The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All

New Edition

====Part 1: Black Holes====

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《Black Holes: The Final Gravitational Collapse Of The Event Horizon Of Any BHs In Nature Would Only Contract To Planck Particle $m_p = M_{bm} = 10^{-5}$g And Disintegrate in Planck Era, But Impossibly Contract To Singularity Of Infinite Density.》

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【Abstract】: In this article, author doesn't propose any hypothesis and any supplementary condition, may derive out directly "the finally gravitational contraction of any black holes (BH) could impossibly become singularity, but Planck particles $m_p = M_{bm}$ and disappear in Planck Era". That result is got from Hawking laws about BH and other classical formulas together. The superiority of author's method is to apply a group of formulas only to research the changes of physical parameters on the event horizon (EH) of any BHs, regardless of the complicated state and structure inside BHs. Thus, the final contracted result of EH of BHs could only become Planck particle $m_p = M_{bm}$ (minimum BH), but not singularity. Since the final collapse of EH of BH with its all mass (M_b) had to become m_p, if there were little BHs inside, it could certainly contract to m_p in advance. The fundamental defect of the General Theory of Relativity Equation (EGTR) is that, any particles in EGTR has no thermodynamic action to resist the gravitational collapse, it would certainly lead to occurrence of singularity. On the contrary, Hawking formulas of BH were built on the foundation of thermodynamics and quantum mechanics, the heat pressure could resist the gravitational collapse forever.

According to above explanations and analyses, an important formula will be got as below:

$$m_{ss} M_b = hC/8\pi G = 1.187\times10^{-10}g^2 \quad (1d)$$

In above formula (1d), m_{ss} is the mass of Hawking quantum radiation (HQR) on the EH, M_b is the mass of whole BH. $m_{ss}M_b$ is a constant. From (1d), in the real universe, $M_b \neq 0$, and, $m_{ss} \neq 0$, the smaller M_b is, the bigger m_{ss} can be. According to axiom of any part ≦the whole, at the limited condition, $m_{ss} = M_b = (1.187\times10^{-10}g^2)^{1/2}$. Thus, M_b is impossible become a singularity.

$$m_{ss} = M_b = M_{bm} = (hC/8\pi G)^{1/2} = m_p = 1.09 \times 10^{-5}g \quad (1f)$$

Formula (1f) is the best important. correct and final conclusion in this article got by author. It clearly shows that, the final gravitational collapse of any BH would become Planck particle m_p, and explode in Planck Era, but not continuously go to singularity of infinite density. Many new concepts and laws in this article are all the further developments to Hawking theory about BHs. In science, the simplest is the best. The demonstrations in this article is the simplest, whether it is good or bad will remain to reader's comments.

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【Key words】。 black holes (BH); singularity; star-formed Schwarzschild (gravitational) black holes: Planck particle--m_p; Planck Era; Hawking quantum radiation (HQR); General Theory of Relativity Equation (GTRE); minimum BH--M_{bm}

In this whole article, only Schwarzschild (= gravitational) BHs of no charges, no rotating and spherical symmetry will be studied as below.

【I】。Regardless of the states and structures in BHs, the final contraction of the event horizon (EH) and mass M_b of any BHs due to emit Hawking quantum radiations (HQR) could only become minimum BH (M_{bm}) equal to Planck particle (m_p), it could impossibly contract to singularity.

According to Hawking radiation law of BHs and Schwarzschild special solution to GTRE and other classical formulas, the relationship of many physical parameters on the event horizon (EH) of BHs can be got as below: M_b — mass of a BH, T_b —temperature on EH of BH, m_{ss} —mass of Hawking quantum radiation on BH, R_b —radius of EH of a BH, h—Planck constant = $6.63\times10^{-27}g{*}cm^2/s$, , C —light speed =$3 \times 10^{10}$cm/s,, G —gravitational constant = $6.67\times10^{-8}cm^3/s^2{*}g$, Bolzmann conseant $\kappa = 1.38\times10^{-16}g{*}cm^2/s^2{*}k$,

m_p –- Planck participle, L_p ---Planck length, T_p ---Planck temperature,

Applying Hawking law and other classical formulas to derive out the final gravitational collapse of EH of BH. Hawking temperature formula on EH of BH,

$T_b = (C^3/4GM_b) \times (h/2\pi\kappa) \approx 10^{27}/M_b$,[2] (1a)

Formula of energy transformation (i.e. gravitational energy transfer into radiation energy through valve temperature) on EH of BH,

$m_{ss} = \kappa T_b/C^2$ [1][2] (1b)

According to Schwarzschild special solution to GTRE,

$GM_b/R_b = C^2/2$ [1][2] (1c)

From (1a) and (1b), then,

$m_{ss} M_b = hC/8\pi G = 1.187\times10^{-10} g^2$ (1d)

Formulas (1a),(1b),(1c), (1d) are 4 general laws effective on any EH of BHs. In formulas (1a) and (1d), due to that, $T_b M_b$ = constant, $m_{ss} M_b$ = constant. So, m_{ss}, T_b and M_b is impossible ∞ or 0, then, m_{ss}, T_b and M_b all have its limit. Furthermore, according to axiom of any part ≦the whole, m_{ss} is impossible > M_b, at the limited condition, the maximum m_{ss} = the minimum M_b-- M_{bm}, so,

$m_{ss} = M_{bm} = (hC/8\pi G)^{1/2} = 1.09 \times 10^{-5} g$ [3] (1e)

Owing to $(hC/8\pi G)^{1/2} \equiv m_p$ [3] **so,**

$m_{ss} = M_{bm} = (hC/8\pi G)^{1/2} \equiv m_p \equiv 1.09\times 10^{-5} g.$ (1f)

$R_{bm} \equiv L_p$[3]$\equiv (Gh/2\pi C^3)^{1/2} \equiv 1.61\times 10^{-33} cm$ (1g)

$T_{bm} \equiv T_p$[3]$\equiv 0.71\times 10^{32} k$ (1h)

$R_{bm} m_{ss} = h/(4\pi C) = 1.0557\times10^{-37} cmg$ (1i)

Similarly, $m_{ss} \neq 0$, $R_{bm} \neq 0$, so, R_{bm} and m_{ss} all have its limit.

