

The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All (Part 1) Nov.-2005

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Abstract: 1. Our Universe was born from minimum gravitational Black Holes (its mass $\approx 10^{-5}$ g), but not from Singularity or Big Bang of Singularity. 2. No Singularity existed in star-formed Schwarzschild's black holes, a steady mini black hole (its mass $\approx 10^{15}$ g) of long lifetime would certainly exist inside as a core to obstruct the collapse of energy-matters to become Singularity. The steady mini black hole ($m_{om} \approx 10^{15}$ g) in black holes instead of Singularity called by General Theory of Relativity could resist the gravitational collapse.

Key Words: universe; singularity; big bang; black holes; cosmology; minimum gravitational black holes:

Part One. Our Universe was born out from minimum gravitational black holes (MGBHs, its mass $m_t \approx 10^{-5}$ g), but not born out from Singularity or "Big Bang" of Singularity

Introduction: In part one of this article, based on some general laws of astronomy, physics and many classical theories, the calculated results could prove that our present expanding Universe was impossible to be born from Singularity or from the Big Bang of Singularity but from the Big Crunch of pre-universe.

Once pre-universe collapsed to ($t = -10^{-43}$ s, $T = 10^{32}$ k) of Plank's Era (see figure 1 on next page), every particle and radiation simultaneously broke off its gravitational linkage between its closest neighbors and stopped their collapse at the state of no gravity. Furthermore, every particle at that moment would exactly become a minimum gravitational black hole (MGBH, its mass $m_t \approx 10^{-5}$ g), their presences jointly obstructed the pre-universe from collapsing into Singularity and directly led the disappearance of pre-universe at the border of Plank's Era. The strongest small bangs of every MGBH in whole pre-universe synchronously formed a so-called Big Bang. After that, the collisions and combinations of all newborn MGBHs would cause an "inflation" and formed the present expanding universe. It was the genesis of our present Universe. The whole process changed from the disappearance of old universe to the genesis of new universe in Plank's Era (Time) was not reversible. Other important conclusions of part one can be seen in conclusions of 7th paragraph. (< > number of reference).

1. The Laws and formulas of Our Universal Evolution

The laws of our universe's evolution can be simply and precisely described by two different methods, which

are based on the achievements of modern physics (GTR & particle physics) and astro-cosmology.

First, Figure 1 specifies the numerical values of time (t) corresponding to Temperature (T) at different time in our universe's evolution. <3><4><2>

Second, Formulas (1a) below precisely describes our universe's evolution relevant between Radiation Era and Big Bang in Figure (1), (from $t = 10^{-43}$ s to $t = 1/3 \times 10^6$ years). <3><4><6>

$$Tt^{1/2} = k_1, <4><6>, R = k_2 t^{1/2}, RT = k_3, R = k_4 \lambda \quad (1a)$$

t—Characteristic Expansion Time, T—Temperature of Radiations, R—Characteristic Size or Dimension of the Universe, λ --Wavelength of Radiation, k_1, k_2, k_3, k_4 —Constants,

Formula (1b) below precisely describes our universe's evolution relevant within the Matter-Dominated Era in Figure 1, (from $t = 1/3 \times 10^6$ years to the present). <3><4><6>

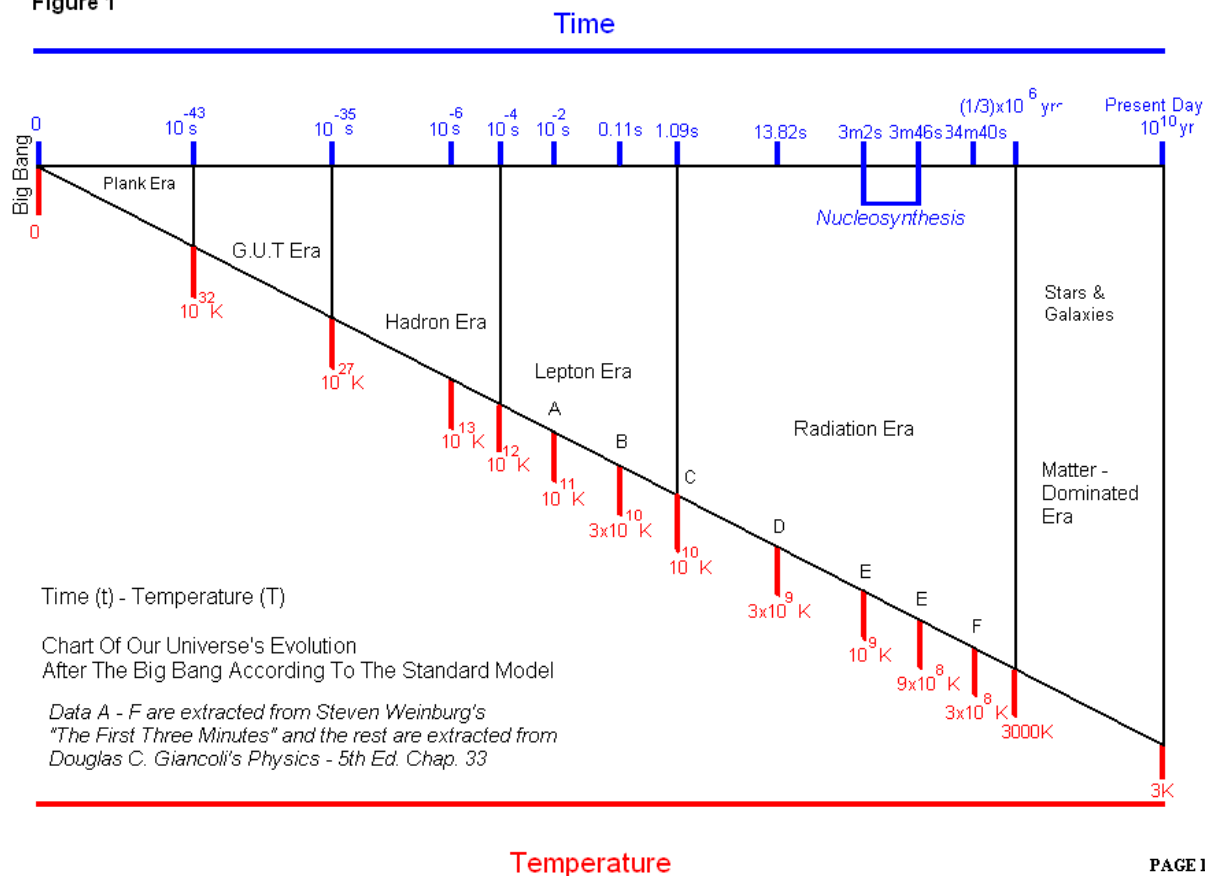
$$Tt^{2/3} = k_6, <4><6> R = k_7 t^{2/3}, RT = k_8, R = k_9 \lambda \quad (1b)$$

t – Characteristic Expansion Time, T – Temperature of the Radiation, R – Characteristic Size or Dimension of the Universe, λ – Wavelength of the Radiation, k_6, k_7, k_8, k_9 – Constants

$R = k_2 t^{1/2}$ in Formulas (1a) and $R = k_7 t^{2/3}$ in (1b) conform to Cosmological principle, GTR, Newton's Mechanics and modern observations, and can be derived from the law of energy conservation ($V^2/2 = GM/R$). (See appendix of "The First Three Minutes", <4> by S. Weinberg and 9th paragraph behind).

