift by Doppler effect -the so-called cosmological redshift- in the light of distant light sources (stars, galaxies, quasars etc.). However, we consider that this redshift is produced because the light scatters the microwaves of the cosmic microwave background radiation (CMBR), losing energy exponentially with the distance [1-3]. The CMBR would not be a product of the BB, but the resultant product of the processes of emission and absorption of thermal radiation in the universe. That is, the CMBR would be the thermal radiation produced by the bodies of the universe. [1-3] And in the case of the radio sources (quasars, radio galaxies, etc. that are sources of electromagnetic radio waves), there is, in addition, an intrinsic redshift -the excess of redshift of the radio sources- in which the light scatters radio waves [1-3]. Therefore, as the redshift would not be produced by any expansion of the space, the universe would be static [1-3]. It would also be flat and infinite.

2. The redshift.

It is assumed that all body with a temperature greater than *0 K* emits electromagnetic radiation in the form of thermal radiation [4] (p. 338); consequently, we may suppose that all body emits this type of radiation [5] (p. 261). As in addition, in a thermal equilibrium, all body emits the same quantity of thermal radiation than absorbs, and vice versa, all body absorbs the same quantity of thermal radiation than emits, [4] (p. 345) [5] (p. 261) we conclude that there will always be thermal radiation in the intergalactic space (IGS). From the works of Eddington, Regener and Nernst on the temperature of the IGS, that use the law of Stefan-Boltzmann (which is characteristic of a black body radiation), [6] we deduce that these processes of emission and absorption of thermal radiation produce a thermal equilibrium at a temperature of *2.7 K*, which corresponds to the temperature of the CMBR [6]. Therefore, we conclude, finally, that the thermal radiation inside of the IGS is the CMBR.

Now, we suppose that the light emitted by the cosmic light sources (stars, quasars, galaxies) when travels in the IGS interacts with the CMBR losing energy. Specifically, the light opens a linear path (without any change of direction) through the microwaves of the CMBR scattering them. We postulate that the light loses energy in this scattering process following an exponential law, that is, following a so-called "tired light" mechanism. Zwicky coined the concept, later called tired light, of that the light would lose energy (by some type of mechanical interaction) in its journey [7].

In effect, our mechanism would be similar, from a quantum mechanical point of view, to the radiation loss by fast electrons, where the mean energy $\langle E \rangle$ of an electron, with initial energy E_0, after having traversed a length x of the medium, is [8] (p. 74) [9] (p. 39)

$$\langle E \rangle = E_0 e^{-x/X_0} \tag{2.1}$$

X_0 being the so-called radiation length, which is inversely proportional to the density of atoms of the medium. The equation (2.1) is obtained from the framework of reference of the electron and considering that this one scatters electromagnetic fields. The fast electron sees the electromagnetic fields of the atoms of the medium like virtual photons because its supposed relative speed is $v \cong c$ (where c is the speed of the light in the vacuum). The electron loses energy when scatters a virtual photon because suffers an inverse Compton effect.

Now, by analogy, we can deduce that (in place of the electron) our visible light photon (acting like a particle of "effective mass" hf/c^2, where h is the Planck's constant and f the frequency) scatters (in place of streams of virtual photons) microwaves of the CMBR losing energy following an exponential law similar to (2.1) [2-3]:

$$E(d) = E(0)e^{-d/\delta} \tag{2.2}$$

where

$$d = ct \tag{2.3}$$

is the distance traversed inside of the IGS and t the time, and

$$\delta = \frac{k_\delta}{u} \tag{2.4}$$

is a radiation length, k_δ being a constant of proportionality to set and

$$u = nhf_{cmbr} \tag{2.5}$$

the energy density of the CMBR, where $n = N/V$ is the number of microwaves per unit of volume and f_{cmbr} their frequency.

u is related with the absolute temperature T by the formula [10]:

$$u = \frac{4\sigma}{c} T^4 \qquad (2.6)$$

where σ is the constant of Stefan-Boltzmann.

From (2.2), as $E = hf$, then

$$f(d) = f(0) e^{-d/\delta} \qquad (2.7)$$

and

$$z = \frac{f(0) - f(d)}{f(d)} = e^{d/\delta} - 1 \qquad (2.8)$$

z being the redshift parameter.

And the cosmological redshift increases exponentially with the distance.