The best important conclusion: 1. From fotmulas (1b), (1c), whether one of M_b, R_b, T_b, m_{ss} is 0 or ∞ can not be judged. That is reason why singularity could present in General Theory of Relativity Equation (GTRE). However, from formula (1a), (1d) and (1i), any one of M_b, R_b, T_b and m_{ss} can impossibly be "0 " or "∞", so, each of 4 has to its limit. That are results of Hawking theory about BHs to apply thermodynamics and quantum mechanics. 2. When a BH could get into the gravitational collapse because of emitting Hawking quantum radiations (HQR) after engulfing all energy-matters outside, it would continuously shrink its size R_b, increase in T_b, lose mass M_b and finally become $M_{bm} = m_{ss} \equiv m_p$. In addition, M_{bm}, R_{bm}, T_{bm}, m_{ss} form a perfect minimum BH, and perfectly and individually equal to m_p, L_p, T_p of Planck Era,

【2】. In the process of the gravitational contraction of any original nebula (matters), the principle of a particle m_s emitted to outside in nebula is the same mechanism with HQR emitted to outside from EH of a BH. They are all from high energy (temperature) flowing to low energy (temperature). The final result of both continuously contracted process are all the complete same, i.e. $M_{bm} = m_p = (hC/8\pi G)^{1/2} \equiv m_p \equiv 1.09 \times 10^{-5} g$. Thus, Hawking quantum radiations (HQR) are just the energy particles, which have the lower energy (temperature) than the valve temperature on EH and may flee out from the restraint of gravity of BHs to go to outside.

For examining the correctness of (1f); Suppose a particle m_s in nebula and on the boundary of R, if m_s is in the state of thermodynamic balance and locate at the end of R, then,

$dP/dR = -GM\rho/R^2$ [3] (2a)

$P = n\kappa T = \rho\kappa T/m_s$ (2b)

$M = 4\pi\rho R^3/3$ (2c)

Formula (2b) is the state equation of gas or particles, Formula (2c) is the formula of ball volume, P – pressure of R end, M –total mass in radius R, ρ – average density of R ball, T – temperature of R end,

Applying formulas (2a), (2b), (2c), (1a), (1c) together. Formulas (1a), (1c) are right to physical parameters on EH of any BHs, so, the results of parameter values got from solving following equations are all on EH of BH. Thus, to any BHs, in reality, M, R are all completely equal to M_b, R_b as below.

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

$dP/dR = d[3hC^3/(32\pi GR^3 m_s)]/dR = -(9hC^3)/(32\pi^2 Gm_s R^4)$, $(\therefore dP/dR \propto R^{-4})$, (2d)

$-GM\rho/R^2 = -(GM/R^2)\times(3M/4\pi R^3) = -(3G/4\pi R^3)\times(M^2/R^2)$,
from (1c), $M_b/R_b = C^2/2G = M/R$.
$\therefore -GM\rho/R^2 = -3C^4/(16\pi GR^3)$, ($\propto R^{-3}$) (2e)
let (2d), (2e) into (2a),
$-(9hC^3)/(32\pi^2 Gm_sR^4) = -3C^4/(16\pi GR^3)$,
or $3h/(2\pi m_sR^4) = C/R^3$
$\therefore R = 3h/(2\pi Cm_s)$, or
$\therefore Rm_s = 3h/(2\pi C) = 1.0557\times10^{-37}$cmg (2f)
From (2f) and (1c), then,
$m_s M_b = 3hC/(4\pi G)$ (2g)

Comparing formulas (1d) and (2g), (1i) and (2f), only under the condition of $m_s = 6m_{ss}$, as the results, (1d) = (2g), (1i) = (2f). Why must $m_s = 6m_{ss}$? Because in deriving process from (2a) to (2g), density ρ and temperature T in formulas (2a), (2b) and (2c) used as the average values in a ball M of R, but not the real density and temperature on EH of BH, which < their average values, so, their combined effects let $m_s = 6m_{ss}$. Thus, under the condition of $m_s = 6m_{ss}$,
$\therefore m_s = 6m_{ss}$, (1d) ≡ (2g), (1i) ≡ (2f) (2h)

Thus, the gravitational collapse and final destiny of any nebula (particles) is the perfectly same with the EH of a BH. Their final destinies are all $m_{ss} = M_{bm} = (hC/8\pi G)^{1/2} = 1.09 \times 10^{-5}$g. In nature, any gravitational collapses of anybody are the certain results of discharging energy nonstop to outside.

Analyses and conclusions:

1*. Since formula (2h) accords with the real conditions, it is a circumstantial evidence to formulas (1d), (1f) and (1i). it shows that, the final collapse of EH of any BHs can reach to Planck Era, but not to singularity.

2*. Formula (2a) is really a simplified equation to Tolman-Oppenheimer-Volkoff equation. [7] Formula (2a) cancelled 3 complicated amended items from TOV equation. Thus, on the foundation of (2a), combined (1a), (1c) and (2b) as the boundary conditions, the correctness of (2f) and (2g) should be reliable.