The numerical values of Figure 1 above and the calculated results from Formulas (1a) and (1b) are put on Chart 1 of Appendix A behind for comparison, both can almost obtain the same numerical values. Those values of the universe's evolution are the sources from different theories and different calculating methods. It confirms that the laws (1a) and (1b) of our universe's evolution are reliable and correct.

Figure 1



It has been unknown for modern sciences that, all problems in Plank's Era on the top of Figure 1 above, such as the micro structure, physical states and character, the genesis of our universe in that Era, have not been solved right now. This article will describe and prove how our universe was born out through "phase transition" in Plank's Era.

If a group of special numerical values taken from Appendix A replace k_n , Formulas (1a) and (1b) can be used to calculate out the values of some other physical parameters.

For example, in Matter-Dominated Era, the numerical values below calculated out from Formula (1b) accord with the values on Figure 1 above and Chart 1 on Appendix A behind.

$$R_1/R_2 = (t_1/t_2)^{2/3}, \quad R_1 T_1 = R_2 T_2, \quad R_1/R_2 = \lambda_1/\lambda_2$$

When $t_1 = (13 \times 10^9 \text{ yr})$ to $t_2 = (4.0 \times 10^5 \text{ yr})$, $t_1/t_2 \approx 32,500$, $(t_1/t_2)^{2/3} \approx 1,000$

$$R_1/R_2 = (12 \times 10^{27} \text{ cm}) / (12 \times 10^{24} \text{ cm}) \approx 1,000$$

$T_1/T_2 = 3\text{K} / 3,000\text{K} \approx 1/1,000$, $\lambda_1/\lambda_2 = 0.1\text{cm} / 10^{-4}\text{cm} \approx 1,000$,

From the beginnings of the Matter-Dominated Era to the present, the numerical values show that, as time (t) in the universe's evolution enlarged 32,500 times, its

size (R) enlarged 1,000 times, its radiant temperature (T) decreased 1,000 times, and wavelength (λ) of radiation increased 1,000 times. The results above are consistent with the modern observations and MBR (Microwave Background Radiation).

The size of our newborn universe might be like a grain of "Grape". That "Grape" might come from two ways. One way to come from Singularity is impossible. Another way is that "Grape" could come from the Big Crunch of pre-universe. It will be proved as below. Formula (1a) is effective to the early expanding process of present universe, and effective to the past collapsing process of pre-universe too. Those two processes were all under the action of the sole gravity produced by the total energy-matters of the universe and were all in an isolated system.

2. In Newborn-hood Universe, the Properties of Radiations and Particles in the States of Super High Temperature

Quantum Mechanics (QM) indicates that all matters and radiations have the duality of particles and waves. In earliest universe, particles and radiations had same grade of ultra-high energy and could transfer between

each other. Three formulas of energy below are equally valid for particles and radiations in some special state of the ultra-high temperature;

$$E_m = mc^2, E_p = \kappa T, E_r = Ch/\lambda \quad (2a)$$

$$m = \kappa T/C^2, \lambda \propto R, R \propto 1/T \quad (2b)$$

E_m, E_p, E_r – Energy of single matter or particle or radiation. m – Mass of particle, C – Light Speed, κ – Boltzmann's Constant, T – Temperature, h – Plank's Constant, λ – Wavelength of Radiation

Therefore, in early universe, when Temperature (T) became higher than the valve temperature of some particles, those particles would become a state of thermodynamic equilibrium with the radiation and would not stop transforming between each others. That demonstrates no differences between radiations and particles. Thus, Formulas (2a) and (2b) was effectively applied in early universe.

Formula (2b) indicates that **when the particle's Temperature (T) goes up, its Mass (m) will correspondingly increase proportionally. Inevitably, it leads to the increase in gravitational force between two closest particles.** That shows exactly why pre-universe could not stop to contract its volume (R) to a cosmic "Grape" state or the Big Crunch.

3. The Transitive Condition Occurred from Big Crunch of Pre-universe to Big Explosion (Big Bang) of Present Universe

From formulas (1a),(2a),(2b), $R = k_2 t^{1/2}$, when pre-universe contracted its size (R) to the Big Crunch, correspondingly its Temperature (T) and Mass (m)

$$dm > |t| \times C \text{ or } -d_m \leq C \times t \leq d_m \text{ or } -d_m / C \leq t \text{ \& } t \leq d_m / C \quad (3)$$

t – Characteristic Expansion Time, d_m – Distance between Two Closest Particle, C – Light Speed

Let ρ = energy-matter density g/cm^3 , $V = HR$, $V^2/2 = GM/R$, $M = 4\pi\rho R^3/3$,

H = Hubble's Constant = constant at the same time of universe, $H = V/R = 1/t$,

$$\rho d_m^3 = m \quad m = \kappa T/c^2 \quad \therefore t^3 < (\kappa T)/(\rho c^5) \quad (3a)$$

$$\rho = 3H^2/(8\pi G) = 3/(8\pi G t^2) \quad \therefore t < T(8\pi G \kappa)/(3C^5) \quad (3b)$$

$$\text{From (1a) } T t^{(1/2)} = k_1 \quad \therefore t^{(3/2)} < k_1(8\pi G \kappa)/(3C^5) \quad (3c)$$

Formulas (3a), (3b), (3c) are all derived from Formula (3), and have the same value of (t). They accord with the principles of GTR.

Now the numerical value of (t) can be calculated as below.

