

An International Journal

Nature and Science

ISSN 1545-0740

Debate 001



Marsland Press, Michigan, The United States

Nature and Science

ISSN 1545-0740

The *Nature and Science* is an international journal with a purpose to enhance our natural and scientific knowledge dissemination in the world under the free publication principle. Any valuable papers that describe natural phenomena and existence or any reports that convey scientific research and pursuit are welcome, including both natural and social sciences. Papers submitted could be reviews, objective descriptions, research reports, opinions/debates, news, letters, and other types of writings that are nature and science related.

1. General Information

(1) **Goals:** As an international journal published both in print and on internet, *Nature and Science* is dedicated to the dissemination of fundamental knowledge in all areas of nature and science. The main purpose of *Nature and Science* is to enhance our knowledge spreading in the world under the free publication principle. It publishes full-length papers (original contributions), reviews, rapid communications, and any debates and opinions in all the fields of nature and science.

(2) **What to Do:** *Nature and Science* provides a place for discussion of scientific news, research, theory, philosophy, profession and technology - that will drive scientific progress. Research reports and regular manuscripts that contain new and significant information of general interest are welcome.

(3) **Who:** All people are welcome to submit manuscripts in any fields of nature and science.

(4) **Distributions:** Web version of the journal is freely opened to the world, without any payment or registration. The journal will be distributed to the selected libraries and institutions for free. For the subscription of other readers please contact with: editor@americanscience.org or americansciencej@gmail.com or editor@sciencepub.net.

(5) **Advertisements:** The price will be calculated as US\$400/page, i.e. US\$200/a half page, US\$100/a quarter page, etc. Any size of the advertisement is welcome.

2. Manuscripts Submission

(1) **Submission Methods:** Electronic submission through email is encouraged and hard copies plus an IBM formatted computer diskette would also be accepted.

(2) **Software:** The Microsoft Word file will be preferred.

(3) **Font:** Normal, Times New Roman, 10 pt, single space.

(5) **Manuscript:** Don't use "Footnote" or "Header and Footer".

(6) **Cover Page:** Put detail information of authors and a short title in the cover page.

(7) **Title:** Use Title Case in the title and subtitles, e.g. "Debt and Agency Costs".

(8) **Figures and Tables:** Use full word of figure and table, e.g. "Figure 1. Annual Income of Different Groups", "Table 1. Annual Increase of Investment".

(9) **References:** Cite references by "last name, year", e.g. "(Smith, 2003)". References should include all the authors' last names and initials, title, journal, year, volume, issue, and pages etc.

Reference Examples:

Journal Article: Hacker J, Hentschel U, Dobrindt U. Prokaryotic chromosomes and disease. *Science* 2003;301(34):790-3.

Book: Berkowitz BA, Katzung BG. Basic and clinical evaluation of new drugs. In: Katzung BG, ed. Basic and clinical pharmacology. Appleton & Lance Publisher. Norwalk, Connecticut, USA. 1995:60-9.

(10) **Submission Address:** editor@sciencepub.net, Marsland Company, P.O. Box 21126, Lansing, Michigan 48909, The United States.

(11) **Reviewers:** Authors are encouraged to suggest 2-8 competent reviewers with their name and email.

2. Manuscript Preparation

Each manuscript is suggested to include the following components but authors can do their own ways:

(1) **Title page:** including the complete article title; each author's full name; institution(s) with which each author is affiliated, with city, state/province, zip code, and country; and the name, complete mailing address, telephone number, facsimile number (if available), and e-mail address for all correspondence.

(2) **Abstract:** including Background, Materials and Methods, Results, and Discussions.

(3) **Keywords.**

(4) **Introduction.**

(5) **Materials and Methods.**

(6) **Results.**

(7) **Discussions.**

(8) **Acknowledgments.**

(9) **References.**

Journal Address:

Marsland Company
P.O. Box 21126
Lansing, Michigan 48909
The United States
Telephone:(517) 349-2362
E-mail: editor@sciencepub.net;
naturesciencej@gmail.com
Websites: <http://www.sciencepub.org>

ISSN 1545-0740



Marsland Press

Nature and Science

Science Debate Issue 001, 2004:
New Concepts to Big Bang and to Black Holes
The Nature of Time and Space

September of 2004, ISSN 1545-0740

Contents

1. [The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All - 1 \(Contents/Preface\)](#)
Dongsheng Zhang
2. [The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All -2 \(Part 1\)](#)
Dongsheng Zhang
3. [The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All -3 \(Part 2\)](#)
Dongsheng Zhang
4. [The Nature of Time and Space](#)
Hongbao Ma
5. [Mankind May Be Impossible to Manufacture out Any Artificial Real Gravitational Black Hole \(BH\) Forever](#)
Dongsheng Zhang
6. [New Explorations to Hawking Radiation With Classical Theories](#)---- Part 4 of "New Concepts to Big Bang and Black Holes"
Dongsheng Zhang

<http://www.sciencepub.org>
editor@sciencepub.net

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

Dongsheng Zhang

Nov./2005

(Graduated in 1957 From Beijing University of Aeronautics and Astronautics. China.