3*. There are no essential distinctions for any BH or a star or a nebula to emit out or to attract in energy-matters. However, any BHs have very strong gravity, even light can't flee out from EH of BH. Owing to the very high density or big mass of current BHs, for example, a BH of $5M_0$, according to formula (1d), it could emit the extremely small energy of HQR equivalent to $m_{ss} = 1.187\times10^{-44}$g and absorb in any energy-matters > $m_{ss} = 1.187\times10^{-44}$g. A BH of mass $=10^{15}$g, its HQR = $m_{ss} = 1.66\times10^{-24}$g = mass of a proton. The current BHs in nature are all star BHs, so in people's mind, all BHs are rapaciously plundering energy-matters outside.

4*. How could HQR flee out from EH of BH? Just like a particle or quantum (energy or light) fleeing out from the boundary of a star or any body, once average energy of HQR < κT on EH, or its instant temperature < κT on EH duo to the heat motion and vibration, they could possibly flee out at a instant under the state of little lower temperature and energy.

【3】。No. 1 essential attribute of any BHs: Once a BH could be formed, it would be a BH forever until it finally become a Planck particle $m_p = M_{bm} = (hC/8\pi G)^{1/2} = 1.09 \times 10^{-5}$g, no matter whether it's expansion because of engulfing energy-matter from outside or it's contraction because of emitting HQR to outside.

According to Schwarzschild solution to GTRE, from (1c),
$R_b = 2GM_b/C^2$, (3a)
$\therefore C^2dR_b = 2GdM_b$
$C^2 (R_b \pm dR_b) = 2G(M_b \pm dM_b)$ (3b)
Suppose another BH M_{ba}, and,
$C^2R_{ba} = 2GM_{ba}$ (3c)
From (3a) + (3b) + (3c)
$\therefore C^2 (R_b \pm R_{ba} \pm dR_b) = 2G (M_b \pm M_{ba} \pm dM_b)$ (3d)

Formula (3d) clearly shows that, any BH, no matter whether it would emit out or plunder in energy-matters, or collide with another BH, it could only be a BH of different mass forever.

In 1998, two groups of U.S.A. and Australia discovered the accelerating expansion of our universe (AEOU) through observations to the bursts of remote supernovas Ia, they pointed out, that remote galaxies

are accelerating away from us. Most current scientists explained AEOU with "dark energy" of exclusive force in the universe. Author considered that, AEOU was due to the collision of our universal BH with other BHs in their early ages. Formula (3d) was proposed as the theoretical foundation for above hypothesis.

【4】。No. 2 essential attribute of any BHs: BHs are all the simplest bodies in nature. All physical parameters on the EH of BHs are only decided by mass of a BH, and have the same, sole, linear and single numerical value corresponding to mass M_b. In other words, any 2 physical parameters on the EH of all BHs have the same relationship of the sole, linear and single numerical value. Furthermore, no matter how structures and states inside different BHs, all EHs of BHs with the same mass M_b can have the completely same essential attributes. Therefore, there are not necessary for us for solving the complicated GTRE to study the structures and states inside BHs. Once knowing the mass of any BHs, then, knowing its all. This is Hawking's great contribution to the theory of BHs. From formulas (1a), (1b), (1c), (1d), it can be seen for any BHs, then,

$$M_b \propto R_b \propto 1/T_b \propto 1/m_{ss} \quad (4a)$$

【5】。No. 3 essential attribute of any BHs: Non-stop emitting HQRs to outside or engulfing in energy-matters from outside is other essential attribute of any BHs. Just like a star or a body to emit lights or infrared radiations, energy would always flow out naturally from high energy to low energy, no exception for any BHs to emit HQRs.

The EH of any BH is its boundary. The exchange of energy-matters must pass through EH. It can be seen from (2a), owing to that, HQR on EH would always be in the condition of heat motion, it could non-stop vibrate and have no an instant precise temperature, so, any HQR on EH could be in the unstable state and impossible to keep the thermodynamic balance at any instant. Thus, the exchange of energy-matters passed through EH would only lead to Event Horizon oscillated.

From formula (1b) $m_{ss}C^2 = \kappa T_b$, T_b is the valve temperature on EH, Really, EHs have become the switch of BHs to transfer energy-matters.

1*. Only in case κT_b of HQRs on or in BH, which instant temperature T_b is a little higher than outside, could flee out. After they fled out from EH. because of decrease in a little energy of BH, BH would contract a little size and increase in a little temperature, then, the energy distance would become bigger between EH and the fled HQR, which could impossibly return back into BH again. Thus, after losing a HQR, BH would continuously emit HQRs to outside, until finally become a Planck particle $m_p = M_{bm} = (hC/8\pi G)^{1/2} = 1.09 \times 10^{-5}$g, and explode in Planck Era.

2*. Obviously, in case outside particle $m_o > m_{ss}$ or outside temperature $T_o > T_b$, m_o and radiation energy κT_o outside can be attracted into BH. Thus, BH can nonstop attract in all energy-matters outside with increase in mass M_b and decrease in T_b on EH. After that, BH will nonstop emit HQRs to outside, until M_b finally become a Planck particle $m_p = M_{bm} = (hC/8\pi G)^{1/2} = 1.09 \times 10^{-5}$g, and explode in Planck Era.

3*. In case $m_o = m_{ss}$ or $T_o = T_b$, generally, because the number of particles and T_o outside are more then those on EH of BH, so. BH can attract in more energy-matters than those fled out. After that, the process and result will be the same with above 2* section.

The character of any BH is always nonstop taking in all energy-matters from outside at first, then, emitting energy to outside until its final vanish in Planck Era, its Event Horizon would be oscillated nonstop.