First, select k_1 in Formula (1a) from column (C) of Chart 1 on Appendix A behind,

$t = 1.09 \text{ s}$, $T = 10^{10} \text{ k}$. [the same results can be gotten by other than column (C)]

$k_1 = T t^{(1/2)} = (10^{10}) \times (1.09\text{s})^{(1/2)} \approx 10^{10}$ (in some books, $T t^{1/2} \approx 10^{10}$ may be as a experiential formula),

From Formula (3c), $t^{(3/2)} < [(8\pi G \kappa)k_1 / (3C^5)]$

$G = 6.67 \times 10^{-8} \text{ (cm}^3/\text{gs}^2)$, $\kappa = 1.38 \times 10^{-23} \text{ J/k} = 1.38 \times 10^{-16} \text{ gcm}^2/\text{s}^2\text{k}$, $C = 3 \times 10^{10} \text{ cm/s}$

would increase, and its time (t) would too much shorten. At an extreme circumstance, when (R) contracted to such an infinitesimal dimension, the real distance between the two neighboring particles would finally become greater than the product of (C) (light speed) multiplied by (t)(time). It shows that there would not be enough time to transmit the gravity between neighboring particles. At that moment, all adjacent particles would instantaneously break off the linkage of gravitational forces and lead the pre-universe to stop contraction. Thus, the pre-universe would change its state from the Big Crunch of pre-universe to the Big Explosion of the present universe. That is scientifically better known as "phase transition." Such a process is different with the Big Bang as an infinitesimal explosive point of Singularity known by most individuals. In reality, Big Crunch was just a big contraction; Big Bang was just a big expansion.

Of course, the detailed process of changing states should be extremely complicated. **Once the expansion of the present universe steadily took place, due to that the increase in size (R) was much less than the increase in time (t), the gravitational force of the two closest particles would recur and renew to connect them together with collisions.** Subsequently, our universe would begin a completely new process of uniform expansion until present.

The transitive condition occurred from the Big Crunch of pre-universe to the Big Bang of the present universe is demonstrated by Formula (3) below:

$$t^{3/2} \leq [8\pi(6.67 \times 10^{-8})(1.38 \times 10^{-16})(10^{10})] / [3(3 \times 10^{10})^5]$$

$$= 0.32 \times 10^{-64}$$

$$\therefore t \leq +10^{-43} \text{ s and } t \geq -10^{-43} \text{ s} \quad (3d)$$

Corresponding $T = k_1/t^{(1/2)} = 10^{10}/(10^{-43})^{1/2} = 0.32$

$$\times 10^{32} \text{ k, } T \approx 0.32 \times 10^{32} \text{ k} \quad (3e)$$

From Formula (2b), mass of particle, $m = \kappa T/C^2 = 10^{-5} \text{ g}$,

$$m = 0.5 \times 10^{-5} \text{ g.} \quad (3f)$$

$\rho = 3/(8\pi G t^2) \approx 1.8 \times 10^{92} \text{ g/cm}^3$, $d_m^3 = m/\rho$, so, $d_m \approx 14 \times 10^{-33} \text{ cm}$, but $C \times t = 3 \times 10^{10} \times 10^{-43} = 3 \times 10^{-33} \text{ cm}$.

$$\text{So, } d_m > C \times t. \quad (3g)$$

Thus, **the gravities of closest particles had surely broken off at time of ($t = -10^{-43} \text{ s}$).**

The calculated values $t \geq -10^{-43}$ s, $t \leq +10^{-43}$ s, and $T \approx 0.32 \times 10^{32}$ k are precisely in accordance with the values at the beginning or ending of Plank's Era on Figure (1).

The calculations shows that once the Big Crunch of pre-universe contracted to $t = -10^{-43}$ s and $T = 0.32 \times 10^{32}$ k, the gravity connected to the two closest particles would thus disappear. **No gravity is equal to no power for contraction, and then $T \approx 10^{32}$ k become the highest temperature in Universe. With no gravity, the only way for the pre-universe and for particles was to stop their contraction and then started the expansion.** After that, $t = +10^{-43}$ s would become the time required for recovering the gravitational linkage between two neighboring particles at the genesis of our present universe at the highest equally temperature of $T \approx 10^{32}$ k.

Between $t = -10^{-43}$ s and $t = +10^{-43}$ s, there should be appearance of time ($t = 0$). However, **time ($t = 0$) does not signify the presence of Singularity at all**, since at that point of ($t = 0$), the temperature $T \approx 10^{32}$ k, T was not infinity. The density $\rho \approx 10^{92}$ g/cm³ $\neq 0$, and the actual radius of universe $R \neq 0$. So, **the point of ($t = 0$) was just a bridge between contracted state ($t = -10^{-43}$ s, +R) and expanded state ($t = +10^{-43}$ s, +R).**

4. Minimum Gravitational Black Hole (MGBH) of ($m_t \approx 10^{-5}$ g)

(A). Particle ($m_t \approx 10^{-5}$ g) was a real gravitational black hole

From Formulas (3) and (3c) of paragraph 3, once pre-universe collapsed to ($t = -10^{-43}$ s, $T = 10^{32}$ k), the gravitational linkage between the closest particles would break off. At that moment, the mass of any particle or radiation m_t is gotten from (2b),

$$m_t = \kappa T / C^2 = 1.38 \times 10^{-16} \times 10^{32} / (3 \times 10^{10})^2 = 1.5 \times 10^{-5} \text{ g} \quad (4a)$$

From (3b), $\rho_t = 3 / (8 \pi G t^2) \approx 7 \times 10^{92}$ g / cm³, so, radius r_t of m_t ,

$$r_t = (3m_t / 4 \pi \rho_t)^{1/3} = 1.4 \times 10^{-33} \text{ cm} \quad (4b)$$

If each particle ($m_t = 10^{-5}$ g) was as a BH, according to GTR, its Schwarzschild's radius r_b was:

$$r_b = 2Gm_t / C^2 = 2 \times 6.67 \times 10^{-8} / (3 \times 10^{10})^2 = 1.48 \times 10^{-33} \text{ cm} \quad (4c)$$

So, $r_b = r_t = 1.5 \times 10^{-33}$ cm,

According to Hawking's formula, the temperature T_b of m_t as a MGBH is: (M_0 - Mass of sun)

$$T_b \approx 0.4 \times 10^{-6} M_0 / m_t = 0.5 \times 10^{32} \text{ k} \quad (4d)$$

$$T_b = T \approx 10^{32} \text{ k} \quad (4e)$$

Thus, According to Formulas (4c), (4d), it has proved that **Particle ($m_t \approx 10^{-5}$ g) is a real micro gravitational black hole (MGBH) at the state ($t = -10^{-43}$ s, $T = 10^{32}$ k), its density was so high that even light inside had no possibility to shake off the trammel of BH's gravity.**

According to Hawking's formula, the lifetime τ_b of BH ($m_t \approx 10^{-5}$ g) was:

$$\tau_b \approx 10^{-27} m_t^3 \approx 10^{-43} \text{ s} \quad (4f)$$

τ_b was consistent with the time, which pre-universe collapsed from ($t = -10^{-43}$ s) to ($t = 0$), or **MGBHs would disappear simultaneously with the disappearance of whole pre-universe. Then, the genesis of our universe surely came out from MGBHs of Plank's Era, but not from Singularity or Big Bang of Singularity.**

(B). Every MGBH (particle) of $m_t \approx 10^{-5}$ g was a single and entire particle; it was not formed by many smaller same particles.