For $d/\delta << 1$ ($e^{d/\delta} = 1 + d/\delta$)

$$z = \frac{d}{\delta} \qquad (2.9)$$

and $z << 1$. And comparing with the redshift of Hubble [11] (p. 486)

$$z = \frac{v_r}{c} = \frac{H}{c} d \qquad (2.10)$$

where (2.10) and H are the law and the constant of Hubble, respectively, and $v_r = Hd$ is the (supposed) speed of recession; we have that

$$\delta = \frac{c}{H} \qquad (2.11)$$

Note that from (2.4) and (2.11)

$$H = \frac{c}{k_\delta} u \qquad (2.12)$$

Note also that substituting (2.11) into (2.8), and since $f(0) = f_e$ and $f(d) = f_o$, where f_e and f_o are the light frequencies emitted and observed, respectively; we obtain the typical redshift expression of the tired light mechanism

$$z = \frac{f_e - f_o}{f_o} = e^{(H/c)d} - 1 \qquad (2.13)$$

All this is in favor of a static universe and rules out the explanation of the cosmological redshift by Doppler effect. Note also that it is not needed any dark energy, for a supposed accelerated expansion of the universe, to explain an exponential redshift.

And note, in addition, that with (2.8), it is also explained the intrinsic redshift, in which the light scatters radio waves, and where now *d* would be the distance traversed by the light inside of the radio source and *u*, in (2.4), the energy density of the radio waves inside of the radio source. [1-3]

3. A static, flat and infinite universe.

In a Cartesian context, the square of the space-time interval *s* would be

$$ds^2 = c^2dt^2 - (dx^2 + dy^2 + dz^2) = c^2dt^2 - dr^2 \tag{3.1}$$

x, *y* and *z* being the space coordinates and *r* the radius of the universe.

From $ds^2 = 0$ (light-like interval), the speed of the light is

$$c = \frac{dr}{dt} \tag{3.2}$$

Now, from [12] (pp. 105-106), we consider two photons emitted from the point r_0 in the times t_0 and $t_0 + dt_0$ and that arrive at the point *r* in the times *t* and $t + dt$, respectively. Then, for the photon emitted at the moment t_0 and that arrives at the moment *t*, we would have that

$$\int_{t_0}^{t} \frac{dt}{r(t)} = \int_{r_0}^{r} \frac{dr}{cr(t)} = \frac{1}{c}\left[\ln r\right]_{r_0}^{r} = \frac{1}{c}\left(\ln r - \ln r_0\right) = \frac{1}{c}\ln\frac{r}{r_0} \tag{3.3}$$

Also, for the photon emitted at the moment $t_0 + dt_0$ and that arrives at the moment $t + dt$, we have that

$$\int_{t_0+dt_0}^{t+dt} \frac{dt}{r(t)} = \int_{r_0+dr_0}^{r+dr} \frac{dr}{cr(t)} = \frac{1}{c}\ln\frac{r+dr}{r_0+dr_0} \cong \frac{1}{c}\ln\frac{r}{r_0} \tag{3.4}$$

for a very small speed of recession: since $dr_0 = v_r dt_0$ and $dr = v_r dt$ are also very small, so $r_0 + dr_0 \cong r_0$ and $r + dr \cong r$. Consequently,

$$\int_{t_0}^{t} \frac{dt}{r(t)} = \int_{t_0+dt_0}^{t+dt} \frac{dt}{r(t)}$$

$$F(t) - F(t_0) = F(t + dt) - F(t_0 + dt_0)$$

$$F(t_0 + dt_0) - F(t_0) = F(t + dt) - F(t)$$

$$dt_0F'(t_0) = dtF'(t)$$

$$\frac{dt_0}{r(t_0)} = \frac{dt}{r(t)}$$

And using the light angular frequencies, $\omega_0 = d\theta/dt_0$ and $\omega = d\theta/dt$, where θ is the angle, we have

$$\frac{d\theta}{r(t_0)\omega_0} = \frac{d\theta}{r(t)\omega}$$

$$r(t_0)\omega_0 = r(t)\omega$$

$$\omega_0 = \frac{r(t)}{r(t_0)}\omega \tag{3.5}$$

Hence, the light angular frequency emitted $\omega_0 = 2\pi f_0$ is not equal to the light angular frequency observed $\omega = 2\pi f$, which is a consequence of considering that the radius of the universe varies with the time: if $r(t_0) = r(t)$, being $t_0 \neq t$, then, from (3.5), $\omega_0 = \omega$. Note in addition that if $dt_0 = dt$, being $t_0 \neq t$, then also it is $\omega_0 = d\theta/dt_0 = d\theta/dt = \omega$. Note that in a static universe, it is $v_r = 0$, then, being $t_0 \neq t$, they are $r(t_0) = r(t)$, $dt_0 = dt$ and $\omega_0 = \omega$, and that for it the observed redshift is explained as above in §2. Now, for the light redshift parameter, we have that

$$z = \frac{\omega_0 - \omega}{\omega} = \frac{\omega_0}{\omega} - 1 = \frac{r(t)}{r(t_0)} - 1 \tag{3.6}$$

And $z > 0$ (redshift) if $r(t) > r(t_0)$. But also, $z > 0$ if $\omega_0 > \omega$, that is, if $hf_0 > hf$, as we have showed above in §2.