Permanent address: 17 Pontiac Road, West Hartford, CT 06117-2129, U. S. A.)

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, but 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. [Nature and Science. 2004;2(3):1-4].

Key Words: singularity; big bang; black holes; Plank's era; cosmology; minimum gravitational black holes;

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

Contents of Part One:

1. The laws of our universe evolution.
2. In the newborn-hood, the properties of radiations and particles in the states of super high temperature.
3. The condition occurred from Big Crunch of pre-universe to Big Explosion (Big Bang) of present universe.
4. Minimum Gravitational Black Holes (QMBH).
5. Uncertainty principle of QM was applied to quantum gravitation.
6. Reviews to our present universe.
7. **Conclusion:** The origin and process turned from the disappearance of pre-universe to the birth of present universe in Plank's Era (-10^{-43} s $\leq t \leq +10^{-43}$ s).

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

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

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

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

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

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

(G). About the universal accelerating expansion

(H). The summary conclusion

8. The further explanations.

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

10. Demonstrations to formulas (1a) and (1b).

Part Two. No Singularity in star-formed Schwarzschild's Black Holes, a steady mini BH (mass $\approx 10^{15}$ g) as a solid core inside BH to obstruct the collapse of energy-matters to become Singularity.

Contents of Part Two:

11. The contracting process of the original interstellar clouds (OIC) in universe as a gigantic BH.

12. The mechanisms of objects to resist its gravitational collapse.

13. The stability and equilibrium of a star-formed gravitational BH (Black Hole).

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

(B) In any small BH (m_o), a stable mini BH of ($m_{om} \approx 10^{15}$ g) can surely exist.

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

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

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

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

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

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).

16. The further explanations and two possible models of BHs.

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

(A) Mini BH ($m_{om} \approx 10^{15}$ g) is a special solution of formula (11c) [$dP/dR = -GM\rho/R^2$], which is the simplified Tolman-Oppenheimer-Volkoss's equation.

(B) About mini BH ($m_{om} \approx 10^{15}$ g); how to be found out, its properties.

(C) In space of BH, it is full of energy-matters, not a vacuum.

(D) Properties of star-formed gravitational BH.

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

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

(G) A formed BH is a real BH forever until its final vanish.

18. About the original universal small BHs.

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

(A) The composition of mini BH inside.

(B) The vanishing process of mini BHs.

(C) About the artificial bombs of mini BHs.

(D) Concepts and formulas about the birth of our universe.

20. A few words of the writer.

Preface

(This is a brief introduction to the full text of the article. The full text will be published in later issues).

Singularity is defined as a point, which has the infinite amount of some physical parameters. It had been proved by General Theory of Relativity (**GTR**) that our present expanding universe was certainly born from Singularity, and Singularity would certainly appear at the center of any star-formed Black Holes (**BH**). Thus, Singularity is an inevitable result of GTR and is a problem unable to be solved by GTR. Singularity has been still the most difficult and complicated problem in astro-cosmology and science. The problem of Singularity had troubled scientists for over fifty years. But right now, neither classical theory nor non-classical new theory has successfully eliminated Singularity from its mathematical equations, and simultaneously has fitted well with the natural reality and universal evolutionary laws. In mathematical equations of any theories, variations of parameters are consecutive, but the changes between different physical states have always existed the suddenly changed points (mutation or phase transition). Thus, it is very difficult to describe the transformed process of multi-physical states included points of "phase transition" with single or united mathematical equations.

Undoubtedly, there should be some mechanisms or origin or laws in nature to obstruct the occurrence of Singularity. For example, owing to that, the electrons in an atom must obey Uncertainty Principle of Quantum Mechanics (QM), as a result, they cannot fall into the atomic nuclei at all so that all atoms have not collapsed to Singularity.

1. As yet Singularity has not been found in nature, it only appeared in mathematical equations. In nature, the occurrence of Singularity would certainly violate the causality and the second law of thermodynamics, and violate the laws of energy conservation. God would not deliver "Free Lunch" in nature at all. It has not been a problem to deny the existence of Singularity on philosophy, logic or physical intuition. However, it has still been a knotty problem to eliminate Singularities from mathematical equations. When physicist R. P. Feynman was asked why he could get Nobel Prize, he answered jocularly: "I just have let infinities to be hidden." In this article, to negate the existence of Singularity in nature (included at the genesis of our universe and in black holes) is based on that, once the state and the

structure of anybody reached before some critical point or “phase transition”, it would certainly transform its state and structure, and could avoid the appearance of Singularity. It will not be conceivable that, if there would be infinities to be contained in a limited universe.