From paragraphs 13 and 19 of part 2 of this article behind, formula (13bd), i.e. $R_b = 3h / (2\pi C m_s) = r_{om}$ had exactly proved that, in case R_b (of $m_t \approx 10^{-5}$ g) = 10^{-33} cm, particle m_s forming m_t is equal to m_s , i.e. $m_s = m_t = 10^{-5}$ g. It is said, entire BH of ($m_t \approx 10^{-5}$ g) is formed by a single particle $m_s = 10^{-5}$ g.

MGBH (particle) of $m_t \approx 10^{-5}$ g was the limitation of shrinkage, it had no possibility to shrink any more exception explosion.

(C). Particle of ($m_t \approx 10^{-5}$ g) had once been the heaviest particles (HP) and the minimum gravitational BH (MGBH) in our universe, but it only existed in the period of our new-born universe and had no possibility to re-appear in nature. Energy of every such particle attained to 10^{19} GeV, i.e. $T_b = 10^{32}$ k, it was the highest energy in our new-born universe, and had no way to re-appear.

From GUT (grand unified theories), the heaviest particle might be X, its mass $m_x = 10^{15} m_p$ (mass of proton) = $10^{15} \times 1.66 \times 10^{-24}$ g $\approx 10^{-9}$ g, its energy $\approx 10^{15}$ GeV ($T \approx 10^{27}$ k). From Figure 1, particle X would locate at the juncture of GUT Era and Hadron Era. However, MGBH (particle) of $m_t = 10^{-5}$ g is much heavier than m_x , energy of $m_t \approx 10^{19}$ GeV ($T = 10^{32}$ k), m_t locate at the juncture of Plank's Era and GUT Era on Figure 1.

X was only a particle, but not a BH at all, because X did not accord with formulas (4c), (4d) and (4f) of BH.

There would be no necessary condition in our universe for occurrence of either X or MGBH of ($m_t \approx 10^{-5}$ g), because the temperature of our universe anywhere could have no way to attain to 10^{27} k or more, therefore, X or MGBH might not be found forever except at the genesis of our universe.

On the other side, owing to the highest temperature in our universe was 10^{32} k at universal genesis, according to formulas (4c) and (4d), BH of (mass $< 10^{-5}$ g) must need higher temperature than 10^{32} k, so, **BH of (mass $< 10^{-5}$ g) would have no way to occur and BH of (mass = 10^{-5} g) was the minimum gravitational BH (MGBH) in our universe.**

$$\text{Let } n_{pm} \text{ -numbers of protons in a MGBH} \\ N_{pm} = 10^{-5} / 1.66 \times 10^{-24} \approx 10^{20} \quad (4g)$$

5. Uncertainty Principle of QM Was Applied to Quantum Gravitation ^{<6>}

According to the Uncertainty Principle of QM, (Quantum Mechanics)

$$\Delta E \times \Delta t \approx h/2\pi \quad (5a)$$

$h = 6.625 \times 10^{-27}$ erg s, h – Planck's constant. Applying formula (5a) to the reactional process of two elementary particles, $\Delta E = 2mC^2$ (5b)

Δt is the time of producing or annihilating two particles (m – mass of particle),

$$\Delta t = t_c = h/(4\pi mC^2) \quad (5c)$$

t_c – Compton time. t_s – Schwarzschild's time, i. e. the time of light passing through the Schwarzschild's radius of particle. $t_s = 2Gm/C^3$ (5d)

Generally, $t_c < t_s$, in case of $t_c = t_s$, then $m = m_p$, m_p – Planck's mass, $m_p = (hC/8\pi G)^{1/2} = 10^{-5}g$ (5e)

According to Uncertainty Principle, time t_p is corresponding to m_p ,

$$t_p = (Gh/2\pi C^5)^{1/2} = 0.539 \times 10^{-43}s \quad (5f)$$

t_p is called as Planck's time, l_p is Planck's length corresponding to t_p , temperature T ,

$$l_p = t_p \times C = (Gh/2\pi C^3)^{1/2} = 1.6 \times 10^{-33}cm \quad (5g)$$

$$T = m_p \times C^2/k = 0.65 \times 10^{32}k = 10^{19}GeV \quad (5h)$$

When the universal age was less than the Planck's time t_p , the quantum effect would appear, time might not be measured precisely.

Planck's time ($+t_p$) only has the positive value in original meaning, the new concept above shows that **the negative value ($-t_p$) has the meaning of time too, at time ($-t_p$), pre-universe collapsed to lose gravity between the closest particles and stopped collapsing.**

Checking up the numerical values from above paragraphs, the results are compared as below:

From 1

No Linkage of Gravity	MGBH	UPQM
$t = -10^{-43}s$ & $10^{-43}s$,	$\tau_b = 10^{-43}s$,	$t_p \approx 0.5 \times 10^{-43}s$,
$T \approx 0.32 \times 10^{32}k$,	$T = 0.5 \times 10^{32}k$,	$T = 0.65 \times 10^{32}k$,
$m \approx 0.5 \times 10^{-5}g$,	$m_t \approx 1.5 \times 10^{-5}g$,	$m_p = 10^{-5}g$,
$d_m/2 \approx 7 \times 10^{-33}cm$,	$r_b \approx 1.5 \times 10^{-33}cm$,	$l_p \approx 1.6 \times 10^{-33}cm$,

The numerical values of three states above have been calculated out and reached to almost same values, it has fully proved that all classical theories and laws applied in this article accord with the state of newborn universe at the juncture of Planck's Era and GUT Era, i.e. the critical state of "phase transition". Such critical state divided the physical state (world) into two completely different states (world), one is Planck's Era of ($l_p < 1.6 \times 10^{-33}cm$), another one is GUT Era of ($l_p > 1.6 \times 10^{-33}cm$). Those two physical states (world) should have different laws, just as there are different laws between ice and water, although they are composed by same molecules and atoms.

6. Reviews to Our Present Universe

Our present universe looks like a gigantic black hole. If the age of our universe is: $L_u = 140 \times 10^8$ years,

Schwarzschild's radius of universe: $R_u = L_u \times C$.

The total mass inside the Event Horizon of our universe: $M_u = C^3 L_u / 2G \approx 10^{56}g \approx 10^{23}M_\odot$,

The radius r_o (before "Inflation") of M_u at the genesis of original Universe: $r_o = [3M_u / (4\pi\rho)]^{1/3} = [3 \times 10^{56} / (4\pi \times 10^{93})]^{1/3} = 1.3 \times 10^{-12}cm$.

The size of original Universe of M_u looks like the size of a present proton or a neutron.

The numbers of particles or QMBHs of M_u in the original Universe are;

$$N_o = M_u / m_t = 10^{56} / 10^{-5} = 10^{61}$$

The proton numbers of M_u of original Universe are;

$$N_{op} = M_u / m_{proton} = 10^{56} / 1.67 \times 10^{-24} \approx 10^{80}$$

Mankind has exactly lived in the gigantic universal black hole, a great number of small and big black holes have scattered in the boundless space.

