A New Method to Calculate The Temperature of MBR T_{urm} = 2.7k

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Preface: Author demonstrated already that our Universe has been a real Schwarzschild black hole (BH) in Reference [1], and the expansive law of standard model of our universal "Big Bang" could much better be in accordance with the expansive law of our Universe as a Cosmo-BH. Then, we may apply the new formulas of BH-theory proposed by author and the standard model of our universal "Big Bang" to find out the temperature of MBR (Microwave background Radiations) T_{urm} = 2.7k.
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《1》。The evolution of standard model of our universal "Big Bang"

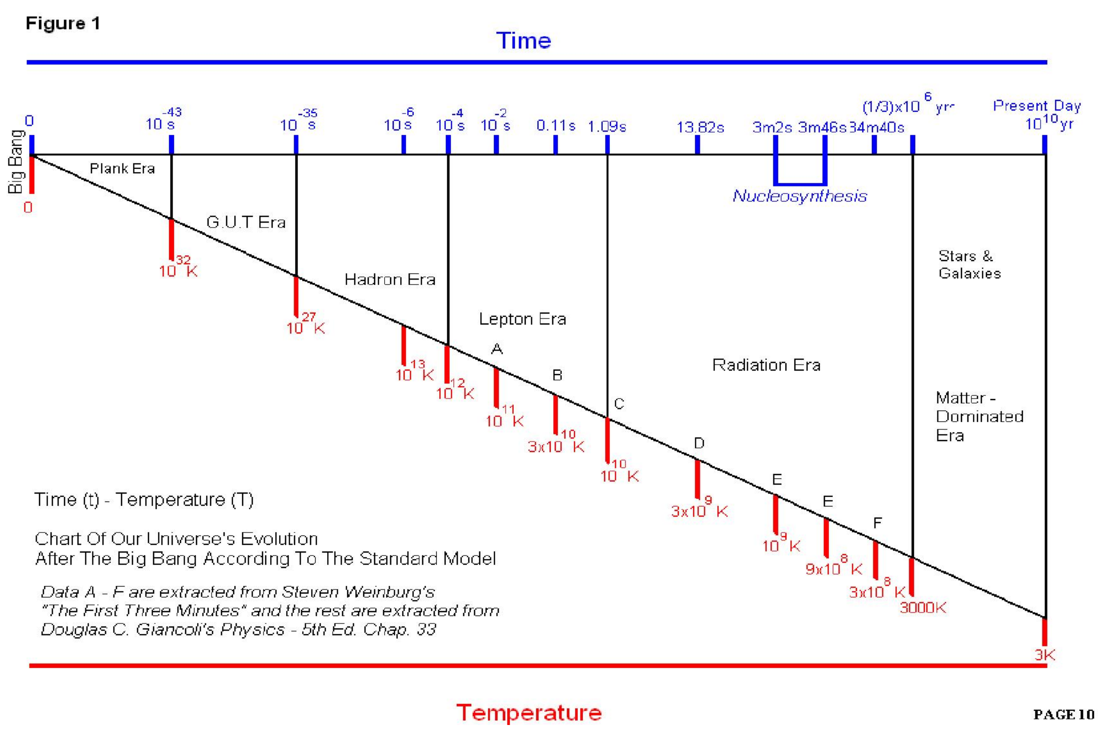

Figure 1. The relationship between T and t in the evolution of standard model of our universal "Big Bang" [10]
T----the radiation tempertature of our Universe; t----the characteristic time;

Figure 1 shows the relationship between T and t in the evolution of standard model of our universal "Big Bang". Data in figure 1 are originated from References [2] and [3], t----the characteristic time of our Universe, T----the universal (radiation energy) temperature. The relationship between t and T can be expressed with formulas (1a) and (1b).

From the beginning of 'the Big Bang' time $t = 10^{-44}$s to the end of Radiation Era, i.e, **t ≈ 385000 yrs,** the formula may be:

$\mathbf{Tt^{1/2} = k_1}$ [3][4] **(1a)**

From t ≈ 385000yrs to the present of $\mathbf{t = 1.37\times10^{10}}$ **yrs,** it was the Matter- dominated Era, the formula may be:

$\mathbf{Tt^{2/3} = k_2}$ [3][4] **(1b)**

It must be pointed out, formulas (1a) and (1b) stemmed from observational data; they had some error, (1a) was more precise. However, the error of (1b) had much more error, because in the 'matter-nominated Era', due to matter -particles separating from radiation energy, the temperature of radiation was lowered much more than the particles'. Besides, the contract of large particles must produce stars and nuclear fusion, and emit a large amount of heat into universal space. Therefore, it would be very difficult to estimate and measure precisely the radiation temperature T in the Universe.