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

$$dE/dt \approx 10^{46} M^{-2} \text{ erg/s}, \quad (5a)$$ [2]

Suppose $M = M_\theta = 2\times 10^{33}$g $= M_\theta$, $dE/dt \approx 10^{-20}$ erg/s, based on such extremely tiny rate, a BH of sun mass (M_θ) needs about 10^{65}years to radiate out all its energy-matters and explode in Planck Era.

Suppose $M = M_\theta = 2\times 10^{33}$g, its HQR $= m_{ss} = 1.187\times 10^{-10}/(2\times 10^{33}) = 6 \times 10^{-44}$g. So, m_{ss} is too small. It shows that, mass of a BH equal to sun can almost absorb any tiny energy in the current space. If no energy outside, that sun BH can radiate HQR of 6×10^{-44}g, It is much smaller than a proton mass of $1,66 \times 10^{-24}$g.

It can be seen, Hawking theory and laws of BHs to emit HQRs are all right, but Hawking's explanations to emit HQRs are not correct and convincing. Normally, Hawking and the most modern scientists may explain HQRs with the concepts of vacuum energy. They recognized that a pair of virtual particles would be suddenly born out from vacuum, then annihilate and appear repeatedly. [1]. After negative particle on EH of BH being captured by positive virtual particle of vacuum and annihilating, then, the positive particle of BH would remain and appear outside BH and become a HQR fled out, Such explanations of them is a deliberate

myth with the new physical concept. The energy value of HQR on EH of BH is certain, why could a pair of virtual particles appeared have the same energy value with HQR on EH and both could meet at the same time and same place? In addition, the explanation of so-called "virtual energy" has not a reliable and certain numerical value right now in any theory and may have no way to be observed and examined forever.

Right now, whether BHs would emit energy-matters or not with other ways except Hawking's radiations remains a question.

【6】。No. 4 essential attribute of any BHs: After plundering all energy-matters outside, any BH could only contract its size R_b, decrease in M_b, increase in T_b and m_{cc} because of emitting HQGs continuously. The final destiny of every BH could only become minimum BH (M_{bm}) equal to Planck particle (m_P), then, explode and vanish in Planck Era at once. See formula (1f),

$$m_{ssm} = M_{bm} = (hC/8\pi G)^{1/2} \equiv m_p \equiv 1.09 \times 10^{-5}g$$

Why could M_{bm} be impossible to become < $\{(hC/8\pi G)^{1/2} \equiv m_p \equiv 1.09 \times 10^{-5}g\}$ and continuous contraction? Surely impossible.

1*. Once $M_{bm} < 1.09 \times 10^{-5}g$, its HQR ($m_{ss}$) < $1.09 \times 10^{-5}g$ too. Thus, $m_{ss} M_{bm} << ((hC/8\pi G)$. It violates formula (1d) of BHs.

2*. Once M_{bm} reach $1.09 \times 10^{-5}g$, its gravitational energy = $M_{bm} C^2 = 10^{16}$erg, its radiation energy = κT_b = $1.38\times 10^{-16}\times 0.71\times10^{32} = 10^{16}$erg too. So,

$$M_{bm} C^2 = \kappa T_b = 10^{16}erg \qquad (6a)$$

It can be seen, the reason why BH can emit HQR is that the bigger BH has surplus gravitational energy to transfer to radiation energy of HQR. However, once M_{bm} reach $1.09 \times 10^{-5}g$, the whole M_{bm} is a whole particle and has no surplus energy as HQR, it can only throughout explode, and wholly transfer $M_{bm} C^2$ to many and many small γ–rays of the highest energy of 10^{32}k.

3*. Owing to M_{bm} reach $1.09\times 10^{-5}g$, $M_{bm} C^2 = m_{ss}C^2$, it is said, the whole M_{bm} is a complete particle, no gravitational forces inside could continuously contract to resist the highest temperature of 10^{32}k inside the whole M_{bm}, thus, the whole M_{bm} must crushingly explode.

4*. According to Uncertainty Principle

$$\Delta E \times \Delta t \approx h/2\pi \qquad (6b)$$

To M_{bm}, $\Delta E = M_{bm} C^2 = \kappa T_b = 10^{16}$erg, Δt = Compton time = $R_{bm}/C = 1.61\times10^{-33}/3\times10^{10} = 0.537\times10^{-43}$.

$\Delta E \times \Delta t = 10^{16} \times 0.537\times10^{-43} = 0.537\times10^{-27}$, but $h/2\pi = 6.63\times10^{-27}/2\pi = 1.06\times10^{-27}$,

Obviously, $\Delta E \times \Delta t < h/2\pi$, it violates Uncertainty Principle. Thus, M_{bm} could impossibly exist, but only disintegrate and vanish in Planck Era, so, it has no way to contract to singularity.

【7】。Various substantial structures just are the best and last mechanism to resist the gravitational contraction in nature. Bodies of no gravitational collapse in nature have always a solid and stable core.

From the process of formation of star BHs, the reasons why singularity can impossibly appear and exist in star BHs will be clearly known. In GTRE, the appearance of singularity is base on the hypotheses of that, a ball of definite energy-matters could free and infinitely contract its size with no resistance. However, in reality, the contracted process of anybody must at least overcome two resistances: the first is the heat pressure of its energy-matters, and the second is its substantial structure.

1*. Any body of mass <10^{15}g, its chemical structure can support its gravity, needs not a solid core. Mass of 10^{15}g has 10^{39} (=$10^{15}/1.67\times10^{-24}$) protons. 10^{39} is a Dirac's large number.