7. Conclusion: The origin and process turned from the disappearance of pre-universe to the birth of present universe in Planck's Era ($-10^{-43}s \leq t \leq +10^{-43}s$)

(A) The transitive origin caused from the big contraction of pre-universe to the big expansion of present universe

From new formula (3c), $t^{3/2} \leq k_1(8\pi Gk)/(3C^5)$, value of ($t = \pm 10^{-43}s$) have been exactly calculated out. The calculated results above show that, once pre-universe collapsed to $t = -10^{-43}s$, and then began to make a "phase transition" from the past contracted universe to the present expanding universe. In the extremely short interval of time ($-10^{-43}s \leq t \leq +10^{-43}s$), every particle and radiation, i.e. MGBH ($m_t = 10^{-5}g$, $r_b = 10^{-33}cm$, $T = 10^{32}k$) in whole universe would undergo a reversible process from disappearance to regeneration. At the time of $-10^{-43}s$, they would simultaneously enter three states: **no gravitational linkages between the closest particles, every particle became a minimum gravitational black hole (MGBH $\approx 10^{-5}g$) and began to reach Planck's Era, (phase transition or critical state). Such three states of particles and radiations jointly obstructed the appearance of Singularity in the process of the big contraction of pre-universe, because every particle became an isolated and no gravitational black hole at $T = 10^{32}k$. As a result, all those MGBHs would not have any possibility to continue their contractions to Singularity, but only to emit the Hawking's radiations (i.e. explosion) to go to vanish. The re-polymerization and growth of micro particle after explosion at gravitational effect would certainly become new_MGBHs and then led the genesis of our present Universe from collisions and combinations of new MGBHs. The whole process of "phase transition" was not reversible.**

That is the most important one of new concepts in this article. Each of physical parameters in the three states on From 1 had the equivalent numerical values at the same time. Those numerical values derived from many current classical theories can successfully reach the same results. It has well proved that, **the process of such a “phase transition” at the birth of our universe can exactly accord with the causality, the second law of thermodynamics and the law of energy conservation.** Singularity possessed some infinite physical amounts had no possibility to become a real existence, so it could not appear and exist in universe in a flash. **The important contribution in this article is to have found out MGBHs ($m_t \approx 10^{-5}g$).**

What were the state and the internal micro composition of MGBHs? There might be have two possible answers, because MGBHs located at the juncture of Plank's Era and GUT Era on Figure 1. It is said, every MGBH of ($m_t = m_p \approx 10^{-5}g$, $r_b = l_p \approx 1.5 \times 10^{-33}cm$) was at the critical state of Plank's Era and GUT Era, so, the internal micro composition of MGBHs was either from compressed quarks (protons) or from disintegrated quarks (quantum). However, the evolutive process from disappearance of pre-universe to the new birth of present universe should be no great difference, no matter which one was true, moreover, it may be impossible to be proved by a correct judgment from experiments forever.

First, if quarks were tightly compressed in every MGBH, old MGBHs would explode and break up into countless protons, new MGBHs would form from re-accumulated protons at the highest density, then, our present universe appeared from collisions and combinations of new MGBHs. Probably, our present universe might keep some information from pre-universe, if such case was true.

Second, if quarks (protons) in every old MGBH had disintegrated into micro quantum at the highest pressure inside and deeply entered quantum world, hence, in the evolutive process from disappearance of pre-universe to the new birth of present universe, every old MGBH would explode and break up into countless quantum. Then, quantum re-accumulated and re-formed new quarks (protons) and then to become new MGBHs at the highest density, at last, the collisions and combinations of new MGBHs formed present expanded universe. Each new modern theory, such as string theory, film theory, quantum gravitation, multi-dimension theory, etc, has attempted to give the completely different physical and mathematical explanations to quantum world of Plank's length $l_p < 10^{-33}cm$. Which will be right? However, it might be a perpetual mystery for mankind. At the beginning of Plank's Era, the energy of a particle (MGBH) was very high to $10^{19}GeV$ ($T \approx 10^{32}k$), but the energy of modern accelerators can just attain about 10^3GeV . The Plank's

length of $10^{-33}cm$ might not be attained and detected by human ability forever too. Therefore, all new modern theories are nothing but conjectures included some reasonable reckoning. Right now, even the quark theory has many shortcomings, such as the imprisoned quarks may possibly have no way to be detected in very remote future. God might not hope that mankind would try to pilfer the invisible mystery of nature. The limitation of human intelligence and ability should be well recognized. The human power comparative with the universal power will be extremely tiny forever.

(B) The gradual vanish of pre-universe in the interval of time ($-10^{-43}s \approx t$) \Rightarrow ($t \approx 0$) of Plank's Era

Once the past universe collapsed to the time ($t \approx -10^{-43}s$) at the beginning of Plank's Era, every particle became an isolate MGBH of ($m_t \approx 10^{-5}g$) and had no gravity between each other. Gravitational transmissions between two closest particles needed time $10^{-43}s$ or more. Thus, **all MGBHs had no enough time to attain combination, but could only emit Hawking Radiations until gradually thorough disappearance within time $10^{-43}s$ i.e. ($from -10^{-43}s$) \Rightarrow ($t \approx 0$).** **The whole pre-universe formed by all MGBHs would synchronous disappear too.** The disappeared process of a single MGBH at the super-high temperature might be a small bang like a double-bang firecracker, and the disappeared process of complete pre-universe included countless MGBHs might be like a great lump of beautiful firework. **Such explosions of all old MGBHs in whole pre-universe were completely difference with so-called “Big Bang” of Singularity at a point.**

Such extremely swift and violent explosions should have γ -ray bursts.

First, owing to that, the explosions of all old MGBHs might not occur at a exactly same time, but in an interval of $10^{-43}s$, in addition, spaces between old MGBHs might have lower density than MGBHs, so **pre-universe after explosion of MGBHs was not microstructural uniform. It was just the origination of non-uniformity of our universe at microstructure.** Such micro structural non-uniformity let to form the different mini embryos ($m \ll 10^{-5}g$) or integrated multi-particles, bigger or smaller, at the gravity and collision. They could grow up to different size with attraction to adjacent different particles.

Second, the mini embryos of ($m \ll 10^{-5}g$) had no way to become smaller BHs.

According to formulas (4c) and (4d), BHs of ($m \ll 10^{-5}g$) must need temperature $\gg 10^{32}k$, Schwarzschild's radius $\ll 10^{-33}cm$, those conditions could be absolutely impossible to appear.

