

The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All (Part 2) 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 (GTR) could resist the gravitational collapse.

Key Words: singularity; big bang; black holes; cosmology; star-formed Schwarzschild's (gravitational) black holes:

Part Two. 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.

Only Schwarzschild's (gravitational) star-formed BHs (no charges, no rotating and spherical symmetry) will be studied in this article below.

Introduction: Jean-pierre Luminet said: "Stephen W. Hawking and Roger Penrose, two scholars of Cambridge University in England, had proved in 1960s that Singularity is an indispensable component of General Theory of Relativity (GTR). It is unsure whether the finality of gravitational collapse for a real star would lead to the formation of a Black Hole (BH) with its Event Horizon. However, it is no doubt that the termination of gravitational collapse will inevitably cause Singularity in BH." <^>

According to GTR, any BH will be composed by three components. First, Event Horizon of BH is its boundary. Second, Singularity exists at the geometric center, $R = 0$, at which all energy-matters in BH would be contracted to infinity, and the space-time would be curved to infinity. Third, a real vacuum space is between Event Horizon and Singularity. It shows that Singularity is the existent premise of a BH. In addition, according to the explanations of GTR, time and space would exchange between each other in BH, the point at the center $R = 0$ would become the termination of time. After that, it would be "out of time". GTR could not explain the meaning of "out of time." <^> <^> <^> Thus, it can be seen, the description of GTR above would be inadequate inside BH. If concepts of GTR were correct, BH should disappear almost instantly with its establishment. Any Singularity that contains an infinite amount of energy and density at an infinitesimal point

cannot exist too long. The mathematical equations of any theory should have their applied limits, just as the gas state equations cannot be applied to the boiling point of water. Since BHs can be found in universe and exist with long lifetime, the other suitable concepts gotten from many theories in this article should be accepted instead of sole GTR. (<^>Reference Number.)

In part two of this article, it will be proved that, in any star-formed black hole (BH), a mini BH of mass ($m_{om} \approx 10^{15}$ g) would occupy the center as a solid core to prevent the energy-matters inside BH from collapse to become a Singularity. The mini BH of long lifetime would lead the whole BH to keep stability. The same numerical values of different physical parameters about mini BH are gotten from six formulas based on different current classical theories. It shows that the existence of mini BH ($m_{om} \approx 10^{15}$ g) is the true reality.

11. If mass (M_b) has collapsed to a Schwarzschild's BH, R_b is Schwarzschild's radius,

$$R_b = 2GM_b/C^2 \quad \text{or} \quad C^2 = 2GM_b/R_b \quad (11a)$$

t_b is the passing time of light in BH from its Event Horizon to center, M_b is mass of BH,

$$C \times t_b = R_b, \quad \text{or} \quad t_b = 2GM_b/C^3 \quad (11b)$$

If $M_b = M_0$ (mass of sun), $t_b = 2 \times (6.67 \times 10^{-8}) (2 \times 10^{33}) / (3 \times 10^{10})^3 = 3 \times 10^{-5}$ s, $R_b = C \times t_b = 3$ km.

To understand the occurrence of a star-formed BH in universe, the contracting process of the original interstellar cloud (OIC) should be known at first. If OIC is in the state of thermodynamic equilibrium, the gas pressure intensity (P) should counterbalance its gravity (F). That is given according to Newton's mechanical equation and thermodynamics.

$$dP/dR = -GM_p/R^2 \quad \text{<^>} \quad (11c)$$

$$P = nkT = \rho kT/m_s \quad (11d)$$

M--mass of OIC, R--radius of M, ρ --density of M, m_s --mass of a particle, T--temperature corresponding to R and M. G--gravitational constant, κ --Boltzmann's constant, n--number of particles in an unit volume.

In order to do the qualitative analysis, the precise solutions of formula (11c) need not to be gotten and are hardly solved. A qualitative solution should be given as below; α --coefficient

$$\kappa T \neq GMm_s/R, \text{ or } \alpha \kappa T = GMm_s/R, \quad (11e)$$

If $\kappa T < GMm_s/R$, $\alpha > 1$, OIC contracts.

If $\kappa T > GMm_s/R$, $\alpha < 1$, OIC expands.

If $\kappa T = GMm_s/R$, $\alpha = 1$, OIC keeps equilibrium.

Three ways can contract (R) in formula (11e); to decrease temperature (T), to increase mass (M) and to change the coefficient (α), (α) is related to structure, location and state in OIC.

12. The mechanisms of objects to resist its gravitational collapse, M_0 --mass of sun,

Universe itself is a gigantic BH (see part one before), if formulas (11c), (11d) and (11e) can be applied to the equilibrium of OIC in our universal BH, they may be used to research the equilibrium and the physical states in star-formed BHs too. No OIC in universe can directly contract to become a BH. In the processes of its contraction, there are many strong resistances. OIC contains about $\frac{3}{4}$ hydrogen (H_2). When an OIC of M_0 contracts to temperature over 10^7k in core with its gravity, the nuclear fusion will occur and keep a very long period. Any OIC of mass ($M \approx M_0$) can certainly attain to $T \approx 10^7k$ of nuclear fusion with its gravitational contraction and form a more solid core of the higher temperature and density to resist the gravitational collapse of materials outside the core. ^{<4>}

After all (H_2) of mass (M_0 or more) in OIC had burned up, the burst of nova or supernova would take place. After that, the collapse of residues M_r of OIC would change into a compact object. M_r are just the dead bodies of a stars. In any compact object, a more solid core would become the antagonist to resist the gravitational collapse. Under the different conditions, the collapses of residues M_r of OIC would get the different outcomes: white dwarf ($M_r < 1.4M_0$ --mass of sun), neutron star [$M_r \approx (3 \text{ to } 1.4M_0)$], BH ($M_r > 3M_0$) or a chunk of dust. ^{<4>} **In nature, any object, body or particle has always a more solid core to resist the contraction of materials and simultaneously to attract the materials outside onto core to keep the stability of whole body, such as galaxy, star, cell, atom, etc. It will be without exception for BHs.**

13. The stability and equilibrium of a star-formed BH (Suppose a BH had formed after nuclear fusion, $5M_0 > M_b \geq 10^{15}g$),

According to Hawking's theory of BH, the temperature (T_b) on the Event Horizon of BH is showed by formula (13a) below; M_b -mass of BH, M_0 -mass of sun, h-Plank's constant, κ -Boltzmann's constant, C-light speed,

$$T_b = (C^3/4GM_b) \times (h/2\pi\kappa) \approx 0.4 \times 10^{-6} M_0/M_b \quad <2> \quad (13a)$$