2*. Planets of mass between 10^{15}g and 0.08 M_θ (1.6×10^{32}g) must need a core of liquid or solid irons to resist its gravitational collapse outside the core.

3*. Stars of mass > 0.08 M_0 (1.6×10^{32}g) : Owing to existence of the very high and stable pressure and temperature supplied by nuclear fusion, all stars cannot collapse in a long-term period, until nuclear fusion stopping in its core.

The pressure P_s in the core of sun is estimative about as below,

$$P_s = \rho_s \kappa T_s/m_p = 10^2\times1.38\times10^{-16}\times1.5\times10^7/1.67\times10^{-24} \approx 1.5\times10^{11} \text{ atm.} \qquad (7a)$$

4*, White dwarfs: It is generally estimated that, after finishing its nuclear fusion and through red giant star, the original star of mass < 3.5 M_0 could compress its remnant to become a white dwarfs of mass ≤1.44 M_0. 1.44 M_0 is called Chandrasekhar's limit. It is said, after a white dwarf plundering energy-matters outside or colliding with another companion star, its mass might go beyond Chandrasekhar's limit >1.44 M_θ, and become a neutron star. White dwarf has a solid core of density about 10^6g/cm^3 and has very long lifetime. In

the solid core, the distance between atomic nucleus is 10^{-12}cm, Electrons can freely flow and have the strong exclusive forces to resist the gravitational collapse outside the core. Once mass of a white dwarfs could approach 1.44 M_θ due to absorb matters outside, it would become a carbon-oxygen white dwarf and occur the strongest explosion of Ia supernova, and turn into powders scattered in space.

5*. Neutron stars: It is generally estimated that, after the original star of (3.5~8) M_θ finishing its nuclear fusion and after the strongest supernova explosion, its remnants might be contracted into neutron star of mass between(1.5~2) M_θ. It is said, mass of neutron stars may be (0.1~1.5~2) M_θ. Their density in core about 10^{14} ~5×10^{15}g/cm^3. Diameter of the biggest neutron star is 33km. The structural figure of neutron stars as below:

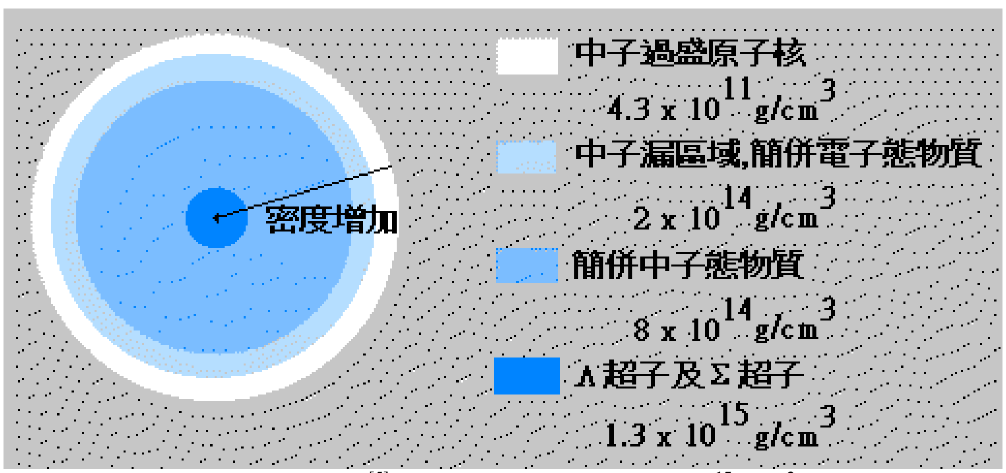
Parameters of neutron stars: mass of most M_n = (1.5~2) M_θ; density in core $\rho_n \approx 10^{14}$~ $10^{15.5}$g/cm^3; distance between neutrons, $d_n \approx 1.2\times10^{-13}$ cm; numbers of neutron in cm^3, $n_n = 10^{39}$ /cm^3; Λ and Σ are hyperons or solid neutrons in core.

Conclusions: 1. It shows clearly from above analyses and demonstrations that, before overcoming the very high density and crushing the extremely solid structure of its core formed by supernova explosion, any stars, no matter how great its mass is, can't continue or complete its gravitational collapse to compress matters to >10^{16}g/cm^3 in core.

2. From figure.1 below, the core of the density of neutron stars $\rho_n \approx 10^{14}$~ $10^{15.5}$g/cm^3. The formation of core of neutron star may be solid neutrons, or hyperons Λ and Σ.

3. If a neutron star could become a BH due to absorb energy-matters outside, only matters outside the core can be greatly compressed, the density in core can hardly increase any more, because the density between a little BH of 2M_θ and a neutron star of 2M_θ is almost the same, just their sizes have the great difference. Diameter of a neutron star of 2M_θ is about 33km, but diameter of little BH of 2M_θ is about 12km.

Figure. 1. Structural figure of neutron stars,



(Picture: LKL Astro-Group) [5] Hyperons Λ and Σ of 1.3×10^{15}g/cm^3 in blue little core.

【8】。Star BHs: Singularity could be impossible to occur in star BHs. The formation of star BHs, Generally, the mass of star BHs may be between (3~10) M_θ.

How could star BHs be formed? It is said, after nuclear fusion having finished and through supernova explosion, the remnants of the original stars of mass > 8M_θ might become a star BH of mass≥3 M_θ. Besides, if a neutron star could engulf energy-matters outside or collide with its companion white dwarf (or another neutron star), it might become a star BH of mass ≥ 3M_θ. 3M_θ is so=called Oppenheimer-Volkoff limit. However, those two conditions are just the theoretical inference, but no real observations can be as evidences.