《2》。Our Universe would have been a real Schwarzschild (gravitational) Cosmo-BH, so, the laws of its birth、growth、decline and death could completely accord with the laws of BHs.

1*; In References [1], i.e, <The The Originative Blackhole- Cosmogony>**,** author completed the BH-theory; proposed many new formulas. It was strictly proved that our Universe would have been a real Schwarzschild (gravitational) BH; proved that our Universe was born from countless Planck particles--$m_p = M_{bm}$— virtual minimum BH; and proved that the expansion of our Universe was just the expansions caused from the combinations by those countless $m_p = M_{bm}$. [1]

2*; Some general formulas on the radius R_b of any BH

$\mathbf{M_bT_b = (C^3/4G) \times (h/2\pi\kappa) \approx 10^{27} gk}$ [6] (2a)

$\mathbf{m_{ss} = \kappa T_b / C^2}$ [4] **(2b)**

$\mathbf{m_{ss} M_b = hC/8\pi G = 1.187\times10^{--10} g^2}$ [1] **(2c)**

$\mathbf{GM_b / R_b = C^2/2}$ [1][4] (2d)

$\mathbf{m_{ss} = M_{bm} = (hC/8\pi G)^{1/2} = m_p = 1.09\times10^{-5} g}$ [5] [1] **(2e)**

Data of parameters of $m_p = M_{bm}$,

$R_{bm} \equiv L_p$ [5] $\equiv (Gh/2\pi C^3)^{1/2} \equiv 1.61\times10^{-33}$cm (2f)

$T_{bm} \equiv T_p$ [5] $\equiv 0.71\times 10^{32}$k (2g)

(2a) is the famous Hawking formula of temperature T_b on R_b; (2b) is the energy transformation on R_b of Hawking radiation m_{ss}.

(2c) is a new geneeal formula on R_b newly derived by author from (2a) and (2b), it let BH theory go to perfection. (2d) is Schwarzschild special solution to the Equation of the General Theory of Relativity, it defined the necessary condition of BH existence.

$\mathbf{M_b}$ **--** mass of a BH, $\mathbf{R_b}$**--**radius of the Event Horizon of a BH, $\mathbf{T_b}$-- temperature on Event Horizon R_b of a BH, $\mathbf{m_{ss}}$ **--** mass of a Hawking quantum radiation, **h**—Planck constant = 6.63×10^{-27} gcm²/s , **C**--light speed =3×10^{10}cm/s, **G--** gravitational constant = $6.67 \times10^{-8} cm^3/s^2 {*} g$, **κ**—Bolzmann constant =$1.38\times 10^{-16} g{*}cm^2/s^2{*}k$, $\mathbf{m_p}$**--**Planck participle, $\mathbf{L_p}$-- Planck length, $\mathbf{T_p}$---Planck temperature, $\mathbf{M_{bm}}$**—** mass of virtual minimum BH, $L_p = R_{bm}$ —Planck length; $T_p = T_{bm}$—Planck temperature; Compton time t_c = Schwarzschild time t_{sbm} , so,

$\mathbf{t_{sbm}} = R_{bm}/C = 1.61\times10^{--33}/3\times10^{10} =$

$\mathbf{0.537\times10^{-43}s,}$ (2h)

$\mathbf{_{bm} = 0.6\times10^{93} g/cm^3}$ **(2i)**

3*; The parameters of our Universe as a Cosmo-BH, [1]

Owing to the age $A_u = 1.37\times10^{10}$yrs of our Universe measured precisely by modern obcervational instrument, then, the radius $\mathbf{R_u}$ of our Universe as a BH, $R_u = CA_u$, and from (2d),

$\mathbf{R_u = R_b = CA_u = 1.3\times10^{28} cm;}$ **(2j)**

$\mathbf{M_u = M_b = 8.8\times10^{55} g \approx 10^{56} g;}$ **(2j)**

$\mathbf{\rho_u} = 3/(8\pi G A_u^2) = 0.958\times10^{--29} g/cm^3$ **(2j)**

Owing to M_u originated from $N_u \times m_p$, and $m_p = M_{bm} =$ $\mathbf{1.09\times10^{-5} g}$, so, $N_u = M_u/m_p$.