From (3.5), following [11] (p. 486), as $t \geq t_0$, we may put $\omega_0/\omega = r(t)/r(t_0)$ in the form $\omega_0/\omega = r(t + \Delta t)/r(t)$, hence

$$\frac{\omega_0}{\omega} = \frac{r(t+\Delta t)}{r(t)} = 1 + \frac{dr(t)}{r(t)dt}\Delta t = 1 + H\frac{\Delta r}{c}$$

where $H = dr(t)/r(t)dt$ would be the Hubble's constant and $\Delta r = c\Delta t$. And

$$z = \frac{\omega_0}{\omega} - 1 = \frac{H}{c}\Delta r \tag{3.7}$$

which is the Hubble's law, with $v_r = H\Delta r$ being the speed of recession (and then $z = v_r/c$), as showed above in §2. Note that as H is a constant and, from (3.4), v_r must be very small, then Δr must also be very small, that is, that (3.7) is valid only for $z << 1$, as in (2.9) with (2.11).

For a flat universe, the radius is infinite, $r(t) = \infty$, then (3.6) is undefined and $H = dr(t)/\infty dt = 0$ and, from (3.7), there would not be any redshift, $z = 0$, which is contrary to the observations; but (3.1) is defined because $dr(t)$ is defined, and we may apply the Newton's mechanics, with the redshift explained by (2.8) and the arguments expressed in §2, in a static and flat universe. Then, for any particle in the surface of the universe, we have [13-14]

$$E = T + V = \frac{1}{2} m \left(\frac{dr}{dt} \right)^2 - G \frac{Mm}{r} \tag{3.8}$$

where E, T and V are the total, kinetic and gravitational potential energies of the particle, respectively, m its mass, G the Newton's gravitational constant, and M and r the mass and radius of the universe, respectively. For a homogeneous and isotropic universe

$$M = \rho \frac{4}{3} \pi r^3 \tag{3.9}$$

ρ being the mass density. Substituting (3.9) into (3.8), we obtain that

$$\left(\frac{dr}{rdt} \right)^2 = \frac{8\pi G \rho}{3} - \frac{k}{r^2} \tag{3.10}$$

$k = -2E/m$ being the curvature constant.

If $T = -V$, where $T > 0$ and $V < 0$, then $E = T + V = 0$, $k = -2E/m = 0$ (flat surface) and $\rho = \frac{3}{8\pi G} \left(\frac{dr}{rdt} \right)^2 = \rho_c$, where $\rho_c = 10^{-29}\ g/cm^3$ [11] (p. 487) is the so-called critical mass density. If $r = \infty$ (flat surface), $\rho = \frac{3}{8\pi G} \left(\frac{dr}{\infty dt} \right)^2 = 0$ (or $\rho \cong \rho_c$).

In addition, if U is the Newtonian energy of the universe, then $U = \sum E = \sum 0 = 0$. And as $\sum T + \sum V = \sum (T + V) = \sum E = 0$, then $\sum T = -\sum V$, where $\sum T > 0$ and $\sum V < 0$, or generalizing, the positive energy creates an equal negative gravitational energy. Also, if $\vec{P}$ and $\vec{L}$ are the linear and angular momenta of the universe and $\vec{p}$ and $\vec{\ell}$ the linear and angular momenta of the particle, respectively, then $\vec{P} = \sum \vec{p} = 0$, since all way has two opposite directions, and $\vec{L} = \sum \vec{\ell} = 0$, since all rotation is clockwise or its contrary. In an infinite universe: infinite surface and infinite number of particles, the domain of the sums would be: $1, 2, 3, \ldots, \infty$.

Hence, in a static, flat and infinite universe, it would be: $k = 0$, $r = \infty$, $\rho = \rho_c$, $U = 0$, $P = 0$, $L = 0$ and $T_{IGS} = T_{CMBR} = 2.7\ K$ (which is the temperature of thermal equilibrium of the universe). Therefore, and in general, all the physical magnitudes of this universe are zero or close to cero (except its infinite radius).