2. Once point-shaped particles (such as mass particle, point charge, wave packet) are put into mathematical equations, Singularities would absolutely appear under the final contraction. In all mathematical equations of any theory, if a particle or a charge were permitted to concentrate into an infinitesimal point, that points would inevitably have infinite mass or infinite charge density. Therefore, all classical theories included GTR or QM cannot eliminate Singularities from its mathematical equations. Quantum Electrodynamics (QED) and Quantum Chromodynamics (QCD) must depend upon re-normalization to eliminate Singularities. Only micro strings in string theories are not the point-shaped structure. Certainly, Singularities would never appear in string theories. However, right now not a string theory has become maturely and successfully. The trace of micro strings cannot be almost observed even in the remote future. Theoretically, string theories built on different dimensionalities may have a great number of kinds; there is no way to know which one is suitable for nature and science. Thus, applying string theories to get rid of Singularities or infinities is only an attractive mathematical game. It will be the same condition for all other new theories, such as quantum gravitation, SUSY or $N = 8$ super symmetry, Theory of Everything (TOE), etc. Any one of them may want to go too far away to become a perfect theory.

3. The specificity of this article is determined by that, under the condition of having “phase transition”, there will be no need to clean out Singularities from mathematical formulas at the point-shaped structure of particles, but only need to find out the inexistent physical origin of Singularity in some physical state. In the demonstrative process of negating Singularities, the most microstructures at our universal birth and black holes will not be necessary to be known, only the macro physical states and its transitive process can be considered. It is said: it will not be necessary to establish complicated new theories and its mathematical equations to solve the unknown

problems of microstructure smaller than Plank’s scale (i.e. $d \leq 10^{-33}$ cm, $t \leq 10^{-43}$ s) in this article. Such as Bernoulli’s equation can successfully be used into fluid mechanics, but anybody needs not to know, that nucleons of hydrogen are made up by quarks. Many new concepts and new conclusions about cosmology and BHs would be drawn out through applying many current classical theories and its mathematical formulas, and through calculating or checking up the current figures in nature and sciences. **(A)** At the genesis of our universe, once pre-universe contracted into -10^{-43} s at the beginning of Plank’s Era, it would stop collapse due to having no enough time to transmit gravity between closest particles, and it would certainly turn into expansion at super-high temperature, it is said, our universe had made a “phase transition” from the past contracted universe to the present expanding universe in the quantum field of Plank’s Era (see 7th paragraph). **A new formula (3c)** $t^{3/2} \leq k_1(8\pi G\kappa/(3C^5))$ has derived, and calculated out $t \geq -10^{-43}$ s with the same exactly value. **(B)** At the center of any star-formed BH, a steady mini BH ($m_{om} \approx 10^{15}$ g) instead of Singularity as a solid core could surely obstruct the collapse of energy-matter in BH and keep the very long-term stability of whole BH. Mini BH has been precisely derived by a **new formula (13bd)** $r_{om} = 3h/(2\pi C m_s)$ and become a simplified solution of (11c) and TOV equation. Demonstrations show that pure GTR has no way to solve problems in BH, especially to solve 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 mini BH (mass $\approx 10^{15}$ g) as a simplified solution of (11c) and TOV equation and no way to find out the long lifetime of mini BH. Just mini BHs can obstruct the occurrence of Singularity in BH (see 17th paragraph). **(C)** The origin and evolutionary process of our universe at genesis. **(D)** Our universe was born from Minimum Gravitational BHs (MGBH) (its mass $m_t \approx 10^{-5}$ g). **(E)** “Primordial inflation” was caused by collisions between those MGBHs. **(F)** The present expansion of our universe

was caused by the continual collided effects between those MGBHs. **(G)** The evolutionary and vanishing process of our universe in the remote future. **(H)**. Whether or not expansion of our universe afterwards will not depend on universal real density ρ , but depend on the total mass M_0 of our primordial universal packet. $\Omega = \rho / \rho_c \approx 1$ just shows the natural character of our universe as a gigantic BH. **(I)** Providing another possible explanation to so-called “accelerative expansion” of our universe. **(J)** The physical state and structure of star-formed BHs. **(K)** Destinies of mini BHs and our universe, etc.

4. All above-mentioned new viewpoints are out of old conventions and worthy to be deeply considered. This article will never exclude conclusions in any new theories. Due to that, all current classical theories and formulas have been proved effectively in nature and sciences, new concepts and conclusions in this article should be successful and have practical significance. Although there is no new theory applied in this article, but in answering the outstanding problems in cosmology and BHs, the new concepts are much better than any current classical or new non-classical theories. The biggest problems in this article are not exact, not sufficient and not complete. The criticisms and instructions from professors, scholars and specialists are welcomed and requested earnestly. Let cosmology go forward and develop up in arguments.

*** Introductory words for readers:** Due to that, this article is very long for its full text, it will be best for you to spend your precious 30 minutes to read three paragraphs at first; (1) preface above; (2) conclusions of 7th paragraph in part one; (3) conclusions of 17th paragraph in part two. All other paragraphs are demonstrations or explanations to three paragraphs above. The full text, which is published on website (<http://www.sciencepub.net>, Volume 2—Number 3), will be published in later issues.

Correspondence to:

Dongsheng Zhang
17 Pontiac Road
West Hartford, CT 06117-2129
The United States
Telephone: 860-523-1197
Email: zhangds12@hotmail.com

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

Dongsheng Zhang

Graduated in 1957 From Beijing University of Aeronautics and Astronautics. China.