$\mathbf{N_u = M_u/m_p = 8.8\times10^{55} g/1.09\times10^{-5} g = 8\times10^{60}} \approx 10^{61}$ **(2k)**

Also $\mathbf{N_u = R_u/R_{bm} = 1.3\times10^{28}}/1.61\times10^{-33} = \mathbf{8\times 10^{60}} \approx 10^{61}$ **(2l)**

(2k) = (2l) shows our Universe must be a real BH and in accordance with formula (2d).

《3》。The heat history of our Universe[5] **. This paragraph is wholly quoted from p.56 of § 3.6 of References[5], the demonstrations are omitted.**

About 35 minutes later from the 'Big Bang', our Universe could go on a stably expansive process in accordance with Hubble law, and the radiation temperature T of our universe would continously decrease along with its expansion. Before the end of Radiation Era, the radiation (energy) composition and matter composition were coupled together through Compton effect; then, the whole Universe had the same temperature T, because it was in the condition of heat balance, and was not daiphanous. However, After the end of Radiation Era, when the temperature T of the Universe lowered into T ≈ **4000k, protons and electrons would integrate to hydrogens, matter particles could separate from radiations, and both had different temoerature. The whole Universe became daiphphanous.** [5]

Let T_r be the radiation temperature, and T_m be the temperature of matter particles, after the Universe expanded to size R, then,

$\mathbf{T_r \propto 1/R}$ **(3a)**

$\mathbf{T_m \propto 1/R^2}$ **(3b)**

It is said, if their mixture had a same temperature before, after the Universe expanded to some size R, then $\mathbf{T_r > T_m}$.

《4》。Finding the radiation temperature T_r= 4720k at the Universal age of t_r = 385000 yrs, i.e., at the end of 'Radiation Era'. The real temperature T_{urm} of Microwave background Radiations (MBR) at present is T_{urm}= 2.7k;

1*; From **(1a)**, $\mathbf{Tt^{1/2} = k_1}$,

$\therefore T_{bm}(\mathbf{t_{sbm}})^{1/2} = \mathbf{T_r(t_r)^{1/2}}$, and,

$\mathbf{T_r} = T_{bm}(t_{sbm}/t_r)^{1/2} = 0.71\times10^{32}k(0.537\times10^{-43}/385000\times3.156\times10^7)^{1/2} = \mathbf{4720k}$ **(4a)**

2*; From t_r =385000yrs to A_u = 1.37×10^10 yrs, applying **(1b) in the whole matter -dominated Era up to the present, get a calculated temperature of MBR T_{ucm},**

From **(1b),** $T_r t_r^{2/3} = \mathbf{T_{ucm} A_u}^{2/3}$;

$4700\,(385000)^{2/3} = T_{ucm}\,(1.37\times10^{10})^{2/3}$;

$\therefore$ <u>T_{ucm1}</u> $= 4720(385000/1.37\times10^{10})^{\mathbf{2/3=0.667}} = 4720(2.8\times10^{-5})^{2/3} =$ <u>**4.36k**</u> **(4b)**

Owing to T_{ucm1}(4.36k) > T_{urm} (2.7k); it can be seen, the error of **T_{ucm1}(4.36k) is too bigger than T_{urm} (2.7k),** it does not tally with the actual situation. **For finding the precise temperature of MBR T_{ucm2}, it is needed to change the exponential number of (1b),**

Let $\mathbf{T_{ucm2}} = 4720(385000/1.37\times10^{10})^{\mathbf{0.712}} =$ <u>**2.71k ,**</u> **so, (1b) of** $T_r t_r^{2/3\,=\,0.667} = k_2$ should be changed into (4c),

$\therefore \mathbf{T_r t_r^{0.712} = k_2}$ <u>**(4c)**</u>

Above calculated results show that (4b), $T_r t_r^{2/3=0.667} = k_2$ is not actual, **only <u>(4c) is more precise</u>. <u>However, for finding the precise T_{urm}</u> theoretically, a new method should be adopted in 3*and 4* paragraphs below.**

It is known that (1b) expresses the common expansions of radiation energy and matter particles together in the Matter-dominated Era. However, according to (3a) and (3b), to radiation energy, $\mathbf{Rt = k_3}$, but the exponential number of (4c) is bigger than (4b)'s, i. e.. 0.712 > 0.667. Then, (4c) is more precise than (4b) shows in the Matter-dominated Era, radiation energy should have more expansion.