On the other hand, this universe would be formed, in equal parts, by gamma radiation and by matter and antimatter [15], since: 1) $\gamma = \bar{\gamma}$. 2) $\gamma + \gamma \rightarrow e^+ + e^-$, and vice versa, $e^+ + e^-$

$\rightarrow \gamma + \gamma$. 3) $e^+ + e^- \rightarrow p + \bar{p}$, and vice versa, $p + \bar{p} \rightarrow e^+ + e^-$ [9] (p. 209). 4) p and e^- form a hydrogen atom and $\bar{p}$ and e^+ an antihydrogen antiatom. 5) $p + e^- \rightarrow n + \nu$ and $\bar{p} + e^+ \rightarrow \bar{n} + \bar{\nu}$. 6) $n \rightarrow p + e^- + \bar{\nu}$ and $\bar{n} \rightarrow \bar{p} + e^+ + \nu$. 7) p and n form nuclei of atoms and $\bar{p}$ and $\bar{n}$ form antinuclei of antiatoms. And the different reactions (or events) are governed by the corresponding laws. The particles mentioned: γ, $\bar{\gamma}$, e^-, e^+, p, $\bar{p}$, n, $\bar{n}$, ν and $\bar{\nu}$, correspond, respectively, to the gamma photon, antigamma photon, electron, positron (or antielectron), proton, antiproton, neutron, antineutron, neutrino and antineutrino. Hence, the radiation and the matter would be transformed into each other in an endless cycle.

Finally, indicate that the gravitational potential energy of the test particle considered above: $V = -GMm/r$, would be equal to $-mc^2$. This is obtained as follows [16]: $V = m\varphi$, where $\varphi = \int_0^R -G\rho 4\pi r^2 dr/r = -2\pi G\rho R^2$ is the gravitational potential and $R = c/H$ the Hubble radius of the universe. For $\rho = \rho_c = (3/8\pi G)(dr(t)/r(t)dt)^2 = 3H^2/8\pi G$, it is $\varphi = -(3/4)c^2$, then $V = m\varphi = -(3/4)mc^2 \approx -mc^2$. Hence, the positive energy $E_0 = mc^2$, which is the rest energy of the test particle, creates an equal negative gravitational energy $V = -mc^2 = -GMm/r$, which is transformed into the kinetic energy $T = (1/2)m(dr/dt)^2$. Now, the energy of the universe would be $U = Mc^2 - GM^2/r$, and $U = 0$ for $M = rc^2/G$ or $Mc^2 = GM^2/r$, that is, that the positive energy Mc^2 creates an equal negative gravitational energy $-GM^2/r$. Note that the equation $E_0 = mc^2$ was obtained numerically by Preston in 1875, implicitly by Poincaré in 1900, exactly by De Pretto in 1903 and 1904, approximately by Hasenöhrl in 1904, by Einstein in 1905 but as $\Delta m = L/c^2$, where L would be the energy radiated by the body and Δm the corresponding decrease of its mass and considering finally that the speed of the body would be $v^2 << c^2$, which is used in non-relativistic approach; and exactly and using the special relativity (SR) by Planck in 1907. For another deduction of the mass-energy relation [17], see the appendix below. Note also that the SR was first developed by Lorentz and Poincaré before 1905, when Einstein formulates his own SR.

4. The BB theory.

In the general relativity (GR) of Einstein, which is developed in a non-Cartesian context because it is supposed that the matter and the energy curve the space-time, there are four models: the static or Einstein model and three non-static or BB models [13-14]. None of them can explain the intrinsic redshift. The Einstein model, that needs the cosmological constant for repulsion, neither can explain the cosmological redshift, and as it is finite (that is, closed) it has the entropy problem: the entropy of a closed (or isolated) system increases. The three BB models are: closed ($v_r < v_e$, $\rho > \rho_c$), flat ($v_r = v_e$, $\rho = \rho_c$) and open ($v_r > v_e$, $\rho < \rho_c$), where v_e would be the escape velocity of the universe. They explain the cosmological redshift by Doppler effect. The closed and flat models can explain the cosmological redshift for small distances only: low or Hubble's redshift ($z << 1$). And the closed model has also the entropy problem. The open model can explain the cosmological redshift for small or large distances (high redshift), but for this last case, it is supposed the existence of an unobserved dark energy for repulsion (recovering the cosmological constant, not needed before now in any BB model and considered a priori a mistake). In our model, §2 and §3, the cosmological and intrinsic redshifts are exponential and explain the redshift for any small or large distance.