For a steady BH, once a parameter such as m_b is decided as a certainly value, all other values of parameters of BH (r_b, t_b, ρ_b and etc.) will be solely decided with the first one. That is the essential

quality of any BH.^{<8>} Thus, such embryos were only the integration of many micro particles, but not a smaller BH at all.

Third, let v_{mt} is the vanishing speed of an old MGBH,
 $V_{mt} = r_b / \tau_b = 10^{-33} / 10^{-43} = 10^{10} \text{cm/s} \approx C$ (light speed)

Above calculation shows that the vanishing speed of old MGBHs $v_m \approx C$, but the growing speed V_g of an new mini embryo was much less than C , it was decided by its gravity to adjacent particles, so, within the interval of (from $-10^{-43}\text{s} \Rightarrow 0 \Rightarrow 10^{-43}\text{s}$) of universal “phase transition”, adjacent new MGBHs grew up from embryos had enough time to transmit their gravity between each others so that new MGBHs could cause collision or engulf its adjacent energy-matters and then expansion, some isolated new MGBHs might have chance to explosions once more. **Just such collisions of new MGBHs or plunder of new MGBHs to adjacent energy-matters caused the “inflation” of our primordial universe.**

Forth, due to that, the density in spaces between old MGBHs before explosion in pre-universe was much lower than density of MGBHs, so, after explosions of MGBHs, the temperature and density in whole universe would lower a little. That was the sole reason and condition for old MGBHs to have space to occur explosions.

(C) The genesis of our new universe within Plank’s Era (Time) of ($t \approx 0$) \Rightarrow ($t \leq +10^{-43}\text{s}$)

The mini embryos of particles ($m \ll 10^{-5}\text{g}$) might be formed at first within above interval of ($-10^{-43}\text{s} \approx t$) \Rightarrow ($t \approx 0$), but they should not have enough time to grow up to become new MGBHs of ($m_b \approx 10^{-5}\text{g}$) within above interval, even within this interval of ($0 \Rightarrow 10^{-43}\text{s}$). The growth of new embryos at $T \approx 10^{32}\text{k}$ would not be very easy, because the hot pressure was too high, so the gravity between embryos could hardly perfectly resist to the hot pressure, embryos might need many times collisions and more time to grow up. In addition, the growing speed of an embryo was much slower than the explosive speed of old MGBHs. It is said, in case of time (t) reached 10^{-43}s , there would not be enough time for particle (embryo) to grow up to a complete new MGBHs ($m_b \approx 10^{-5}\text{g}$). Thus, new MGBHs ($m_b \approx 10^{-5}\text{g}$) could only compose and re-combine or collide out of Plank’s Era ($t > 10^{-43}\text{s}$) i. e. into GUT Era. That was the origin of “Primordial Inflation” at the birth of our present universe in GUT Era. **Once new MGBHs of (mass $\approx 10^{-5}\text{g}$) became mature from embryos, the closest MGBHs would absolutely have enough time to transmit gravity between each others and then collide together, because the increase in size [see formula (1a), $R = k_2 t^{1/2}$] of MGBHs was much less than the increase in time (t). That is the expanded cause of our universe until the present.**

Why would new MGBH be still (mass $\approx 10^{-5}\text{g}$)? MGBH of (mass $\approx 10^{-5}\text{g}$) was the minimum and the lightest BH in our universe, any BH of (mass $< 10^{-5}\text{g}$) had no possibility to appear in our universe [see(B) and (C) of 4 paragraph, and 19 paragraph of part 2]. However, forming a bigger BH of (mass $> 10^{-5}\text{g}$) must need more time and energy-matters. Thus, new MGBHs of (mass $\approx 10^{-5}\text{g}$) should naturally be formed at the first and the shortest time of our new-born universe under the highest density needed by MGBHs.

(D) “Inflation Era” of the primordial universe ($t > +10^{-43}\text{s}$) \Rightarrow GUT Era

According to the principle of BH, if a new BH was formed from the collision of two old BHs, the properties of new BH are as behind: Suppose parameters of old BH 1; $C^2/2 = GM_1/R_1$, old BH 2; $C^2/2 = GM_2/R_2$,

$M, R, --$ parameters of new BH.

Due to $M = M_1 + M_2$, as a result; $R = R_1 + R_2$. (7d)

Formula (7d) shows the origin of “Inflation”.

Above formula clearly indicates: a), the collision of two or more BHs would certainly cause “Inflation”, i.e. **$M \propto R$** . b) “Inflation” caused in GUT Era . c) A new BH formed from the collisions of two or more original BHs would become a really new bigger gravitational BH. d). A BH after absorbing energy-matters outside other than another BH was still a BH, a bigger BH.^{<8>}

Most importantly, provided any one of two (M_1 or M_2) is a real gravitational BH, no matter whether another one is a BH or not (particle of energy-matters), (7d) is perfectly correct. It is said, values of M and R after collision would have no difference.

Every small explosion caused from collisions between adjacent MGBHs of newborn universe would compose jointly a greatest burst in whole universe. Such explosions should be much weaker than the vanished explosions (i.e. Hawking’s radiation) of old MGBHs of pre-universe. Explosions certainly caused “Primordial Inflation” of newborn universe in GUT Era. **That was the parturient pangs and the real birth of our present new universe.** After collisions, BHs would need longer time to complete combination, merge and expansion until becoming a new perfect BH.

Such collisions should emit strong X-rays.

(E) The reason for nonstop expansion of our universe until present

Let us look back to formulas (4c), (4d) and (7d), no matter whether collisions between the smaller BHs or adjacent energy-matters plundered by a BH, the new formed bigger BH would certainly increase in its Schwarzschild’s radius (r_b).^{<8>}

Check up the calculated numerical values: At the birth of our universe, for a new MGBH, its mass $m_t \approx 10^{-5}\text{g}$, its Schwarzschild’s radius $r_b \approx 1.5 \times 10^{-33}\text{cm}$. According to (7d), if our present universal BH is surely

composed from the combinations of “primordial inflation” of all new MGBHs (or replaced by equal energy-matters) at the birth of universe, hence, the radius of Event Horizon of present universe R_u must be equal to the total sum of the radius of all primordial new MGBHs (r_b). From 6th paragraph, the mass of present universe within Event Horizon $M_u \approx 10^{56}g$, the numbers of primordial particles (MGBHs), $N_o = 10^{61}$, $R_u = N_o \times r_b = 10^{61} \times 10^{-33} = 10^{28}cm$,

Check up real radius R of our present universe on chart 1 of Appendix A of paragraph 9, $R \approx 1.2 \times 10^{28}cm$,

$$R = R_u \approx 10^{28}cm \quad (7e)$$

Correspondingly, our present universe as a real BH, according to formula (4c), **the expanded multiples of Schwarzschild’s radius μr should accord with its increased multiples μa of mass, i.e. $\mu r = \mu a$.**

$$\mu r = R_u / r_b = 10^{28} / 10^{-33} = 10^{61} \quad (7e_1)$$

$$\mu a = M_u / m_t = 10^{56} / 10^{-5} = 10^{61} \quad (7e_2)$$

(7e₁) = (7e₂)

Therefore, the present expansion of our universe did surely come from the collisions or combinations (primordial inflation) of countless new MGBHs from GUT Era to present time.