Permanent address: 17 Pontiac Road, West Hartford, CT 06117-2129, U. S. A.

Email: ZhangDS12@hotmail.com;

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

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

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

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

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

1. The Laws and formulas of Our Universal Evolution

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

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

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

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

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

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

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

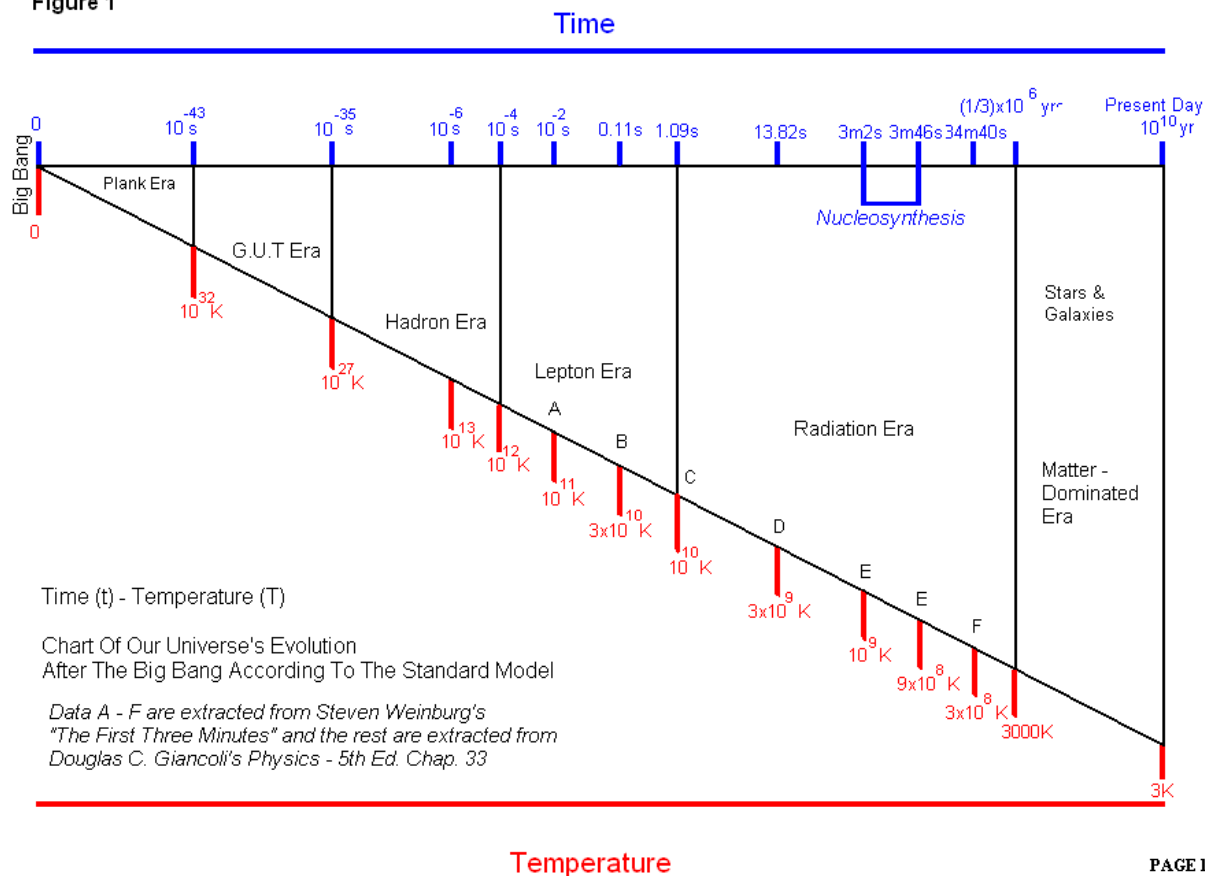
$$Tt^{2/3} = k_6, <4><6> R = k_7 t^{2/3}, RT = k_8, R = k_9 \lambda \quad (1b)$$

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

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

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

Figure 1



Temperature

PAGE 10

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$14 \times 10^{-33} \text{ cm, but } C \times t = 3 \times 10^{10} \times 10^{-43} = 3 \times 10^{-33} \text{ cm.}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

From 1

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

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

6. Reviews to Our Present Universe

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

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

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

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

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

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

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

The proton numbers of M_u of original Universe are;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Such collisions should emit strong X-rays.