$$R_b = 2GM_b/C^2, \text{ or } M_b/R_b = C^2/2G \quad (11a)$$

$$dP/dR = -GM\rho/R^2 \quad <5 \times 7> \quad (11c)$$

$$P = n\kappa T = \rho\kappa T/m_s \quad (11d)$$

$$\alpha \kappa t_{om} = m_s Gm_{om}/r_{om} \quad (11e)$$

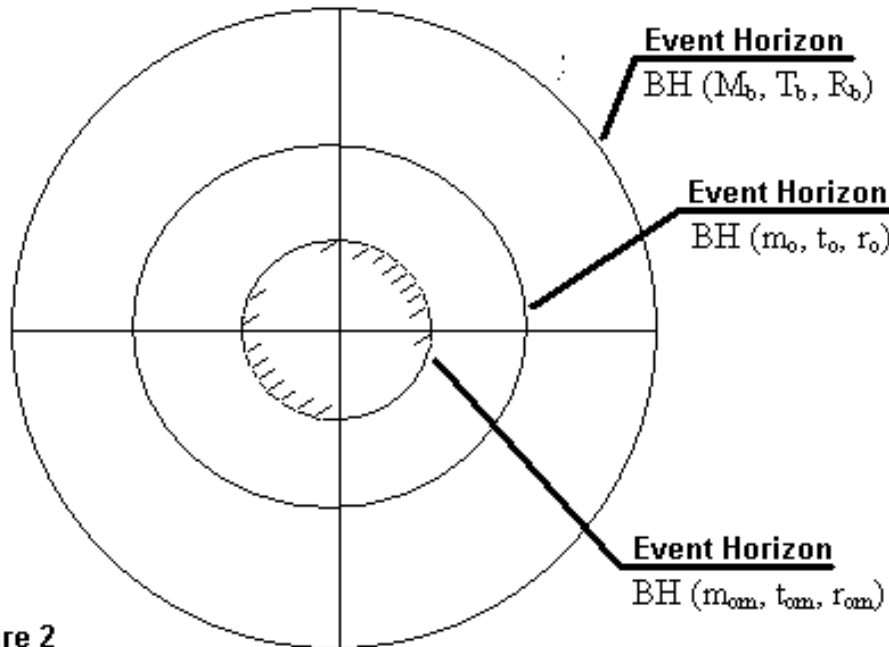


Figure 2

Five formulas above are all idealized. They will be applied in BHs effectively. They can jointly constitute the stability and equilibrium of a BH and reveal the macro physical states in a BH.

Formula (11a) is the necessary condition to construct a BH according to GTR. Formula (13a) is the necessary temperature on the Event Horizon of a BH derived from Hawking's theory of BH. Formula (11c) is an equilibrium equation between pressure intensity and gravity in any BH and can be simplified and idealized instead of Tolman-Oppenheimer-Volkoff's (TOV) equation.^{<7>} Since TOV equation had been successfully applied to neutron stars, formula (11c) should be better used to BHs inside. Formula (11e) is a special solution of formula (11c): (11e) is juxtaposed there for showing its importance. It is balance equation of a particle between gravitational potential energy and heat energy, It is not independent. (α) is a coefficient depended on the state, structure and location in a BH. Formula (11d) is the ideal (gas or ion plasma) state equation in BH. **It will not need to know the microstructure in a BH in this article.** The purpose of this article is to find out the simplistically special solution of formula (11c) in star-formed Schwarzschild's BH of spherical symmetry and to research the macro state or structure in BH.

Furthermore, **five formulas come from the different theories. Thus, the explanations to BHs in this article are completely different with the conclusions of pure GTR.**

Formulas (13aa), (11aa) below are derived from (13a), (11a) and have equally effective.

$$T_b \times R_b = (C^3/4GM_b)(h/2\pi\kappa)(2GM_b/C^2) = Ch/4\pi\kappa \approx 0.1154 \text{ cmk} \quad (13aa)$$

$$M_b/R_b = m_o/r_o = C^2/2G \approx 0.675 \times 10^{28} \text{ g/cm} \approx 10^{28} \text{ g/cm}, \text{ or } T_b \times M_b \approx 10^{27} \text{ gk} \quad (11aa)$$

From formula (11aa), there is the equal potential energy in any BH with $m_s = \text{constant}$.

$$P_b = P_o = \text{constant}, P_b = m_s GM_b/R_b, P_o = m_s Gm_o/r_o \quad (13b)$$

P_o, m_o, r_o – parameters of a point in a BH (Figure 2),

Suppose the energy of each particle $\Delta E = \kappa T$, and $\Delta t \geq 2R/C$, R —Event Horizon of a BH,

$$\Delta E \times \Delta t = \kappa T \times 2R/C. \text{ Thus,}$$

$$T \times R \geq Ch/4\kappa\pi \quad (13c)$$

$$(13aa) = (13c) \quad (13d)$$

Formulas (13aa),(13d) express that the state on the Event Horizon of any BH exactly obeys the Uncertainty Principle of QM. The temperature (T_b) on the Event Horizon of a BH is too low. For example, to a BH of sun mass ($M_b = M_o$), $T_b = 0.4 \times 10^{-6} \text{ k}$.

(A). In any BH (mass = M_b), ($5M_o > M_b > 10^{15} \text{ g}$), there is always a small BH (m_o) inside,

In Figure 2 on above page, suppose a small BH in a BH, (M_b, T_b, R_b)--corresponding to mass, temperature and Schwarzschild's radius of BH; (m_o, r_o, t_o)--

corresponding to mass, Schwarzschild's radius and temperature of the small BH inside.

$$\text{Let } m_o = \beta_1 M_b, \beta_1 < 1, \beta_1\text{-coefficient,} \\ R_b = 2GM_b/C^2 = 2G \times m_o/(\beta_1 C^2) \quad (13e)$$

If $R_b = r_o/\beta_1$, or $M_b/R_b = m_o/r_o = C^2/2G \approx 0.675 \times 10^{28} \text{ g/cm}$ can be proved, then BH (m_o, r_o, t_o) will be a really small BH (m_o) in BH (M_b).

First, from formulas (11a), if BH (m_o, r_o, t_o) were not a small BH in BH, two possibilities would happen. In case of $m_o/r_o > M_b/R_b$, so, $m_o/r_o > C^2/2G$, it is impossible, because $C^2/2G$ is the maximum. In case of $m_o/r_o < M_b/R_b$, as a result, the potential energy of m_s in BH (m_o) will be $P_o < P_b$ (potential energy of M_b). It indicates that all energy-matters in BH (M_b) will rush to its Event Horizon and lead to BH (M_b) disintegrated, that case is impossible too. Thus, the only way of a steady BH is $M_b/R_b = m_o/r_o = C^2/2G$, or $R_b = r_o/\beta_1$.

As a result, BH (m_o, r_o, t_o) is a really small BH in BH (M_b, R_b, T_b).

$$\text{Second; Formula (11a) can be turned into} \\ m_s C^2/2 = m_s GM_b/R \quad (13f)$$

Formula (13f) indicates that, when a particle (m_s) drops onto the Event Horizon of a BH from infinity, its speed will attain the light speed (C), and its kinetic energy ($K_b = m_s C^2/2$) is equal to its potential energy ($P_b = m_s GM_b/R_b$), or $P_b = K_b$. However, after (m_s) enters inside of BH, (K_b) can keep only a constant with light speed (C). Thus, the potential energy (P_b) should keep a constant in BH too. The result in BH should be: $P_o = K_o$, or $m_o/r_o = C^2/2G = 0.675 \times 10^{28} \text{ g/cm} = M_b/R_b$ or $R_b = r_o/\beta_1$. It is no doubt that (m_o, r_o, t_o) is a really small BH in BH (M_b, R_b, T_b).

The results above have also proved that formulas (11aa) and (13b) are perfectly correct.

The conclusion above is not relative to the Hawking's theory of BH.

It is said, **according to pure GTR, once a BH (M_b) was formed, the various small BHs (m_o, r_o) would certainly appear in M_b . However, due to no way to obstruct $r_o \Rightarrow 0$, Singularity would inevitably appear in BH. Besides, GTR can not solve the problems about temperature and lifetime of BHs.**

$$T_b = 0.4 \times 10^{-6} M_o/M_b = 0.4 \times 10^{-6} M_o/(\beta_1/m_o) = \beta_1 t_o \quad (13g)$$

$$T_b \times R_b = (\beta_1 t_o)(r_o/\beta_1) = t_o \times r_o = 0.1154 \text{ cmk} \quad (13h)$$

Formula (13hd) expresses that (m_o, r_o, t_o) is a really small BH in BH (M_b) in accordance with Hawking's theory.

(B). According to Hawking's theory, in any small BH (m_o), a stable mini BH of ($m_{om} \approx 10^{15} \text{ g}$) can surely exist, it is a minimum BH.