Parameters of a BH of mass = 3 M_θ: M_{b3} = 3M_θ = 6 ×10^{33}g, its R_{b3} = 8.89×10^5cm≈9km, T_{b3} = 1.3× 10^{-7}k, HQR--m_{ss3} = 2 × 10^{-44}g. ρ_{b3} = 2× 10^{15}g/cm^3, [see formulas (1a), (1b), (1c), (1d), (2c)]

In 2006, a smallest star BH called XTE J1650-500 [6] was discovered, its mass = 3.8 M_θ. According to imagination and calculations by scientists, limit of mass of the smallest star BHs not still discovered in universal space might be (1.7~2.7) M_θ, then its density calculated is about $\rho_{b2} \approx 5\times10^{15}$g/cm^3.

Many important inferences and conclusions can be got from above calculations and analyses:

1*. Comparing the density of core between neutron star $\rho_n \approx 10^{14} \sim 10^{15.5} g/cm^3$ and density of the smallest star BH, their $\rho_{b3} = 2\times 10^{15} g/cm^3$ to $\rho_{b2} \approx 5\times10^{15} g/cm^3$, so, the core of small star BHs and neutron stars are the same thing, which may be all hyperons Λ and Σ. or solid neutrons. They have almost the same density, and are all originated from the explosion of supernovae.

The distance d_n between two adjacent neutrons in the core of neutron stars and star BHs,

$N_n = \rho_n / m_n = 5\times10^{15}/1.67\times 10^{-24} = 10^{39}$

$d_n = (1/N_n)^{1/3} = 10^{-13} cm$ **(8a)**

From (8a), in the core of neutron stars and star BHs, The distance d_n between two adjacent neutrons is equal to diameter of a neutron or a proton. Thus, under the density of about $5\times10^{15} g/cm^3$, atomic nucleuses of neutrons or protons are just closely contacted together, but far away from break.

2*. Owing to no star BHs < $2M_\theta$ existed in nature, the forces and pressures produced by the supernova explosions are the strongest forces in current universe and later. Thus, the matters of density $\rho > 5\times10^{15} g/cm^3$ have impossible to appear and exist in nature afterwards, then, matters of density $\rho_n \approx 5\times10^{15} g/cm^3$ are the highest density in nature.

3*. Since star BHs are all originated from the superstar explosion, supernova explosion would impossibly occur inside any star BHs again. Thus, star BHs inside would impossibly continue its gravitational collapse, so, it have impossibility of appearance of singularity.

4*. Owing to that, the bigger a star BH is, the lower its density can be. Thus, all BHs (> star BH of 10 M_θ) inside can be more impossible to produce > density of $10^{16} g/cm^3$, so, absolutely impossible to produce singularity inside.

5*. Since matters of density ≈ $5\times10^{15} g/cm^3$ in star BHs are hyperons or solid neutrons, it shows that, protons having become hyperons are not broken or disintegrated, and still keep their own quark chains, i.e. keep their proton formation. Maybe it is reason why protons have so long lifetime of about 10^{30} years.

6*。Since protons can keep their particle formation at about density $5\times10^{15} g/cm^3$, how great density may let protons disintegrated into quarks? Author consider that, protons may be disintegrated in density about $10^{53} g/cm^3$.

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 Sm--original entropy before the collapse of a star, S_b--the entropy after collapsing, M_θ--mass of sun = 2×10^{33}g,

$S_b/S_m = 10^{18} M_b/M_\theta$ [2] **(8b)**

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. From formula (8b), M_b will be 10^{15}g, and M_b = original mini BH = M_{bo} [1] [2]

Density of ($M_{bo} = 10^{15}$g) is $\rho_{bo} = 0.7\times10^{53} g/cm^3$; $R_{bo} = 1.5\times10^{-13}$cm; $T_{bo} = 0.77\times10^{12}$k; $m_{sso} = 12\times10^{-24}$g;

7*. The best important conclusions: Bekinstein only did a well mathematical arrangement to formula (8b), but neglected the profound physical implications of (8b). Author think, (8b) should be applied to explain some significant physical process.

Firstly, the gravitational collapse under the condition of density < $10^{53} g/cm^3$, the collapsed process should not be equal entropy. It clearly tell us that, protons can keep its particle formation, and not be disintegrated, so, protons as particles must have heat motions and frictions, and can change entropy more or less. Hyperons Λ and Σ are only protons of high temperature, and still formed from quarks.

Secondly, however, since in the changed process of density from $10^{53} g/cm^3$ to $10^{93} g/cm^3$, entropy can impossibly change, it shows that, protons must be disintegrated, and become into quarks. It also shows that, quarks might only be changed in the ideal state between density region from $10^{53} g/cm^3$ to $10^{93} g/cm^3$, no matter whether they were in expansive or contractive process, which were all the ideal process of equal entropy. In other words, quarks might have no heat motion and frictions changed between $10^{53} g/cm^3$ and $10^{93} g/cm^3$.

The best important conclusion: The strongest pressure in present universe produced from the supernova can only compress matters into density of about $5\times10^{15} g/cm^3$, what could be the most powerful force in nature to compress matters to density of $10^{53} g/cm^3$, even finally to $10^{93} g/cm^3$ of Planck particle (m_p)? The most powerful force is only the contracted force of very small BHs (<< star BH) due to radiating HQRs continuously, it can let BHs (mass < 10^{15}g) to contract nonstop to Planck particles. It obviously shows that, BHs only radiating nonstop its HQRs outside can nonstop go on its gravitational contraction until becoming to minimum BH-- $M_{bm} = (hC/8\pi G)^{1/2} \equiv m_p$ and disappearing in Planck Era.