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

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

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

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

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

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

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

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

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

$(7e_1) = (7e_2)$

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

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

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

According to our universal expanded law,

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

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

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

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

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

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

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

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

8. The further explanations

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

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

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

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

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

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

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

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

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

IV Hadron Era				V Plank Era
10^{-4} s	10^{-6} s	10^{-35} s	10^{-43}	
10^{12} K	10^{13} K	10^{27} K	10^{32} K	
Formula (1-a)				
1.07×10^{12}	1.07×10^{13}	3.38×10^{27}	0.338×10^{32}	
3.4×10^{16}	3.4×10^{15}	10.7	10.7×10^{-4}	
2.8×10^{-13}	2.8×10^{-14}	8.85×10^{-29}	8.85×10^{-33}	
1.8×10^{14}	1.8×10^{18}	1.8×10^{76}	1.8×10^{92}	

Take the initial numerical values below, which are at present universe time:
 All other values on the above chart can be calculated out according to Formulas (1a, 1b)
 Suppose the Hubble’s Constant $H = 75 \text{ Km}/(\text{sxMP}_{\text{sc}})$
 So $t_0 = 1/H = 13 \times 10^9 \text{ yr}$
 $R = t_0 c = (13 \times 10^9 \text{ yr}) \times c = 12 \times 10^{27} \text{ cm}$ $\lambda = 0.1 \text{ cm}$ $\rho_c = 10.6 \times 10^{-30} \text{ g/cm}^3$ $T = 3 \text{ k}$

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

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

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

- P.E. = (mMG)/R,
- m – Mass of a particle on the surface,
- M – Total masses in the sphere of radius R
- G – Gravitational Constant,
- R – Characteristic scale factor (dimension)

The kinetic energy (K.E.) of m on the surface is
 $K.E. = 0.5mV^2$.

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

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

P.E. = K.E.
 $0.5V^2 = (MG)/R$ (B)

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

$E_m = mc^2$ $E_p = \kappa T$ $E_r = ch/\lambda$ (2a)
 $m = \kappa T/C^2$, $R \propto \lambda$, and $T \propto 1/R$, (2b)

References of Part One

1. Micheal D. Lemonick; How The Universe Will End. TIME, June 25, 2001.
2. Giancoli, Douglas C. Physics, Principles With Applications. 5th Ed. Upper Saddle River, NJ: Prentice Hall, 1998. 999-1034.
3. Su, Yi. New Instruction to Astronomy. Wuhan, People's Republic Of China: Publishing House of Central China University, 2000. 374-413.
4. Weinburg, Steven. The First Three Minutes. Chinese Edition, Beijing, People's Republic of China: Chinese Foreign Language Translation and Publishers, 1999.
5. Wang, Yong-jiu. Physics of Black Holes. Publishing House of Hunan Normal University. Hunan, China. 2002.
6. He, Xiang-tao. Observational Cosmology. Science Publishing House. Beijing, China. 2002.

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

Because in Formula (B), $\sum m_i = M$ (B1)

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

From Formula (B)(B1) (2b),
 So $M \propto 1/R$ **M ≠ Constant** (B2)

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

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

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

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

Formula (1a) is proven correctly.

(2). In The Matter-Dominated Era

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

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

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

In this era, to radiation, Formula (B1) is still right

So from Formulas (B1)(B4)

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

Formula (1b) is proved correctly.

7. Gribbin, John. In Search of the Big Bang: Quantum Physics and Cosmology. Chinese Edition, Shanghai Science-Techno-Education Publishing House. China. 2000.

8. See part two of this article behind.

Author: Dongsheng Zhang, graduated in 1957 from Beijing University of Aeronautics and Astronautics of China, retired now. Permanent Address: Seventeen Pontiac Road, West Hartford, CT 06117-2129. Email: zhangds12@hotmail.com.

This article had gotten number of Certificate of Registration TXu1-156-325, from UNITED STATE COPYRIGHT OFFICE.

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

The New Concepts to Big Bang and to Black Holes: Both Had No Singularity at All (Part 2) Nov.-2005

Dongsheng Zhang

Graduated in 1957 From Beijing University of Aeronautics and Astronautics. China.

Permanent address: 17 Pontiac Road, West Hartford, CT 06117-2129, U. S. A.

Email: ZhangDS12@hotmail.com;

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.

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

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

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,

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

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

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

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

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

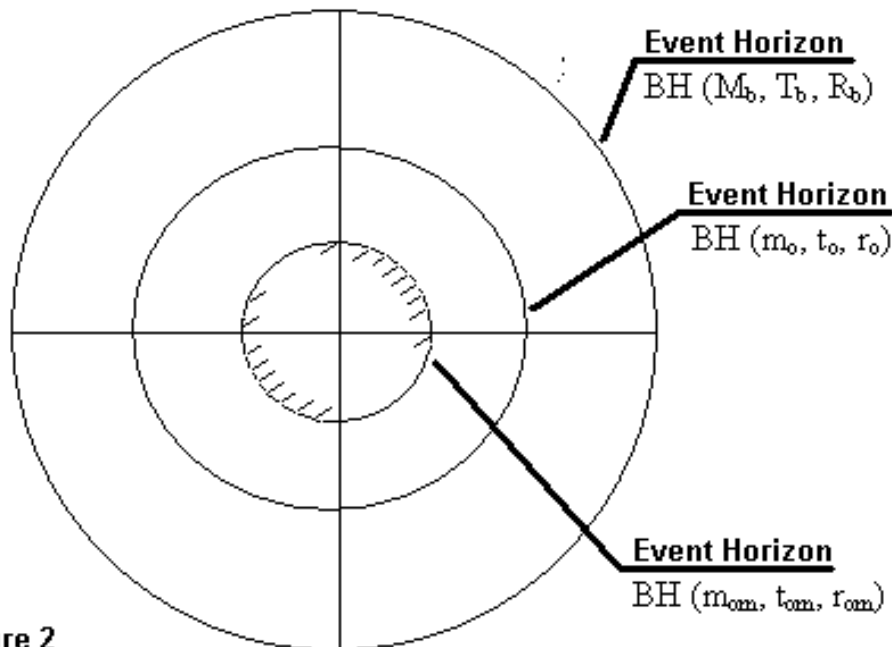


Figure 2

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,

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

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

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

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_b, T_b , mini BH-- m_{om}, t_{om}, r_{om} , medium BH-- m_o, r_o, t_o , τ --lifetime, ρ --density,)