First: According to Hawking's theory of BH, in the collapsing process of any star, its entropy always increased and its information capacity always decreased. Suppose S_m --original entropy before the

collapse of a star, S_b --the entropy after collapsing, M_0 --mass of sun = $2 \times 10^{33} \text{g}$,

$$S_b/S_m = 10^{18} M_b/M_0^{<2>} \quad (13i)$$

Jacob Bekinstein pointed out at the ideal conditions, $S_b = S_m$, or, the entropy did not change before and behind the collapse of a star, its mass M_b will be a minimum m_{om} of a mini BH. ^{<2>}

From (13i), $m_{om} = M_b/10^{18} = 2 \times 10^{33}/10^{18} = 10^{15} \text{g}$ = mass of the mini BH, $\therefore m_{om} = 10^{15} \text{g}$ (13j)

Schwarzschild's radius r_{om} of m_{om} ($=10^{15} \text{g}$), $r_{om} = 2Gm_{om}/C^2 = 3 \times 10^{-13} \text{cm}$, (\approx neutron radius),

$r_{om} = 3 \times 10^{-13} \text{cm} \neq 0$, and r_{om} is the minimum size. Singularity cannot appear in any BH. Temperature t_{om} of m_{om} , $t_{om} = 0.1154/R_{om} = 0.38 \times 10^{12} \text{k}$,

Second: The thermodynamic equilibrium between gravity (F) and pressure intensity (P) inside BH is gotten from the Newton's mechanics and thermodynamics.

All demonstrations and analyses behind are built on the foundation of that, in star-formed BHs, because of its high density, the density of energy-matters $\rho \neq$ constant, just in that case, energy-matters inside BH would certainly collapse into its center and become a mini BH ($m_{om} \approx 10^{15} \text{g}$) other than a Singularity as considered by GTR.

$$\text{From 2 page before, } dP/dR = -GM\rho/R^2 \quad (11c)$$

$$P = n\kappa T = \rho\kappa T/m_s \quad (11d)$$

From $M = 4\pi\rho R^3/3$, and from (13a),

$$T = (C^3/4GM) \times (h/2\pi\kappa)$$

$$P = \rho\kappa T/m_s = (\kappa/m_s) \times (3M/4\pi R^3) \times (C^3/4GM) \times (h/2\pi\kappa) = 3hC^3/(32\pi^2 GR^3 m_s)$$

$$dP/dR = d[3hC^3/(32\pi^2 GR^3 m_s)]/dR = -(9hC^3)/(32\pi^2 Gm_s R^4) \quad (13ba)$$

$$-GM\rho/R^2 = -(GM/R^2) \times (3M/4\pi R^3) = -(3G/4\pi R^3) \times (M^2/R^2),$$

$$\text{from (11a) } M_b/R_b = C^2/2G = M/R,$$

$$\text{So, } -GM\rho/R^2 = -3C^4/(16\pi GR^3) \quad (13bb)$$

Take (13ba), (13bb) into (11c),

$$-(9hC^3)/(32\pi^2 Gm_s R^4) = -3C^4/(16\pi GR^3)$$

$$\therefore 3h/(2\pi m_s R^4) = C/R^3 \quad (13bc)$$

$$R = 3h/(2\pi C m_s) = r_{om} \quad (13bd)$$

$$r_{om} = 3 \times 6.63 \times 10^{-27} / (2\pi \times 3 \times 10^{10} \times 1.67 \times 10^{-24}) \approx 0.63 \times 10^{-13} \text{cm}$$

The numerical value of R is the same with the First section ($r_{om} = 3 \times 10^{-13} \text{cm}$) above.

$$\text{So, } R = 0.63 \times 10^{-13} \text{cm} \approx r_{om} = 3 \times 10^{-13} \text{cm} = \text{constant,}$$

$$T = 0.1154/R = 10^{12} \text{k} = t_{om}.$$

From (11aa), (13aa),

$$M = RC^2/2G = r_{om} C^2/2G = 0.43 \times 10^{15} \text{g} \approx m_{om},$$

Formula (13bd) above is not relative to the mass of any BH (M_b). A sole value of (R) can be gotten in any BH, if any mass (mass $> 10^{15} \text{g}$) could collapse to become a BH. R = a constant $\approx r_{om} \approx 0.63 \times 10^{-13} \text{cm}$. **As a result, BH ($m_{om} \approx 10^{15} \text{g}$) is the sole minimum BH in**

any BH and is a special solution to formula (11c). Except the mini BH, another points in BH cannot get the perfect equilibrium between the contracting gravity (F) and the pressure intensity (dP/dR). It is seen from formula (13bc), if (R) contracted to $R < r_{om}$, the result would be in mini BH, $dP/d(-R) > +GM\rho/R^2$, that case would be impossible to presence. Thus, in BH, $m_{om} = 0.43 \times 10^{15} \text{g}$ is the minimum BH. If $R > r_{om}$, then $dP/d(-R) < +GM\rho/R^2$, the energy-matters in BH would ~~collapse~~ the trend contracting to its center, but the mini BH (m_{om}) at the center as a solid core can counteract the surplus of the contracting gravity and obstruct the collapse of energy-matters in BH to become a Singularity. **Thus, mini BH ($m_{om} = 10^{15} \text{g}$) is the smallest or minimum BH in any BH.**

The lifetime τ_{om} of m_{om} , $\tau_{om} \approx 10^{-27} \times m_{3om} (s) = 10^{10}$ years. ^{<2>} **Therefore, the mini BH ($m_{om} \approx 10^{15} \text{g}$) is very stable. Its lifetime of 10^{10} years is equal to the present age of our universe.** In 1970s, many scientists endeavored to find out the primordial black holes of that size ($m \approx 10^{15} \text{g}$) coming from our baby universe, but their efforts were all in vain.

Density ρ_{om} of m_{om} , $m_{om} = 4\pi\rho_{om}r_{om}^3/3$, $\rho_{om} \approx 10^{53} \text{g}$. The density of mini BH ($m_{om} \approx 10^{15} \text{g}$) is very great. Thus, the mini BH cannot be formed from the direct collapse of a star in nature, but can only formed from the collapse of the energy-matters with great density in BH. It is said, mini BH was only formed closely after a BH had built up. It can only exist at the center of a star-formed BH with spherical symmetry, because the contracting gravities in Schwarzschild's BH are spherical symmetry.

The proton numbers n_{pom} of m_{om} ;

$$n_{pom} = m_{om}/m_p = 10^{15}/1.67 \times 10^{-24} = 10^{39}.$$

10^{39} = static electric force/gravitational force. It shows that 10^{39} neutrons broken up occupy the space of a present neutron. It is said, **inside mini BH, the gravity between two closest particles is equal to the exclusive force of their electricity.** The number 10^{39} is a mysterious number hidden in nature.

Third; Formulas (13aa), (11a) and (11e) as a group of simultaneous equations can be solved, and the sole solutions of M_b , T_b , R_b can be precisely gotten. From formulas (11e) and (11a), $\alpha\kappa T = m_s GM/R$, let $\alpha = 1$, then $R_b = 2GM_b/C^2$, let T_b , R_b , M_b instead of T, M, R,

$$\text{So, } T_b = m_s C^2/2\kappa = 5.4 \times 10^{12} \text{k} = t_{om}. \quad (13be)$$

$R_b = 0.1154/T_b = 0.2 \times 10^{-13} \text{cm} \approx r_{om} \neq 0$. Thus, no Singularity can appear.

$$M_b = R_b C^2/2G = 0.13 \times 10^{15} \text{g} \approx m_{om}.$$

The mini BH has the approximately equal numerical values of (m_{om}, r_{om}, t_{om}) in three sections above and is derived from six formulas of the different theories. ($\alpha = 1$) shows an ideal state. Formula (11e) expresses that the potential energy of a particle (m_s) ($P_{om} = m_s Gm_{om}/r_{om} = m_s C^2/2$ = a maximum constant)

in mini BH is exactly equal to its heat energy ($Q_{om} = \kappa t_{om}$) after its gravitational collapse. Thus, temperature t_{om} is the highest one, and then ($m_{om} \approx 10^{15}g$) is a **minimum BH as a balance point at the center in any BH.**

From formula (11e), if $\alpha < 1$, so $\kappa t_{om} > m_s$, Gm_{om}/r_{om} , that condition is the same with $dP/d(-R) > +Gm_{om}/r_{om}$ above. If $\alpha > 1$, so $\kappa t_{om} < m_s$, Gm_{om}/r_{om} that condition is the same with $dP/d(-R) < +Gm_{om}/r_{om}$ above.