I think that the GR -and also the SR- and the BB theory (with or without inflation) are false [18]. The mass and the energy do not curve the space-time, but they polarize the vacuum space producing the gravity [19]. This together with the cosmological and intrinsic redshifts rules out the GR and the BB theories. No relative speed can contract the length, dilate the time or increase the mass [20]. This invalidate the SR. The inflation process is founded on quantum field (QF) theories based on the vacuum energy [21] and the interchange of carriers of the forces. I am also contrary to these theories [18].

5. Conclusion.

The universe would be static because the cosmological and intrinsic redshifts are not produced by Doppler effect due to an expansion of the space of the universe, but both redshifts are produced by the scattering of electromagnetic waves. There is an obvious analogy between the radiation loss by fast electrons ($v \cong c$) and a tired light mechanism, and that therefore the light loses energy when scatters the microwaves of the CMBR inside of the IGS and the radio waves inside of the quasars and the radio galaxies, and that this loss of energy is exponential. The universe would also be flat (infinite radius, and very low mass density) and infinite, because is gravitational potential energy is transformed into kinetic energy. It is in thermal equilibrium at $2.7\ K$. And the radiation and the matter would be transformed into each other in an endless cycle. If the universe is static, we can assume that it has always existed (which is in accordance with the energy conservation law that establishes that the energy, by principle, cannot be created or destroyed, only transformed) and then there would be no beginning and no end.

Appendix (The Mass-Energy Relation)

The mass-energy relation applies, but only in the form: $E_0 = m_0c^2$. We can deduce it without using the SR as follows: when an atom absorbs a photon, the energy is converted into matter, that is, into mass. Thus, an atom at rest of mass m_0 recoils with a speed v when it absorbs a photon of an energy E that corresponds to a mass μ. The momentum of the photon would be $p = F\tau = F\lambda/c = W/c = E/c$, where F is the force exerted by the photon, $\tau = \lambda/c$ the duration of the event, λ the wavelength, c the speed of the light in the vacuum and $W = F\lambda$ the work done by the photon (the energy E is converted into the work W during the event). (Note that as $E = hf$ and $c = \lambda f$, then $p = E/c = hf/\lambda f = h/\lambda$, where h is the Planck's constant and f the frequency; and also that $\tau = \lambda/c = \lambda/\lambda f = 1/f$). From the conservation of the momentum, $(p_1 + p_2)_{final} = (p_1 + p_2)_{initial}$, where the subscript 1 is for the atom and the 2 for the photon; we would have that $mv + 0 = 0 + E/c$, or $mv = E/c = (E/c^2)c = \mu c$, where m is the moving mass of the atom and $\mu = E/c^2 = hf/c^2$ the so-called "effective mass" of the photon. From the conservation of the energy, $(E_1 + E_2)_{final} = (E_1 + E_2)_{initial}$, we would have that $E_a + 0 = E_{0a} + \mu c^2$, $E_a - E_{0a} = \mu c^2$, and as $\mu = m - m_0$, then $E_a = mc^2$, $E_{0a} = m_0c^2$ and $T_a = \mu c^2$, where E_a, E_{0a} and T_a are, respectively, the total, rest and kinetic energies of the atom.

If we do $m = \gamma m_0$, then $\gamma m_0 = m = m_0 + \mu$, $(\gamma - 1)m_0 = \mu$, $(\gamma - 1)m_0c = \mu c = mv = \gamma m_0v$, $(\gamma - 1)c = \gamma v$ and $\gamma = (1 - v/c)^{-1}$. Therefore, for a body of rest and moving masses m_0 and m its energy would be $E = mc^2 = \gamma m_0c^2 = (1 - v/c)^{-1}m_0c^2$, and for $v << c$, $E \approx m_0c^2 + m_0vc + m_0v^2$, which is a balanced expression but erroneous. In the SR, it is $\gamma = (1 - v^2/c^2)^{-1/2}$

and $E = mc^2 = \gamma m_0c^2 = (1 - v^2/c^2)^{-1/2}m_0c^2$, and for $v^2 << c^2$, $E \cong m_0c^2 + (1/2)m_0v^2$, which is correct because $(1/2)m_0v^2$ is the Newton's kinetic energy. It seems that from the absorption process we cannot obtain the correct value for the gamma factor, and that we need the SR.

However, this is not true because $m = \gamma m_0$ is a fallacy since it supposes the conversion of energy into matter in a simple process of absorption of a photon. In this process, the photon energy (which is only kinetic energy: $E = hf = pc$) is transformed in kinetic energy of the atom. Therefore, we have obtained only that $E_{0a} = m_0c^2$, and that $E_a = E_{0a} + T_a = m_0c^2 + hf$, that is, the total energy is the rest energy plus the kinetic energy.

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