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

(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, $r_{om} = 3h/(2\pi C m_s)$] 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 [$r_{om} = 3h /$**

$(2\pi C m_s) \dots (13bd)$] 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)-- $r_{om} = 3h/(2\pi C m_s)$, the size r_{om} of mini BH is only decided by m_s (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 ($m_{om}, t_{om}, r_{om}, m_s$) 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,

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

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;

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

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

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

Formula (18d) [$T_1 \approx 10^{32}$ 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 ($m_i \approx 10^{-5}$ g, $T_b \approx 10^{32}$ k, $r_b \approx 10^{-33}$ 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 ($m_{om} \approx 10^{15}$ g) in star- formed BH, the commonality between universe and BHs,

According to analyses before, originally universal mini BHs ($m_{om} \approx 10^{15}$ g) would be impossible to exist in universe, mini BHs could only form and exist inside star-formed BHs. Mini BH ($m_{om} \approx 10^{15}$ 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 ($<10^{-6}$ 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 ($m_{om} \approx 10^{15}$ 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, $m_{om} \approx 10^{15}$ g, $r_{om} \approx 10^{-13}$ cm, $t_{om} \approx 10^{12}$ k, $\tau_{om} \approx 10^{10}$ yrs, $\rho_{om} \approx 10^{53}$ g/cm³, $m_s = 1.67 \times 10^{-24}$ g. Those values are gotten under the condition of every particle ($m_s = 1.67 \times 10^{-24}$ 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 ($>10^{30}$ 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-----

References of Part Two

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. Dennis Overbye: Lonely Hearts of the Cosmos; 2002 by CITTC Publishing house, Beijing, China. Chinese Edition. 2002.
4. John & Gribbin: Companion to the Cosmos; Hainan Publishing House, Hainan, China. 2001. Chinese Edition.
5. He, Xiang-Tao: Observational Astronomy; Science Publishing House, Beijing, China. 2002.
6. Kip S. Thorne: Black Holes and Time Warps; Hunan Science & Technology Press, China, Chinese Edition. 2001.
7. Wu, Shi-Min: A Course in the General Theory of Relativity; Beijing Normal University Publishing House, Beijing, China. 1998. 8.

Author: Dongsheng Zhang, graduated in 1957 from Beijing University of Aeronautics and Astronautics of China, retired now. Permanent Address: Seventeen Pontiac Road, West Hartford, CT 06117-2129. Email: zhangds12@hotmail.com.

This article had gotten number of Certificate of Registration TXu1-156-325, from UNITED STATE COPYRIGHT OFFICE.

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

The Nature of Time and Space

Hongbao Ma

Department of Medicine, Michigan State University, East Lansing, MI 48824, USA, hongbao@msu.edu

Abstract: Related to human activities, there are two aspects of the world: One is the observed world (epistemology) and the other is the existed world (ontology). This article discusses the nature of time and space from the epistemological and the ontological aspects. From the epistemology angle, time and space are relative (observed). From the ontology angle, time and space are absolute (existed) and the universe is a timeless world, which means that all the past, the present and the future exist eternally. [Nature and Science 2003;1(1):1-11].

Key words: time; space; nature; universe; ontology; epistemology

Contents

1. Introduction
2. Newton's Concepts
3. Classical Relativity
4. Special Relativity
5. General Relativity
6. Quantum Mechanics
7. Simultaneous Events
8. Time Dilation
9. Lorentz Contraction
10. Gravity and Light
11. Gravitational Waves
12. Big Bang
13. Black Hole
14. Twin Paradox
15. Length Paradox
16. Probability Paradox (Oppugn the Second Law of Thermodynamics)
17. Uncertainty Principle
18. Three-dimensional Time
19. The Measurement of Time
20. Absolute Time and Space
21. Timeless World
22. Determinism
23. Discussions and Conclusions

1. Introduction

Does the past still exist? Where is the past? Does the future exist already and wait us to meet? Does the life still exist after death? What is time? What is space? Is there an absolute time or space in the universe or not? St Augustine, who died in AD 430, said: "If nobody asks me, I know what time is, but if I am asked then I am at a loss what to say" (Barbour, 2000; Folger, 2000). This answer is true for most of the people on the earth.

Related to human's activities, there are two aspects of the world: One is the observed world and the other is the existed world. For the observed world concept, it is related to epistemology, empiricism, idealism, mentalism, immaterialism, spiritualism, subjectivity,

and measurement, etc. For the existed world, it is related to ontology, naturalism, materialism, physical entity, and existence, etc.