At the end of radiation Era, the space (=1/2R_R) occupied by radiation energy should be about equal to the space (1/2R_R) of matter particles, but from that time to the present, from R_R to R_u, the expansion of matter particles should be much less than R_u/2, then, the expansion of radiation energy must be much more than R_u/2. **The final result may let T_{ucm2}(2.71k) < T_{ucm1}(<u>4.36k</u>).**

3*; Finding the whole size R_R (radius) of the Universe at t_r=385000 yrs of the end of radiation Era. Finding a 'mini BH'--M_r at t_r=385000 yrs, radius **R_r of** M_r, numbers **N_r of** M_r, density **$_r$ of M_r.**

From (2j), M_u = <u>8.8×10^55 g</u>≈10^56 g, R_u = 1.3×10^28 cm; N_u = 10^61 Planck particles m_p=M_{bm}=1.09×10^−5 g are known numbers. If let m_p=M_{bm} =1.09×10^−5 g be called as 'mini BH' in the Planck Era, then, in the expansive process of 1.37×10^10 yrs, our Universe had different size and numbers of 'mini BHs' at every instant to form the whole Universe M_u. Then,

$\mathbf{R_r} = Ct_r = 3\times10^{10}\times385000\times3.156\times10^7 = \mathbf{3.645\times10^{23}cm;}$

$\mathbf{M_r} = C^2 R_r/2G = \mathbf{2.46\times10^{51}g;}$

$\mathbf{N_r = M_u}/M_r = \mathbf{10^{56}/2.46\times10^{51} = 3.6\times10^4}$

$_r = 3M_r/4\pi R_r^3 = \mathbf{1.2\times10^{-20}g/cm^3;}$

Owing to the density $_r$ of M_r 'mini BH' should just be the same density of M_u at that time, so, R_R is,

$\mathbf{R_R} = (3M_u/4\pi\ _r)^{1/3} = \mathbf{1.26\times10^{25}cm;}$ **(4d)**

4*; Finding the temperature T_{ucm} of MBR at present,

From above mentioned, at t_r = 385000 yrs of the end of Radiation Era, the space of radiation energy = the space of matter particles = R_R/2. From (2d), $M_b \propto R_b$. From (3a), $T_r \propto 1/R$. So, $T_r R$ = Const。Suppose the expansoin of matter particles may be neglected in the period from t_r to the present, then, the expansion of radiation energy would be from R_R/2 to present R_u = 1.3×10^28 cm. (**the space** R_R/2 of matter particles may be neglected, because $R_R/2 << R_u/2$)。Thus, from (3a), T_{ucm} can be got。

<u>$\therefore T_{ucm}$</u> $= T_r R_R/2R_u = 4720\times0.63\times10^{25}/1.3\times10^{28} =$ <u>**2.3k**</u> **(4e)**

<u>Above calculated temperature of MBR T_{ucm} (2.3k) is smaller than the actual temperature of MBR T_{urm}(2.7k), i.e., $T_{ucm} < T_{urm}$</u>. The actual reasons may be: 1; the matter particles could really have some small expansion due to the universal pressure and temoerature lowered. 2; A large amount of heat caused from the nuclear fusion in stars, it would increase in some temperature of MBR.

《5》。Some conjectures;

1*; On the end time of Radiation Era t_r=385000 yrs , the radiation temperature T_r = 4720k. From (2b), $m_{ss} = \kappa T_b/C^2$, find mass m_{ne} of corresponding particles,

$\mathbf{m_{ne}} = \kappa T_r\ /C^2 = 1.38\times10^{-16}\times4720/9\times10^{20} = \mathbf{7.23\times10^{-34}g}$ **(5a)**

What could be m_{ne} = 7.23×10^−34 g? the upper limit of a electrical neutrino $_e$ = 9.1×10^−33 g , the corresponding mass of a photon =4.2×10^−33 g, mass of an electron = 9.11× 10^−28 g, the upper limit of a μ-neutrino = 4.8× 10^−28 g。It can be seen, **<u>m_{ne} should be the various neutrinos. They might be the smallest matter-particles in the Universe, and to couple with radiation before the end of Radiation</u>**

Era. After that time, radiations would unsolve the coupling with neutrino m_{ne}, then, the Universe could become daiphanous. Therefore, radiations would continuously expand up to the present to obey Hubble's law. On the other side, the matter particles could continuously contract up to form galaxies, stars, planets, etc. Owing to the nuclear fusion caused in stars, on some planets the intelligent living things could be evolved out.

2*; mass of a proton $m_p = 1.67\times10^{-24}$g, then,

$$m_p/m_{ne} = 1.67\times10^{-24}/7.23\times10^{-34}g = 2.3\times10^9 \approx 10^9 : 1 \quad \textbf{(5b)}$$

The proportion of $10^9 : 1$ may be just the same proportion of photon numbers /baryon numbers in the Universe.

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