(C). The space in BH (M_b) is full of energy-matters; the states and structures in BH

According to GTR, the space between Event Horizon of a BH and Singularity at its center is a pure vacuum. That corollary of pure GTR would be negated by the concepts in this article below.

Suppose another BH (m_o, t_o, r_o) in the space between the BH (M_b, T_b, R_b) and the mini BH (m_{om}, t_{om}, r_{om}). Let $m_o = \beta_2 M_b$, β_2 --coefficient, $\beta_2 < 1$. From formulas (11a), (13a) and (13aa),

$$t_o = T_b/\beta_2, \quad r_o = \beta_2 R_b, \quad t_o \times r_o = (T_b/\beta_2) \times \beta_2 R_b = T_b \times R_b = 0.1154 \text{cmk},$$

The results above show that (m_o, t_o, r_o) is a real small BH between Event Horizon and the mini BH at the center. By the same method, it can be proved that there are innumerable small BHs full of the space in BH with the countless β_2 . Every small BH composes a concentric sphere with the same radius and contains all smaller BHs in its Event Horizon. Therefore, the space inside Event Horizon of BH (M_b, T_b, R_b) is full of energy-matters and not a vacuum state.

The states and structure in a BH can be expressed by some parameters relative to the different radius r_o in BH (M_b). (suppose exterior BH -- M_o, R_o, T_o , mini BH-- m_{om}, t_{om}, r_{om} , medium BH-- m_o, r_o, t_o , τ --lifetime, ρ --density,)

$$\begin{aligned} r_o \text{ in } (M_b), r_o = \text{radius of } m_o, & \quad r_{om} \approx 10^{-13} \text{cm}, & \quad R_b \approx 3 \times 10^5 \text{cm} \\ \text{mass, } m_o = (C^2/2G) \times r_o, & \quad m_{om} \approx 10^{15} \text{g}, & \quad M_b \approx 2 \times 10^{33} \text{g} \\ t_o \text{ of } (m_o), t_o = 0.1154/r_o, & \quad t_{om} \approx 10^{12} \text{k}, & \quad T_b \approx 10^{-6} \text{k} \\ \rho_o \text{ of } (m_o), \rho_o = (3C^2/8\pi G)/r_o^2, & \quad \rho_{om} \approx 10^{53} \text{g/cm}^3, & \quad \rho_b \approx 10^{17} \text{g/cm}^3 \\ \tau_o \text{ of } (m_o), \tau_o = (10^{-27} C^6/8G^3) \times r_o^3, & \quad \tau_{om} \approx 10^{10} \text{yrs}, & \quad \tau_b \approx 10^{65} \text{yrs} \end{aligned}$$

(D). How can the different temperatures (t_o) be changed with the different radius (r_o) in a star-formed BH in accordance with the Hawking's theory of BH?

The approximately equivalent numerical values of mini BH (m_{om}, r_{om}, t_{om}) in above three sections of (B) are gotten under the condition of every particle possessed the same mass ($m_s = 1.67 \times 10^{-24}g =$ mass of a proton or a nucleon,). Is it really? Why is it so? Will the mass of (m_s) be the maximum particles of long lifetime in any BH and in nature? (see 19th paragraph)

Firstly; If $m_s \neq$ a constant in nature, and they were all stable particles of enough long lifetime, from formula (13aa) $t_o = 0.1154/r_o$, formula (13bd) $R = r_{om} = 3h/(2\pi C m_s) = 0.63 \times 10^{-13} \text{cm}$, and formula (11aa) $m_{om} = r_{om} C^2/2G$. So, (r_{om}) or (m_{om}) or (t_{om}) of mini BH is

decided only by every same (m_s) in BH. As a result, the different (m_s) in nature will lead to the formation of the different mini BHs (m_{om}) in BHs. That condition does not accord with reality of our universe.

However, the real condition in our universe is that $m_s =$ mass of proton $= 1.67 \times 10^{-24}g =$ constant. **Protons are the largest and most stable particles in nature;** its lifetime is over 10^{30} years. Thus, **in our universe, at the center of all star-formed BHs, the same mini BH ($m_{om} \approx 10^{15}g$) would certainly exist.**

Suppose there were enough different kinds of stable particles m_o (mass $m_o < m_s$) other than $m_s (=$ proton) in a star-formed BH, the real structure in BH should be: a mini BH ($m_{om} \approx 10^{15}g$) formed by m_s at the center, particles m_o lighter than m_s would occupy the space between mini BH and Event Horizon. The lighter particles would locate the place of the bigger radius of BH r_o . The lightest particles are on Event Horizon. Thus, temperature t_o of any radius r_o in a BH could accord with demand of Hawking's theory, because formula (11aa) shows, $t_o \times m_o = 10^{27} \text{gk}$.

Secondly; Under the condition of **all $m_s = 1.67 \times 10^{-24}g =$ a constant = mass of a proton in a star-formed BH,** mini BH (r_{om}) formed by enough m_s at the center has the highest temperature (t_{om}), and Event Horizon (R_b) has the lowest temperature (T_b). Thus, at different place of radius ($r_o > r_{om}$) in BH, surplus m_s except m_s in mini BH would spread in space between mini BH and Event Horizon. For attaining the demand of Hawking's theory to temperature t_o on different r_o , the bigger r_o is, the lower density ρ_o should have. Thus, the different temperature on different radius could accord with Hawking's theory.

Two conditions above may simultaneously exist in actual star-formed BHs.

(E). The exchange of energy-matters through Event Horizon, unstableness of the Event Horizon of BH

In any BH (M_b) ($5M_o > M_b > 10^{15}g$), energy emissions are extremely low. The exchange of energy-matters passed only through Event Horizon would lead to Event Horizon oscillated. From formulas (11a) $R_b = 2GM_b/C^2$, and (13aa) $T_b R_b = 0.1154$, If the temperature on Event Horizon is lower than environment outside, BH can take in energy-matters outside and simultaneously increase (M_b), lengthen (R_b) and lower (T_b). That condition will never stop until taking in all energy-matters outside. It is the same condition for a BH to take in materials outside or collide with the star objects. In addition, according to Hawking's theory, if the temperature on Event Horizon is higher than the temperature of its environment outside, BH can radiate energy-matters to outside. It leads to the decrease in (M_b), (R_b), and to the increase in (T_b) and (ρ_b) (density of BH). The process of radiating energy-matters is a contracting process onto the mini

BH from Event Horizon.^{<1>} A BH is composed by the infinite small BHs of concentric spheres with different r_0 . If a BH nonstop radiates energy-matters to outside, its concentric spheres will be shrink and split off from Event Horizon to mini BH layer by layer. The finality of the disappearance of whole BH would be the last explosion of gradually shrunk mini BH with emitting the strongest γ -rays and x-rays.^{<1><4>}

The character of any BH is always nonstop neither emitting energy to outside nor taking in energy-matters from outside until its final vanish, its Event Horizon would be oscillated nonstop.