【9】。Original mini BH = $M_{bo} \approx 10^{15}$g, Could those M_{bo} be found in the universe at present? In nature, the great significance of M_{bo} is its density of 10^{53}g/cm^3, only substantial density > 10^{53}g/cm^3, protons can be broken and disintegrated. That may be an important reason why protons have so long lifetime of 10^{30}years,

From formula (8b), the mass of original mini BHs = $M_{bo} \approx 10^{15}$g. Its other parameters are:

$R_{bo} = 1.5\times10^{-13}$cm; $\rho_{bo} = 0.7\times10^{53}$g/cm^3; $T_{bo} = 0.77\times10^{12}$k; $m_{sso} = 12\times10^{-24}$g

From formula (6b), lifetime of M_{bo}, $\tau_{bo} \approx 10^{-27} M_b^{\ 3}$ (s) = $10^{18}/ 3.156\times10^7$s $\approx 3\times10^{10}$yrs.

Compton time $t_{bo} = R_{bo}/C = 5\times10^{-24}$s,

Numbers of proton: $n_{bo} = M_{bo}/1.66\times10^{-24} = 10^{39}$, n_{bo} is other Dirac's large number.

According to calculations above, the lifetime τ_{bo} of original mini BH=$M_{bo} \approx 10^{15}$g , $\tau_{bo} \approx 3\times10^{10}$yrs. The age of our universe is 1.37×10^{10}yrs, which is the same scale with τ_{bo}. In 1971, Hawking proposed, M_{bo} might exist in our universal space, if some of them could be survivals from the newborn time of our universe. However, in 1970s, many scientists attempted to observe and find out such original mini BHs in universal space, but their efforts about 10 years were all in vain. It clearly shows that, no such M_{bo} could remain to the present.

In the newborn time of our universe, at least before the end of Hardron Era, i.e. the expansion of our universe from density 10^{93}g/cm^3 to 10^{53}g/cm^3 could have perfect homogeneity, because that expansive process would be completely equal entropy known from above paragraph. The numerical values of 3 main parameters ρ_{bo}, T_{bo} and t_{bo} of M_{bo} are all in Hadron Era of universal evolution. At that time, all M_{bo} in universe were closely and evenly linked together into a whole, and had no way to exist single. With their expansion later, they could only combine each others and become bigger and bigger. In other words, in the universal expansive process, any original BHs of high density could not exist single at all, no matter how great they were, because BHs linked together could only combine and expand, but have no way to exist independently. Only after Radiation Era of universal evolution, because radiations separated from matters and led to lower temperature in matters, then, matters could do a renew contraction. As a result, the nebulas could have a great gravitational contraction to become the compact stars or a BHs through supernova explosion.

【10】。The super great BHs of（10^7 ~10^{12}）M_θ and Quasars.

In the center of every galaxy and star cluster, there is a super great BH, its mass can reach to（10^7 ~10^{12}）M_θ. Recently, a super giant BH called Q0906+6930 discovered by an astronomy group of Stanford University in the remote center of our universe. Its mass more than 10^{10} M_θ, and it formed 127×10^8 years ago. i.e. after 10^9 years of the birth of our universe. [9]

Let that BH be $M_{bs} = 10^{10}$ $M_\theta = 2\times10^{43}$g, so, its $R_{bs} = 2.96\times10^{15}$cm, its $\rho_{bs} = 1.74\times10^{-4}$g/cm^3.

The simple calculations to Quasars in the 8th chapter of Prof, He Xiangtao's book "Observation Cosmology" [3] are as follows:

The mass of a Quasar must be satisfied by the following formula,

$M_Q > L_Q M_\theta/1.5\times10^{38} = 3.3\times10^8 M_\theta$ (10a)

In above formula (10a), $L_Q = 5\times10^{46}$erg/s.

If the light period of a Quasar is 1 hour, its scale D should be:

$D \le C\Delta t = 1.1\times10^{14}$cm, (10b)

For a Schwarzschild's BH of the same size , its mass M_S should be:

$M_S = RC^2/2G = 1.9\times10^8$ M_θ (10c)

It can be seen, $M_Q \approx M_S$，the numerical values of both are very close.

Conclusion: Really, Quasars should be the predecessor and the childhood of super great BHs, which might all come from the evolution of Quasars.

There has been an important problem in astronomers and cosmologists: Was BHs formed before as a core to contract its outside energy-matters to compose galaxy and star cluster, or substantial particles contract to form nebula at first, and then ignite the nuclear fusion in the core to form BH through supernova explosion? Author think, the later can accord with the real circumstance in nature, because forming a galaxy needed time is << forming a BH needed time.

【11】。The simple summations, further analyses and important conclusions as bellow:

A: No matter whether the EH of any BHs or a large ball of matters (mass of a nebula 5 M_θ ~8 M_θ) would be, their finally contracted destinies could be the perfectly same, i.e. $m_{ss} = M_b = M_{bm} = (hC/8\pi G)^{1/2} = m_p = 1.09 \times 10^{-5}$g, but impossible to contract to singularity of infinite density. It proved that, Hawking laws about HQR, Schwarzschild solution to GTRE, uncertain principle and other classical dynamic laws are completely harmonious and identical, No singularity shows that, General Theory of Relativity Equation (GTRE) has had the fatal weakness.