According to Webster's Dictionary: "Time – The system of those sequential relations that any event has to any other, as past, present, or future; indefinite and continuous duration regarded as that in which events succeed one another"; "Space – The unlimited or incalculably great three-dimensional realm or expanse in which all material objects are located and all events occur" (Webster's, 2003). According to the New Webster's Dictionary: "Time - The measure of duration. A particular part or point of duration"; "Space: Extension. Internal between points or objects quantity of time" (New Webster's, 2003). As another reference, according to the Hyperdictionary: "Time is the continuum of experience in which events pass from the future through the present to the past" (Hyperdictionary, 2003). From the definitions we can see that the time and space have both the observed (measure) and existed (duration and extension) characterizations.

The modern physics is mostly talking about the measured time and space with observations and mathematics, but ignoring the existed time and space (Hawking, 1996). According to the relativity, a traveler could see that the time and the space are shrink as his/her observation, if it is true. But he/she cannot change the time and space. The time and space are still the same time and space no matter there is a traveler to observe it or not. The time and space do not shrink, but the observer feels them shrink. There are essential conflicts of the time and space concepts between the observed and existed aspects. If we only think about the measured world, including time and space that are measured by human, we should say that there is nothing if the measurers die.

In this article, I will describe and discuss the nature of time and space from both the observed aspect and the existed aspect.

2. Newton's Concepts

In 1687, Sir Isaac Newton (1/4/1643-3/31/1727) created precise notions of time, space and motion. Newton's time and space concept is absolute. According to Newton's theory, time flows with perfect uniformity forever and space is a limitless container. Nothing in the universe affects the time's flow. The space stretches from infinity to infinity. The time and space are more fundamental than matters. It can be imagined as an empty world without matter but not a matter world without time and space. All the things in the Newtonian world are at definite positions and conditions. All the things in the universe move through absolute space according to the definite laws of motion. If all the conditions of the universe are known at some instant, the laws determine all the future movements, and also all the history of the universe can be known. This is so called mechanical determinism. Even though the Newton's mechanical determinism has been criticized by relativity and quantum theories, it is still considered as the true verity of the objective world from the ontological angle.

3. Classic Relativity

Motion is observed when something moves relatively to other things. Observers moving relatively to each other report different descriptions for the motion of an object, but the objects obey the same laws of motion regardless of reference system. The laws of physics are the same in all inertial reference systems (Galilean principle of relativity). For example, measurements in one inertial reference system yield the same forces as measurements in any other inertial reference system.

Observers in different reference systems can reconcile different velocities they obtain for an object by adding the relative velocity of the reference systems to that of the object (However, this procedure breaks down for the velocities near that of the light according the Einstein's special relativity). In a reference system accelerating relatively to an inertial reference system, the law of inertia does not work without the introduction of fictitious forces that are due entirely to the accelerated motion. Centrifugal force arises in rotating reference systems and is an example of inertial forces. The earth is noninertial reference system as it rotates always.

4. Special Relativity

In 1905, Albert Einstein (3/14/1879-4/18/1955) set up the special relativity with the two basic postulates:

1. The laws of physics are the same in all inertial reference systems.
2. The speed of light in a vacuum is a constant value regardless of the speed of the source or the speed of the observers.

The first postulate says that there is no absolute space and any inertial reference system is just as good as any

other. This is a reaffirmation of the Galilean principle of relativity. According to Galilean's classical relativity, a traveler in a ship moving with a constant velocity could not conduct experiments that would determine whether the ship is moving or at rest. However, a theory by the Scottish physicist James Clerk Maxwell describing the behavior of electromagnetic waves, such as light and radio, yielded unexpected results. In Newton's laws, reference systems moving at constant velocities are equivalent to each other. However, if one system accelerates relatively to another, the two reference systems are not equivalent. The Newton's laws depend on acceleration and not on the velocity. The acceleration of a reference system can be detected, but its velocity cannot be detected absolutely. In Maxwell's theory the velocity of the electromagnetic waves appears in the equations rather than their acceleration. Maxwell's equation and Galilean principle of relativity were apparently in conflict. To reconcile the contradiction between the principle of relativity and Maxwell's equation, Einstein supposed an absolute reference system in the universe, which depended on his second postulate of special relativity: There is a speed limit. According to Newtonian mechanics a charged particle (charge q , mass m) in a constant electric field E can be accelerated to an arbitrary velocity: $v(t)=qEt/m$. The velocity could be arbitrarily big according to the equation. But, the Einstein's special relativity supposes that particles cannot be accelerated beyond the light speed $c=3\times 10^8$ m/s (Kogut, 2001). As the Figure 1 shows, according to Newton's law, the relative velocity of the light to the observer should be $v'=c+v$, but the relativity denies the rule called addition of velocities in Newton's world and gives the result as $v'<c+v$ or $v'=c$, with the speed limit postulate. It rests on Newton's ideas of absolute time and space. As my opinion, the speed limit is the postulated idea by the theory of special relativity and it is an idealistic concept.