According to Hawking's theory, the rate of radiating energy of a BH is:

$$dE/dt \approx 10^{46} M^{-2} \text{ erg/s}, \quad (13k)$$

Suppose $M = M_0 = 2 \times 10^{33} \text{ g}$, $dE/dt \approx 10^{-20} \text{ erg/s}$, based on such extremely tiny rate, a BH of sun mass (M_0) needs about 10^{65} years to radiate out all its mass. Lifetime τ_b of a sun mass (M_0) BH;

$$\tau_b \approx 10^{-27} M_b^3 (\text{s}) = 10^{-27} M_0^3 = 10^{-27} \times (2 \times 10^{33})^3 \approx 8 \times 10^{72} \text{ s} \approx 10^{65} \text{ years}, \quad (13l)$$

In reality, the strong gravitational field of star-formed BH can almost absorb in energy-matters from its surrounding, and its radiation speed is extremely slow, BH mostly expands its size, except that its surrounding has become a vacuum state or the temperature of surrounding is lower than temperature of Event Horizon of BH.

Right now, whether BHs would emit energy-matters with other ways except Hawking's radiations remains a question.

(F). The formation of BH, its mass = M_b , , ($5M_0 > M_b \geq 10^{15} \text{ g}$)

As above-mentioned, the stability and equilibrium in BH (M_b) of ($5M_0 > M_b \geq 10^{15} \text{ g}$) have been studied. It is no doubt that $M_b \geq (10^{15} \text{ g} = m_{\text{om}})$ should be right. Why should ($M_b < 5 M_0$) be right too? For building up a star-formed BH, the density of BH must be greater than the density of the neutron star $\rho_n \approx 10^{15} \text{ g/cm}^3$. Suppose the density of BH $\rho_b \geq \rho_n \approx 10^{15} \text{ g/cm}^3$,

$$\text{From formula (11a), } R_b = C[3/(8\pi G \rho_n)]^{1/2} = 0.423 \times 10^{-4} C, M_b = \rho_n R_b^3 4\pi/3 = 8.5 \times 10^{33} \text{ g} \approx 5 M_0$$

The simple calculation above shows that the density of a BH (mass $M_b < 5M_0$) would be $\rho_b > \rho_n \approx 10^{15} \text{ g/cm}^3$. At that state, neutrons would be broken up and become quarks. That is to say, in the limits of ($5M_0 > M_b \geq 10^{15} \text{ g}$), there would be small BHs or quark stars inside or a mini BH at the center. Neutron stars cannot appear. Right now, it is uncertain whether quark stars could exist and have the quark degeneracy to resist the gravitational collapse, how quark star turns into BH and what limits of density should be had by quark stars. In any case, there is no Singularity at all.

14. The formation of BH (M_b) in limit of ($10^5 M_0 > M_b > 5M_0$) (Suppose BH had established after nuclear fusion)

With the same analysis above, the density of the white dwarf is about $\rho_w \approx 10^6 \text{ g/cm}^3$. The Schwarzschild's radius R_b of BH with the density ρ_w is:

$$R_b = C \times (3/8\pi G \rho_w)^{1/2} \approx 1.3C, \quad M_b = 4\pi \rho_w R_b^3 / 3 \approx 2.65 \times 10^{38} \text{ g} \approx 10^5 M_0$$

The simple calculations above express that in BH (M_b) of ($10^5 M_0 > M_b > 5M_0$), either neutron star or BH might presence. If BH appeared, a mini BH would exist at the center, but the white dwarf would hardly appear. Probably, with taking in energy-matters from its surroundings, neutron star would become a quark star or a BH. Right now, it is not known what process and mechanism are necessary for the change from a neutron star into a quark star or into a BH.

15. The structure in BH (M_b) of ($10^5 M_0 < M_b < 10^{23} M_0$) ($10^{23} M_0$ is the total mass of our present universe in its Event Horizon)

Such immense BH looks like our present universe. In our universal BH, the different locations can attain the different relative stability and equilibrium, which can obey the formulas (11a), (11e) and (13a). Everything except Singularity may appear and had existed in our universe. Singularity, which possesses the infinity of some physical quantities, is impossible to attain and keep the relative stability and equilibrium of its inside, so. Singularity has no possibility to appear.

Recently, many super-massive BHs of mass ($M_b \approx 10^9 M_0$) were discovered in universal space. According to calculation, its density on average is about $\rho_s \approx 0.0183 \text{ g/cm}^3$. In such BH, the different location can get the different stability and equilibrium to accord with formula (11e) and formulas (11a), (13a). Thus, anything could appear in it; the dust clouds, nuclear fusion, white dwarfs, neutron stars, BHs, etc, except Singularity.

In any case, within the universal endless evolution, after all H_2 in universe burn away, everything in universe included white dwarfs and neutron stars will finally turn into BHs. Along with the establishment of a BH, a small stable BH would inevitably appear and exist inside BH as a solid core to obstruct the gravitational collapse of the energy-matters. Through the extremely long evolution, all BHs will disappear with the quantum vaporization (Hawking's radiation) according to Hawking's theory of BH.

16. The further explanations and two possible models of BHs

In above-mentioned paragraphs, formulas (13a), (13aa), (13i), (13k), and (13l) all come from Hawking's theory about BHs. All BHs collapsed from the mass of few stars and came from broken neutrons, which are in the state of subatomic particles. Thus, applying Hawking's formulas in this article should be correct and suitable.

In reality, without Hawking's theory of BH, according to deduction of pure GTR, the small BHs or

the mini BH might appear and exist in any BH. [See sections (A) of paragraph 13 above].

There would be two possible models of BHs and two possible different destinies of BHs.

First, under the condition of that, no energy-matters radiate out permanently from BH (M_b), suppose the appearance of various small BHs (m_o, r_o, t_o) except Singularity appeared in a BH [see section (A) of paragraph 13], BH might permanently exist in nature. However, a BH could only increase its masses and size with taking in energy-matters or other objects from outside, after that, it would only become an absolutely bigger BH and keep the same size forever. Thus, **all BHs would have the infinite lifetime and would be eternal beings in nature. Is it possible in universe?** Another condition might be the appearance of Singularity in BH, it would lead to instant vanish of whole BH. Both conditions above have no possibility to appear in nature. Two wrong conclusions can be drawn from the principles of GTR, Newton's mechanics except Hawking's theory of BH.

Second, under the condition of that, the energy-matters can radiate out from BH, after the appearance of mini BH (m_{om}, r_{om}, t_{om}) except Singularity in a BH, mass of BH will decrease with energy-matters radiated out. Although BH could take in all energy-matters outside, after that, BH will gradually radiate out all energy-matters and disappear with the last explosion of mini BH. **The limited lifetime of BH can be calculated from formula (13l).** That result can be mainly gotten from Hawking's theory of BH and associated with Newton's mechanics, thermodynamics and GTR. In such a model of BH, the different radius (r_o) would have the different temperature (t_o). The new concepts in this article accord with the structures of above model.