B: The fatal weaknesses of GTRE are to neglect the thermodynamic effects to resist the gravitational contraction of matter particles. For simplifying the difficulties to solve GTRE, the most scholars proposed two bad hypotheses which violate thermodynamics, i.e. the contraction of equal matters and the "universal model of zero (constant) pressure". Just those two bad hypotheses lead gravitational contraction to singularity in GTRE. Of course, GTRE may have other important defects, such as, permitting the infinite contraction of participles of point structure. In addition, GTRE is hardly to be solved. The hypothesis of inertial mass equal to gravitational mass has no reliable evidences, etc.

Particles of point structure, which may be infinite contraction in GTRE, must have a limit. It is just Planck Era, in which time and space are not continuous, [8] **and it certainly leads GTRE lose effect.**

C: Hawking theory and some important laws about BHs based on quantum mechanics and thermodynamics are very correct and effective, they avoid and overcome the important defects of appearance of singularity in GTRE, just as quantum mechanics could demonstrate that, electrons could not fall into atomic nucleus in the past. Similarly, Hawking theory and laws about BHs demonstrated that, GTRE lost effectiveness in Planck Era, just as GTRE demonstrated that, Newton mechanics had lost effectiveness in the movements of near light speed.

However, the explanations of Hawking and modern physicists to HQRs with the concept of "a pair of virtual particles would be suddenly born out from vacuum" may be a deliberately mystifying with the new physical concept. HQRs flow out from the EH of BH to outside, just as energy or matters naturally flow down from high position to low position, or from high temperature to low temperature.

D: Through studying star BHs, the conclusion is that, singularity could have no possibility to occur in BHs. After the Big Bang, the strongest explosions in nature have been the supernova explosions, which explosive forces can only compress matters to density about 10^{16}g/cm^3, i.e. the density of core of neutron stars, in such level of density, protons cannot be broken yet. Only the substantial density reaches to 10^{53}g/cm^3 of original mini BH (M_{bo}), protons can be destroyed. Protons are the most stable and solid particles, and have the longest lifetime of 10^{30} years. The forces to destroy protons have not appeared in nature as yet. Of course, no more powerful forces can compress matters to the density 10^{93}g/cm^3 of Planck particles ($m_p = M_{bm}$), except the contraction of BHs < 10^{15}g due to emitting HQRs.

On the contrary, if there were singularity or smaller BH in BHs, certainly, singularity could explode at once and change into rays of extremely high energy in BHs. At the same time, the smaller BH could absorb energy-matters of its outside, finally, the event horizon (EH) of smaller BH could enlarge to combine with the EH of BH together.

E: Only the contracted forces of mini BH, which mass ($M_{bo} = 10^{15}$g) due to radiate HQRs, could compress protons disintegrated into quarks. After that, the contracted forces of mini BHs of mass $M_{bmi} < (M_{bo} = 10^{15}$g) due to radiate HQRs could raise the density of M_{bmi} and decrease in distance between quarks in M_{bmi}. The finally contracted results of M_{bmi} would just become to ($m_p = M_{bm}$), and explode and disappear in Planck Era.

F: A few words out of this article about the destiny of our universe, if the current mass M_u of our universe is about 10^{56}g, and no energy-matters outside can be absorbed. Thus, our universe can only nonstop emit HQRs to contract its size up to become $m_p = M_{bm} = 10^{-5}$g, and explode and vanish in Planck Era. The lifetime of M_u will be ($= 10^{-27}M_u^3$) about 10^{132}years.

The problem is to judge whether energy-matters have or no outside our current universe. Author think, if the real lifetimes of some bodies in nature measured by scientists, such as some celestial bodies or aerolites, are the same with Compton time of our current universe (UBH), and Hubble constant has a certainly reliable value as normal, it may shows that, there might still be energy-matters outside our universe. Correspondingly, our universe will plunder all energy-matters outside, after that, it can nonstop contract its size with emitting HQRs until become $m_p = M_{bm} = 10^{-5}$g, and explode and vanish in Planck Era. Thus, its lifetime will prolong to >>10^{132}years. If the real lifetimes of some bodies in nature > Compton time of our UBH, and Hubble constant = 0, it shows no energy-matters outside our UBH.

However, if a insolated star BH of $3M_0$ had no energy-matters outside to be engulfed, it could only contract its size to $m_p = M_{bm} = 10^{-5}$g, then, explode and vanish in Planck Era too. Its lifetime = $10^{-27}(3M_0)^3 \approx 10^{67}$years is too long. It is much longer than lifetime = 10^{30}years of protons.

G: Author's few words: Author may only forge ahead a little step from Hawking theory about BHs with simple explanations and calculations to BHs in this article, and get many important and basic conclusions. It may help people to understand many fundamental and principal concepts to BHs from profound theories and complicated mathematical equations of modern scientists.

====The End====

References:

1. Jean-Pierre Luminet: Black Holes; Hunan Science-Technology Publishing House, China: Chinese Edition. 2000.
2. Wang, Yong-Jiu: Physics of Black Holes; Hunan Normal University Publishing House China. 2000. **
3. He, Xiang-Tao: Observational Astronomy; Science Publishing House, Beijing, China. 2002.
4. John & Gribbin: Companion to the Cosmos; Hainan Publishing House, Hainan, China. 2001. Chinese Edition.
5.Compact star: http://hometown.aol.com/lklstars8/15b.htm
6. http://popul.jqcq.com/big5/natural/2007- 08/187918038.html
7. Wu, Shi-Min: A Course in the General Theory of Relativity: Beijing Normal University Publishing House, Beijing, China. 1998. 8.
8. John & Gribbin: Companion To The Cosmos. Hunan Publishing House. China. 2001, 9
9. An oldest and biggest BH was discovered by astronomers. http://tech.sina.com.cn/other/2004-06- 30/0752381423.shtml

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Note:
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