Formula (7e) shows that, our present universe is a perfect gigantic BH formed and expanded from all original MGBHs, which had disappeared already after their collisions at “primordial inflation” of universal genesis, and the Event Horizon of our present universe are formed by the total sum of original MGBHs after their expansions. From analyses of (7d), even if numbers (N_o) of original MGBHs (m_t) were less than 10^{61} because of the micro structural non-uniformity of our new-born universe, i. e. $N_o < 10^{61}$, and if there were enough equal energy-matters to replace the rest MGBHs (m_t) so that the total values of M_u or R_u could keep no change, our universal evolution would have no difference at all.

(F) Whether or not expansion of our universe at present would not depend on the universal real density ρ , but only depend on the total energy-matters of primordial universal packet M_o , the end of our universe

According to our universal expanded law,

$$t^2 = 3 / (8\pi G\rho) \quad (3c)$$

According to laws (4c) of BH, and $R_b = Ct$, $M_b = 4\pi\rho_b R_b^3 / 3$,

$$t^2 = 3 / (8\pi G\rho_b) \quad (7f)$$

Our universe as an expanded universal ball and as an expanded BH is the same one, because its Event Horizon has no difference. At Event Horizon, $C^2 = 8G\rho_b R_b^2 / 3$ (for universal BH) = $8G\pi\rho R_u^2 / 3$ (expanded universal ball), for $R_b = R_u$, so, $\rho_b = \rho$. Inside an uniform universe, $\rho = a$ constant at the same time, so, $V^2 = 8G\pi\rho R^2 / 3$. Undoubtedly, $H^2 = 8G\pi\rho_b / 3 = 8G\pi\rho / 3$.

Therefore, t in (3c) is equal to t in (7f). Thus, its real density ρ and density of BH ρ_b is the exactly same one [i.e. (3c) = (7f)]. It will be seen that, $\rho = \rho_b = \rho_c$ (critical density) is all right for our expanded universal ball as an expanded BH. That is the main character of BHs. Obviously, $\rho_b = \rho = \rho_c$, or $\Omega = \rho / \rho_c = 1$, **that is an inevitable outcome to our sufficient expanded universe as a sufficient expanded BH.** Therefore, in several decades ago, the debates or researches about ($\Omega \neq 1$ or $\Omega = 1$) seemingly had no significance.

Now let us review how to get mass M_u of our universe within its Event Horizon, firstly, real density $\rho \approx 2 \times 10^{-29} g/cm^3$ could be measured, then, from formula (3b), $t^2 = 3 / (8\pi G\rho)$, t is the age of our universe, $t \approx 4.23 \times 10^{17} s \approx 1.37 \times 10^{10}$ yrs. Thus, the radius of Event Horizon $R_u = t \times C = 1.2 \times 10^{28}cm$, and $M_u = C^2 R_u / (2G) \approx 10^{56}g \approx 10^{23} M_o$. Since our universe is a real BH, a certain M_u should correspond with a certain and sole ρ . Thus, a deduction below should be gotten. If there is more mass ($M_o - M_u$) outside Event Horizon of our universe, (M_o – total mass of our originally universal packet,) M_u will increase as the enlargement of Event Horizon. Only under the condition of $M_o - M_u = 0$, or $M_o = M_u$, our universe will stop to expand. After that, our universe will only show to emit Hawking’s radiation, to lose energy-matters and to contract its size till its thorough disappearance. The lifetime of disappearance (τ_o) is extremely long, (τ_o) can be calculated by formula (4f), $\tau_o \approx 10^{-27} M_o^3 (s)$. For example, if $M_o = M_u \approx 10^{23} M_o \approx 10^{56}g$, $\tau_{ou} \approx 10^{130}$ yrs.

(G) Several years ago, some astrophysicists proposed that our universe is accelerating its expansion according to observations from remote supernova 1a, and pointed out that over 60% dark energy of exclusive force exists in universe^{<1>}. Since our universe as a gigantic BH should inevitably possess the essential quality of any BH, the unusually accelerated expansion of our universe only depends upon absorbed energy-matters which did not belong to our original universe. More energy-matters were taken in, faster its expansion would be. Of course, if absorbed energy possesses exclusive force, the expansion of universe should be much faster or accelerated.

(H). The summary conclusion: Our present expanded gigantic universe (its mass $M_u \approx 10^{56}g \approx$ total mass of 10^{61} MGBHs) really originated from minimum gravitational black holes (MGBH, its mass = $10^{-5}g$) and was formed by the collisions and combinations of a large number of MGBHs, the expanded law inside our universe after collisions and combinations of MGBHs had accorded with Hubble’s law and formulas (1a) and (1b).

8. The further explanations

The new concepts in this article show that GTR cannot be applied to describe the state of Plank’s Era ($-10^{-43}\text{s} \Rightarrow 0 \Rightarrow (+10^{-43}\text{s})$) in the primordial universal evolution, just as Newton’s mechanics cannot describe the motion of any matter which speed is close to the light speed (C). Without exception, the mathematical equations of all theories including GTR would always have its applied conditions and limits.

The four difficult and complicated problems (Singularity, flatness, Event Horizon and magnetic monopole) at the genesis of universe had troubled scientists for several decades. After existence of Singularity has been negated by new concepts in this article, the other three problems may be easily solved. Moreover, the new concepts in this article have given the better explanation to the origin of “Inflation” and “inflationary cosmological model”.

If the new concepts in this article could exclude the occurrence and existence of Singularity at the genesis of our universe, for which scientists will not need to beg the marvels or any new theories or to provide some special original conditions.

All numerical values calculated from the current classical theories and its formulas in this article are precisely consistent with the observational results and the real evolutionary process of our universe in Figure 1. Probably, the new concepts in this article may not be accepted and convinced by the most scientists and scholars because of no abstruse theory, no complicated mathematical equations, no exact demonstrations as well as the old conventions broken down. However, as a reasonable explanations to the genesis of our universe, new concepts in this article are much better than “Big Bang” of Singularity, because people do not need to be puzzled by uncertain Singularity and by uncertain Plank’s state of “dimension $< 10^{-33}\text{cm}$ ”.