17. Conclusions taken out from applying many current classical theories and formulas

(A). Mini BH [$m_{om} \approx 10^{15}$ g, $r_{om} = 3h/(2\pi C m_p)$] is a special solution of formula (11c) [$dP/dR = -GMp/R^2$], which can be considered as the simplified Tolman-Oppenheimer-Volkoff's equation.^{<7>}

The simple analyses above show that pure GTR has no way to solve problems in BH, especially Singularity. In substantiality, principles and equations of GTR are just the space-time geometry with four dimensionalities instead of gravity, and are without thermodynamic effect. Therefore, inside BH described by pure GTR, due to no antagonistic force produced by the thermodynamic effect, the gravitational collapse would inevitably lead to appearance of Singularity. **If there had been no Hawking's theory about BH, there could be no way to find out the mini BHs (mass $\approx 10^{15}$ g) possessing stability and long lifetime. Just such mini BH can obstruct the occurrence of Singularity in BH. A new formula [$r_{om} = 3h /$**

$(2\pi C m_p) \dots (13bd)$] of mini BH as a special solution to (11c) can be precisely gotten [see paragraph 13 (B)]. Once thermodynamic effect had been applied to GTR equation, it would become TOV equation. However, TOV equation is too complicated and has no additional temperature restraints, it cannot be solved in BHs right now. In this article, formula (13a) [$T_b = 0.4 \times 10^{-6} M_o/M_b$] is used as the additional temperature conditions to (11c), hence formula (11c) can be solved. **Without Hawking's theory of BH, there could be no way to know the lifetime of any size of BHs**, in addition, Hawking's formulas (13k), (13l) can insure the stability and long lifetime of mini BH. **Just from Hawking's theories of BHs, it has been known that BHs can change its energy-matters with its surroundings.** Now, BHs have become the living bodies from the dead bodies in the past.

The Hawking's theory about BH extricates the crisis of pure GTR about Singularity in BH. The same condition had already happened in atoms. Just Uncertainty Principle of Quantum Mechanics has obstructed all electrons in our universe from dropping into atomic nuclei so that we can live in an admirable present world.

(B). In any star-formed BH, the equilibrium between gravity and thermodynamics can certainly lead to the occurrence of a mini BH ($m_{om} \approx 10^{15}$ g) formed by stable protons at its center, mass of mini BH is decided by mass of stable proton.

Mini BH is a perfect equilibrium body; it has extremely long lifetime (10^{10} years) and possesses the greatest density. Mini BH would become a solid core to obstruct the collapse of energy-matters in BH to become Singularity. In nature, anybody has its solid core or its bone to support and attract the materials outside the core. There will be no exception for BHs. **From formula (13bd)-- $r_{om} = 3h/(2\pi C m_p)$, the size r_{om} of mini BH is only decided by m_p (mass of proton). In nature, protons have the longest lifetime and stability. The lifetime of protons $L_p \approx 10^{30}$ years \gg the lifetime of mini BHs 10^{10} years, but $L_p \ll$ the lifetime of star-formed BHs 10^{65} years. Right now, in the final analysis, the stability of mini BH may probably be decided by the stability of protons. The age of present universe is only about 10^{10} years, it will not be known how will be the evolution of our universe after disappearance of protons.**

From six formulas of different classical theories, the same values of every physical parameters of BHs have been exactly gotten. It is said, **four physical parameters ($m_{om}, t_{om}, r_{om}, m_p$) of mini BH can be exactly gotten from four independent formulas below:**

First, from formula (13i) [$S_b/S_m = 10^{18} M_b/M_o$], $m_{om} \approx 10^{15}$ g can be got.

Second, from formula (11a) [$R_b = 2GM_b/C^2$],

$r_{om} \approx 3 \times 10^{-13}$ cm can be got.

Third, from formula (13a) [$T_b \approx 0.4 \times 10^{-6} M_0 / M_b$], $t_{om} \approx 10^{12}$ k can be got.

Fourth, from formula (13bd) [$r_{om} = 3h / (2\pi C m_s)$], $m_s = 1.67 \times 10^{-24}$ g = mass of proton.

Here the value of m_s can be exactly calculated out. It has important significance. Formula (11e) can be used for checking the calculated values of m_s and t_{om} above, **the results are exactly right and precisely accord with all calculated results.** It has perfectly proved that, **the actual existence of mini BH and its physical state in BH are completely consistent with all laws of classical theories applied before as well as the natural reality, i. e. $m_s =$ mass of proton = 1.67×10^{-24} g.** If no mini BH at the center had successfully obstructed the collapse of gravity of energy-matter in star-formed BH, star-formed BHs would have no possibility to exist in nature.

It has clearly showed that, **just protons (m_s) have excessive stability and long lifetime, and can keep the balance between gravity and thermodynamics. Thus, the formations and existence of mini BHs are the inevitable result of gravitational collapse.**

(C). In space of a star-formed BH, it is full of energy-matters, not a vacuum. That conclusion has important significance for mankind.

Structure of the star-formed Schwarzschild's BHs inside are composed by countless small BHs of concentrically sphere layer by layer, the mini BH ($m_{om} \approx 10^{15}$ g) is at the center. There are two completely different kinds of BHs in nature, one kind is star-formed BHs, and another kind is gigantic BH, such as our universal BH and super-massive BHs. Now that the space in star-formed BH is full of materials, not a vacuum; the space of universal BH with very low density should more be full of materials. People cannot directly see BHs only from their outside, so, BHs are absolutely black bodies and so-called BHs. However, once mankind and energy-matters could live in the space of a gigantic universal BH, those energy-matters would be visible for mankind. That is the reason that, mankind in the universal BH could have researched and detected the various interior states and structures of universe as a BH. It shows that the new concepts about BH in this article accord with the reality. Therefore, **The inside of a BH is not black.**

(D). Star-formed BH is a simple object in nature.

In all parameters of physical states of a BH ($M_b, T_b, R_b, \tau_b, \rho_b, \dots$ etc), once a parameter, such as M_b , is firstly decided, correspondingly, a sole value of all other parameters is decided by M_b . Thus, in reality, star-formed BH is a simple object in nature. BH is not the mysterious objects at all but only the object unknown by people in the past.

Especially, mini BH of (mass = 10^{15} g) is not only the simplest object, but is in the ideal state, because its entropy is the smallest in nature.

(E). Event Horizon of BH would be always oscillated.

A BH is always nonstop either to emit energy (Hawking's radiation) to outside, and to contract its size until its disappearance with last explosion, or to take in materials from outside and to increase in mass and size until outside become vacuum state. Thus, Event Horizon of BH would be always oscillated. BHs are very brisk objects and can be indirectly detected, but not the dead black bodies.

(F). Any BH would be a real BH forever until its final vanish.

Once a BH has formed, no matter whether it absorbs in materials from outside or radiates energy to outside, it would be a real BH forever until its final vanish.

(G). Any BHs must be formed at the center by gravitational collapse from a large amount of mass much more than mass of any BH itself. Any large amount of mass with very high density would have no possibility to form a BH with same density without gravitational collapse.

(H). From second section of 13 (B), it can be seen that, all above conclusions are derived on the foundation of $\rho \neq$ constant in any star-formed BHs. In case of $\rho =$ constant in star-formed BHs, the collapse of energy-matters would not appear, of course, Singularity would not appear too, moreover, G. B. Birkhoff's theorem should be able to be successfully applied. However, nobody can prove the validity of Birkhoff's theorem in star-formed BHs.

18. The original universal small BHs (its mass = mass of mini BH) had no possibility to have existed

According to analyses above, the lifetime of mini BH ($m_{om} \approx 10^{15}$ g, $r_{om} \approx 10^{-13}$ cm, $t_{om} \approx 10^{12}$ k) is about 10^{10} years, and equal to the present age of our universe. In 1970s, many scientists attempted to observe out such small BHs in universal space, but their efforts were in vain. Let's review our universal evolution at first. Look back the numerical values on figure (1) and chart 1 of Appendix A in part one, at the condition of temperature $T = 10^{12}$ k, corresponding time $t = 10^{-4}$ s, $\rho_c \approx 1.8 \times 10^{14}$ g/cm³. It was said, at that time, the whole expanding universe was like a gigantic neutron star. However, the density $\rho_{om} \approx 10^{53}$ g/cm³ of mini BH ($m_{om} \approx 10^{15}$ g) is too high, such ultra-high density were impossible to exist in an expanding universe at time of $t = 10^{-4}$ s. At the another condition, when the evolution of our expanding universe was at the density of ($\rho_c \approx 10^{53}$ g/cm³), the corresponding universal temperature $T \approx 10^{20}$ k and $t \approx 10^{-23}$ s, but the temperature (t_{om}) of mini BHs is about 10^{12} k, so, mini BHs ($m_{om} \approx 10^{15}$ g) had no possibility to appear at that time too. Where is the intersection

between temperature T of the universal evolution and temperature T_b of the different BHs?