This article are separated into three big parts, the full text can be searched on website: (<http://www.sciencepub.org/nature/debate-001>)

-----The End-----

9. Appendix A: Chart 1. Values Compared Between Figure 1 And Formulas (1a), (1b).

**10. Appendix A
Chart 1 Values Compared Between Figure 1 And Formulas (1a) (1b)**

	I Matter-Dominated Era		II Radiation Era					III Lepton Era	
Time (t) yrs,min,sec Figure 1	13.0 x 10 ⁹ yrs	4 x 10 ⁵ yrs	F	E	E	D	C	B	A
Temperature (T) K Figure 1	3 K	3000 K	34 m 40 s	3 m 46 s	3 m 2 s	13.82 s	1.09 s	0.11 s	2 x 10 ⁻² s
	<i>Formula (1-b)</i>		<i>Formula (1-a)</i>					<i>Formula (1-a)</i>	
Temperature (T) Kelvin	3 K	3000 K	2.3 x 10 ⁸	7.1 x 10 ⁸	0.8 x 10 ⁹	2.9 x 10 ⁹	1.02 x 10 ¹⁰	3.2 x 10 ¹⁰	0.75 x 10 ¹¹
R cm	12 x 10 ²⁷	12 x 10 ²⁴	1.5 x 10 ²⁰	0.5 x 10 ²⁰	4.6 x 10 ¹⁹	1.5 x 10 ¹⁹	3.5 x 10 ¹⁸	1.1 x 10 ¹⁸	4.8 x 10 ¹⁷
Wavelength (λ) cm	0.1	10 ⁻⁴	1.25 x 10 ⁻⁹	4.2 x 10 ⁻¹⁰	3.8 x 10 ⁻¹⁰	1.25 x 10 ⁻¹⁰	2.9 x 10 ⁻¹¹	9 x 10 ⁻¹²	4 x 10 ⁻¹²
ρ _c g / Cm ³	10.6 x 10 ⁻³⁰	1.12 x 10 ⁻²⁰	0.4	35	54	9.4 x 10 ⁻³	1.5 x 10 ⁶	1.48 x 10 ⁸	4.5 x 10 ⁹

IV Hadron Era				V Plank Era
10 ⁻⁴ s	10 ⁻⁶ s	10 ⁻³⁵ s	10 ⁻⁴³	
10 ¹² K	10 ¹³ K	10 ²⁷ K	10 ³² K	
<i>Formula (1-a)</i>				
1.07 x 10 ¹²	1.07 x 10 ¹³	3.38 x 10 ²⁷	0.338 x 10 ³²	
3.4 x 10 ¹⁶	3.4 x 10 ¹⁵	10.7	10.7 x 10 ⁻⁴	
2.8 x 10 ⁻¹³	2.8 x 10 ⁻¹⁴	8.85 x 10 ⁻²⁹	8.85 x 10 ⁻³³	
1.8 x 10 ¹⁴	1.8 x 10 ¹⁸	1.8 x 10 ⁷⁶	1.8 x 10 ⁹²	

Take the initial numerical values below, which are at present universe time:
 All other values on the above chart can be calculated out according to Formulas (1a, 1b)
 Suppose the Hubble’s Constant H = 75 Km/(sxMP_{sc})
 So t₀ = 1/H = 13x10⁹yr
 R = t₀ c = (13x10⁹yr) x c = 12 x 10²⁷cm λ = 0.1 cm ρ_c = 10.6 x 10⁻³⁰g/cm³ T = 3k

10. Appendix B: Demonstration to formulas (1a) and (1b)

To prove the Formulas (1a, 1b) as below, Suppose R is the radius of a sphere in the universe. R's dimension should be large enough.

The potential energy (P.E.) on the spherical surface is:

$$P.E. = (mMG)/R,$$

m – Mass of a particle on the surface,

M – Total masses in the sphere of radius R

G – Gravitational Constant,

R – Characteristic scale factor (dimension)

The kinetic energy (K.E.) of m on the surface is

$$K.E. = 0.5mV^2.$$

V – Radical Velocity, expanding or escaping velocity are corresponding to the end-point of R.

According to the "Cosmological Principle", the universe, which is both isotropic and homogeneous, looks the same in any direction and at every point. Therefore, the whole sphere should be considered an isolated system and no energy exchange with the other system. Based on the principle's of Newton Mechanics, the real space with three dimensions can be treated in one dimension R in the process of the universe's evolution.

$$P.E. = K.E.$$

$$0.5V^2 = (MG)/R \tag{B}$$

(1) In the process of the universe's evolution from Big Bang to the end of Radiation Era, to particles or radiations (photons), from (2a), (2b), (1a)

$$E_m = mc^2 \quad E_p = \kappa T \quad E_r = ch/\lambda \tag{2a}$$

$$m = \kappa T/C^2, \quad R \propto \lambda, \quad \text{and } T \propto 1/R, \tag{2b}$$

Formulas (2a), (2b) show that, in the early process of universe's expansion, the increase in wavelength of the radiations λ is proportional to increase of R, and as **temperature T slow down, mass m of a particle would decrease, and then the gravity between particles would weaken. That is the important reason for that, pre-universe quickened its contraction to Big Crunch and the present universe accelerated its expansion in the earlier period after its birth.**

$$\text{Because in Formula (B), } \Sigma m_i = M \tag{B1}$$

Therefore, M's increasing is proportional every m_i 's increasing,

From Formula (B)(B1) (2b),

$$\text{So } M \propto 1/R \quad M \neq \text{Constant} \tag{B2}$$

From Formula (B)(B2), $V^2 \propto 1/R^2$, $V \propto 1/R$, $VR = \text{Constant}$

$$\text{So } RV = \text{Constant i.e. } R(dR/dt) = \text{Constant} \tag{B3}$$

From (B)(B1)(B2)(B3), $dR^2/dt = \text{constant}$

$$Tt^{1/2} = k_1, \quad R = k_2 t^{1/2}, \quad RT = k_3, \quad R = k_4 \lambda, \quad RV = k_5 \tag{1a}$$

Formula (1a) is proven correctly.

(2). In The Matter-Dominated Era

Because in Formula (B), **M = Constant**

So $R^{1/2}V = \text{Constant}$ i.e. $R^{1/2}(dR/dt) = \text{Constant}$, So $R^{1/2}V = \text{Constant}$

$$\text{Therefore, } R^{3/2} = t \times (\text{Constant}), \quad R = k_7 t^{2/3} \tag{B4}$$

In this era, to radiation, Formula (B1) is still right
So from Formulas (B1)(B4)

$$Tt^{2/3} = k_6, \quad R = k_7 t^{2/3}, \quad RT = k_8, \quad R = k_9 \lambda, \quad R^{1/2}V = k_{10} \tag{1b}$$

Formula (1b) is proved correctly.

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8. See part two of this article behind.

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Chinese edition of this article was published on "Aeronautical Education" magazine, June 2004, Beijing University of Aeronautics and Astronautics, China. Publication Number: ISSN1005-8176 | CN11-2548/G4.