From formulas of BHs before, $M_b/R_b = C^2/2G$, $T_b \times R_b = 0.1154$, $M_b = 4\pi\rho_b R^3/3$. So,

$$\rho_b = (3C^2 \times T_b^2)/(8\pi G \times 0.1154^2) \quad (18a)$$

$$\text{In universal evolution of part one, } \rho_c = 3/(8\pi G t^2), \\ T t^{1/2} = k_1 \approx 10^{10}, \text{ so, } \rho_c = 3T^4/(8\pi G k_1^4) \quad (18b)$$

In case $\rho_b = \rho_c$ and $T_b = T$, the double T 's solutions (T_1, T_2) can be gotten as below;

$$T^4/k_1^4 = C^2 T_b^2/0.1154^2, (k_1 \approx 10^{10}), \quad (18c)$$

$$T_1 = C k_1^2/0.1154 = 3 \times 10^{10} \times (10^{10})^2/0.1154 \approx 10^{32} \text{ k} \quad (18d)$$

$$T_2 = 0 \quad (18e)$$

Formula (18d) [$T_1 \approx 10^{32} \text{ k}$] shows that, only under the condition of 10^{32} k , temperature of BHs T_b was equal to temperature T of the universal genesis, the states of the universal small BHs were exactly consistent with the states of universe at the beginning of Plank's Era. From part one, at that moment; all minimum gravitational BHs ($m_i \approx 10^{-5} \text{ g}$, $T_b \approx 10^{32} \text{ k}$, $r_b \approx 10^{-33} \text{ cm}$) had jointly obstructed appearance of Singularity at genesis of original universe. That is a sole intersection between T and T_b in the universal endless evolution. Formula (18e) [$T_2 = 0$] expresses no physical meaning or the intersection of T and T_b will be in the unlimited remote future, because ($T_2 = 0$) is almost impossible or inconceivable. Is that result a coincident or an inevitable?

The demonstrations above only expresses that, in universal endless evolution, it would be impossible forever to produce out some original mini BHs, which density accorded with the same density of whole universe at that time. In universal evolution, especially before the end of Radiation Era, i.e. from genesis of our universe to its age of 400,000yrs, universe expanded very rapidly, its macro structure was still very uniform, and its temperature was high to over 3,000k, under that conditions, some parts in universe was no possible to cause the gravitational collapse to become some kinds of originally small BHs at each center.

However, after the end of Radiation Era, universe entered Matter-dominated Era, due to that, the density of whole universe became not uniform, the universal temperature decreased much lower than 100k, and the expanded speed between each parts became relatively slow. Therefore, at the center of some parts with higher density, the gravitational collapse could cause small BH, but once after such small BHs had been formed, they would certainly plunder enough energy-matters from each surrounding, and become greater and greater BHs, which would become the embryos of each galaxy or cluster. It is said, **any BHs must be formed at the center by gravitational collapse from a large amount of mass much more than mass of any BH itself, any isolated BH would not be formed at all only by the gravitational collapse of its own mass.**

19. The composition, the state and the vanishing process of mini BH ($m_{om} \approx 10^{15} \text{ g}$) in star- formed BH, the commonality between universe and BHs,

According to analyses before, originally universal mini BHs ($m_{om} \approx 10^{15} \text{ g}$) would be impossible to exist in universe, mini BHs could only form and exist inside star-formed BHs. Mini BH ($m_{om} \approx 10^{15} \text{ g}$) is a body of perfect equilibrium between thermodynamics and gravity, it has very long lifetime. The space outside its Event Horizon is full of energy-matters. Mini BH not only emits energy through its Event Horizon into outside, but also absorbs in energy-matters from outside, so that mini BH can keep dynamical equilibrium with outside as well as its stability. However, the temperature on Event Horizon of a star-formed BH is too low ($< 10^{-6} \text{ k}$). Thus, star-formed BH would almost take in energy-matters from outside, increase in its size and mass. Only temperature on Event Horizon of star-formed BH is a little higher than temperature of outside, such a BH will nonstop radiate energy to outside and decrease in its size and mass until mini BH may become a naked body. According to above calculation, if a BH of mass = M_0 could emit energy-matter over ($10^{65} - 10^{10}$) years, its mini BH would be naked out. What will happen next? **What will be the final destiny of mini BH?** See analyses below.

(A). The composition of mini BH ($m_{om} \approx 10^{15} \text{ g}$)

$$\text{Formula (13bd), } R_b = 3h/(2\pi C m_s) = r_{om} \quad (13bd)$$

$$\text{Formula (13aa), } T_b \times R_b \approx 0.1154 \text{ cmk} \quad (13aa)$$

$$\text{Formula (11aa), } M_b/R_b \approx 0.675 \times 10^{28} \text{ g/cm} \quad (11aa)$$

$$\text{Formula (13l), } \tau_b \approx 10^{-27} M_b^3 (s) \quad (13l)$$

The values of physical parameters of mini BH have been gotten in 13th paragraph, $m_{om} \approx 10^{15} \text{ g}$, $r_{om} \approx 10^{-13} \text{ cm}$, $t_{om} \approx 10^{12} \text{ k}$, $\tau_{om} \approx 10^{10} \text{ yrs}$, $\rho_{om} \approx 10^{53} \text{ g/cm}^3$, $m_s = 1.67 \times 10^{-24} \text{ g}$. Those values are gotten under the condition of every particle ($m_s = 1.67 \times 10^{-24} \text{ g} \approx$ mass of a proton or a quark) in mini BH.

At the moment of formation of star-formed BH, neutrons in neutron star must be broken up before a BH formed. From (13bd), perfect equilibrium and stability between gravity and thermodynamics in mini BH is only depend on mass of m_s (quark or proton). The heavier m_s is, the smaller mini BH will be. Are there heavier particles $> m_s$ in mini BH? It's impossible. If by any chance heavier particles appeared, they would have shorter lifetime and disintegrate sooner. Thus, in mini BHs, particles of (mass \approx proton) would steadily exist, its Event Horizon like a wall separated itself from its outside. Protons have extremely long lifetime ($> 10^{30} \text{ yrs}$).

(B). The vanishing process of mini BHs

After all energy-matters outside Event Horizon of a mini BH were emitted away, mini BH would become naked. Now, we know no way can stop emitting energy (Hawking's radiation) to a naked mini BH, because its

size is so small as a present neutron and its temperature is high to 10^{12} k. Thus, mini BH cannot choose but nonstop emit energy to outside, at the same time, its size and mass m_{om} are decreased and its temperature t_{om} are increased according to properties of BH. From (13bd), mass of particles m_s must grow up as the size r_{om} shrunk as to attempt keeping the equilibrium of shrunken mini BH. The characteristic of BH is that, once a BH had made up, no matter whether it enlarge or shrink, it would keep a BH forever until it vanished at the last moment. What is a last limit of size r_{om} shortened? The answer is: **once mini BHs shrink to its mass to $m_{om} \approx 10^{-5}$ g, i.e. $m_{om} = m_t \approx 10^{-5}$ g, mini BH would shrink no more and vanish at a strongest explosion, here m_t is the same one with original Minimum Gravitational Black Holes (MGBH) in part one of this article.** Check up values of all parameters of m_t as below; $m_t \approx 10^{-5}$ g, $r_b \approx 10^{-33}$ cm, $T_b \approx 10^{32}$ k, $\tau_b \approx 10^{-43}$ s, $\rho_b \approx 10^{92}$ g/cm³. Applying formulas (13aa),(11aa),(13l), when mini BH ($m_{om} \approx 10^{15}$ g) shrink to ($m_{om} = m_t \approx 10^{-5}$ g), all values of other parameters of m_{om} after shrinking are respectively equal to that of m_t , such as $r_{om} = r_b \approx 10^{-33}$ cm. Now calculating m_s in m_{om} from (13bd),

$$m_s = 3h/(2\pi Cr_{om}) = 3 \times 6.63 \times 10^{-27} / (2\pi \times 3 \times 10^{10} \times 10^{-33}) \approx 10^{-5} \text{ g} \approx m_t,$$

Calculation above expresses that, once m_{om} shrinks to $m_t \approx 10^{-5}$ g, then, **$m_{om} = m_s = m_t \approx 10^{-5}$ g.** It is said, **whole Minimum Gravitational Black Holes (MGBH) is just equal to single particle m_s .** Thus, MGBH(m_t) would be impossible to shrink any more, according to (11aa), r_{om} would shorten with decrease in m_t and lead increase in m_s , as a result, **$m_s > m_t$, it is absolutely impossible.** Could a leg of a person be heavier than his whole body? Thus, **any particle ($m_s = m_t \approx 10^{-5}$ g) of $r_{om} \approx 10^{-33}$ cm cannot choose but last vanish at an explosion in 10^{32} k. That is the last destiny of mini BH ($m_{om} \approx 10^{-5}$ g) as well as all BHs. It has been proved once more that, universe absolutely was not born from Singularity and there would absolutely have no Singularity in any BH.**

The vanishing conditions between mini BH after shrinking to $m_t \approx 10^{-5}$ g and the big contraction of pre-universe are completely different. Mini BH is just a single particle and emit energy to outside before its vanish, no new thing can be born after its explosion. However, collapse of pre-universe was extruded by countless particles between each other, and our new universe could emerge from ruins of pre-universe, **no collection of enormous energy, no birth of our universe.**

Analysis above indicates a possibly vanishing process of mini BHs or a possibly destiny of mini BHs. However, the age of our universe is about 10^{10} years. According to modern physical theory, once the age of our universe was beyond 10^{30} years,

all protons would vanish with their decay. Is it true? How will be the state and structure of our universe after protons have disappeared?

(C). About the artificial bombs of mini BHs

Some Russian scientists had advertised to produce artificial bombs of mini BHs or so-called Otone. It was not known how they got the exactly calculated numerical values about such bombs. It had been pointed out before that, in reality, BHs are the simplest bodies, once one physical parameter of BH is decided, all others will be respectively and solely decided by the first. For example, according to the stipulation of Russian scientists, mass of 1 Otone = mass of 40 atoms = $40 \times 1.67 \times 10^{-24}$ g $\approx 10^{-22}$ g = m_{ot} , correspondingly, from (13aa),(11aa),(13l),(13bd) above, $r_{ot} \approx 10^{-50}$ cm, $t_{ot} \approx 10^{51}$ k ($\approx 10^{38}$ GeV), $\tau_{ot} \approx 10^{-93}$ s, but mass of particle $m_{sot} \approx 10^{14}$ g. Utterly absurdly, ($m_{sot} \approx 10^{14}$ g) \gg ($m_{ot} \approx 10^{-22}$ g). In addition, could such bomb be made up with values of any parameter above? Could such bomb exist with lifetime of 10^{-93} s? How could radiations of its energy be obstructed at temperature 10^{51} k? Otherwise, suppose a bomb of mini BH will be wanted to have lifetime $\tau_{30} \approx 30$ yrs, according to (13aa), (11aa), (13l), (13bd) $m_{30} \approx 10^{12}$ g, $r_{30} \approx 10^{-16}$ cm, $t_{30} \approx 10^{17}$ k, mass of particle $m_{s30} \approx 10^{-21}$ g $\approx 5 \times 10^2$ GeV. How can mass of 10^{12} g be extruded into the size of 10^{-16} cm? How can control and stop its energy emission? They said, it will be the century of "Otone" after 50 ~60 yrs. They also advocated that, mini BHs inside earth would ignite volcanic eruption, and mini BHs would lead to spontaneous combustion in human body, etc. It is really not known what are the scientific foundations about their talking to mini BHs.

(D). The commonality between universe and BHs,

For checking up the correctness of used theories, concepts and formulas about the birth of our universe and BHs before, the evolutionary process of a pretended mini universe as a example will be calculated below for reference to others who are interesting in this article.

Suppose a pretended mini universe out of ours was simultaneously born with our universe and both born from the same MGBHs ($m_t \approx 10^{-5}$ g), and the mini universe included N_m^{20} particles (MGBHs) of m_t . Thus, mass of mini universe $M_m \approx N_m^{20} \times 10^{-5}$ g $\approx 10^{15}$ g. It is obvious, $M_m = m_{om} \approx 10^{15}$ g, so, all other parameters of M_m are the same with m_{om} , $R_m \approx 10^{-13}$ cm, $T_m \approx 10^{12}$ k, $\tau_m \approx 10^{10}$ yrs, $m_{sm} \approx 1.67 \times 10^{-24}$ g.

How long would be the expanded time (t_2) of mini universe from N_m^{20} of $m_t \approx 10^{-5}$ g to $M_m \approx 10^{15}$ g? Let us return back formula (1a) of part one, $R_1/R_2 = (t_1/t_2)^{1/2}$, here $R_1 \approx 10^{-33}$ cm, $R_2 \approx 10^{-13}$ cm, $t_1 \approx 10^{-43}$ s, so, according to (1a), $t_2 \approx 10^{-3}$ s. From calculation before, it is known the vanishing time of $m_{om} \approx 10^{15}$ g in emitting energy would be 10^{10} yrs. Therefore, the **whole lifetime** of mini

universe M_m from its birth to vanish would be equal to: $10^{10} \text{ yrs} + 10^{-3} \text{ s}$.

However, the mass M_u of our universe in Event Horizon is 10^{56} g , numbers of MGBHs are ($N_o \approx 10^{61}$) $\gg (N_m \approx 10^{20})$. Are there any surplus mass outside M_u ? Have dark energy existed inside Event Horizon of our universe? Does such dark energy have exclusive force? What are dark energy? Such many problems have not been known, no way can calculate out the expansible time of our present universe. At last, **our universe would stop its expansion only with no energy-matters taken in from outside of Event Horizon, and then instantaneously emit energy (Hawking's radiation) to outside to lose its mass gradually until it come to naught finally at an explosion.**

Our universe was born from countless MGBHs and would finally vanish at an explosion of MGBHs, it is the same with BHs in essence. Both are all BHs and have all commonalities in BHs, but our universe is just a gigantic BH. The tremendous difference in mass between BHs would lead to the enormous differences in their structures, states, developments and lifetimes. The bigger the mass of BH is, the lower its temperature and density will be, and the much longer its lifetime is, the lifetime of a BH is proportional its mass³. Thus, the district of lower temperature in gigantic BH would have enough time to evolve out intelligence living beings even mankind.

20. A few words of the writer

The demonstrations in this article are simple, rough and break down the old conventions. It probably will not be welcomed and convinced by the majority of scientists and professors, because of lacking new theory and complicated mathematical equations. However, the new concepts, inferences and all calculated results in this article are derived from many current classical theories, and are very closely consistent with the physical and natural laws in nature. **The important contribution in this article is to have found out mini BH ($r_{om} = 3h/(2\pi C m_s)$) as a special and simplified solution of formula (11c) [$dP/dR = -GM_p/R^2$] and TOV equation applied in star-formed BH.** Another contribution is to apply some rough and simplified methods to have effectively researched macro states, structures inside the star-formed BHs. Of course, many

problems have been solved, much more complicated and knotty problems would have been left for others.

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-----

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