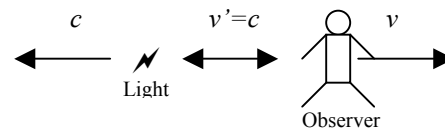


Figure 1. A light moves to the left direction with the speed c and an observer moves to the right direction with the speed v . According to the Einstein's special relativity, the speed of the light observed by the observer is also c , rather than $c+v$.

5. General Relativity

In the second half of 1915, Einstein expanded on his general theory of relativity and most definitely included "time" as a very important factor. According to the general relativity, the laws of physics are the same in all reference systems, and constant acceleration is

completely equivalent to a uniform gravitation (gravitational mass=inertial mass). One of Einstein's postulates of this theory states that the fabric of space-time, in the vicinity of a large mass, is curved. This "curvature" can be observed affecting the motion of other bodies in the vicinity in a way that is manifested as a force. This is called the force of gravity. Another tenet of Einstein's relativity notes the slowing of "time" at high speeds. According to the theory of relativity, some space-time future and past are relative to every space-time point P (Figure 2) (Zeh, 1992).

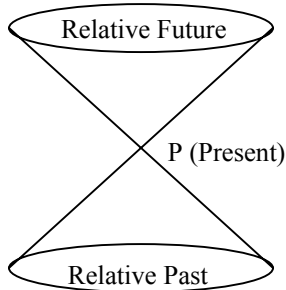


Figure 2. Local space-time structure according to the theory of relativity. Space-time future and past are defined relatively to every event P and independently of any frame of reference.

Although the general relativity has been universally accepted by modern science, many questions still need asked. Is acceleration relative? If there is no absolute space in the universe, what is the reference of the acceleration motion? We can say that there is no way to determine which of two inertial reference systems is really at rest and which is absolute motion, but we really feel the absolute acceleration if the system is accelerated. Accelerated to what? It does not need reference to determine acceleration and the acceleration is absolute. Be absolute to what? As my conclusion the answer should be "space". The space is the absolute reference in the existed world. The space is absolute.

6. Quantum Mechanics

The submicroscopic atomic world of the quantum mechanics and the vast cosmic world of the general relativity provide a radically different conception of time each, and physicists simply don't know how to reconcile the two views. Specifically, DeWitt hijacked the Schrödinger equation, named for the great Austrian physicist who created it. In its original form, the equation reveals how the arrangement of electrons determines the geometrical shapes of atoms and molecules. As modified by DeWitt, the equation describes different possible shapes for the entire universe and the position of everything in it. The key difference between Schrödinger's quantum and DeWitt's cosmic version of the equation - besides the scale of the

things involved - is that atoms, over time, can interact with other atoms and change their energies. But the universe has nothing to interact with except itself and has only a fixed total energy. Because the energy of the universe does not change with time, the easiest way to solve what has become known as the Wheeler-DeWitt equation is to eliminate time. In theories of quantum mechanics, time is essentially taken for granted, and it simply regularly ticks away in the background, just as it does in our own lives. Time in the quantum theory has no remarkable properties at all. That is not agreed in the general relativity. The pictures of time in the general relativity and the quantum mechanics are fundamentally incompatible (Peskin, 1995).

7. Simultaneous Events

According to Einstein's special theory of relativity, the time clock varies and the simultaneity is relative from the different observers. There is no universal way to say if two specific physical events are simultaneous or not. (Kirkpatrick, 1995). With Figure 3, the following gives the description. For the two events X and Y, observer A can say that they are the simultaneous events, observer B can say that X is after Y, and observer C can say that X is before Y (Figure 3). What is true? My answer is that there is no answer. The real thing is that the events X and Y are existed events. The differences of time order gotten from different observers are their description on an observed world, not an existed itself. All the history is there forever, and all the future is there already. There is neither before nor after in the nature.

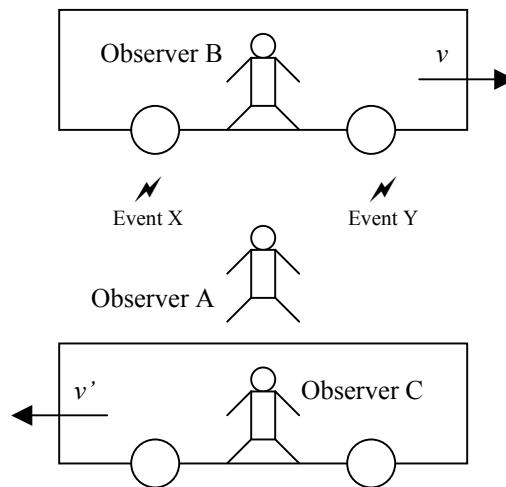


Figure 3. There is no universal way to say if two specific physical events are simultaneous or not according to the special theory of relativity. As for the events X and Y, if it is simultaneous for observer A, the event Y will happen before the event X for observer B and after the event X for observer C.

8. Time Dilation

According to the special theory of relativity, time interval increases with the object's moving speed (Figure 4).

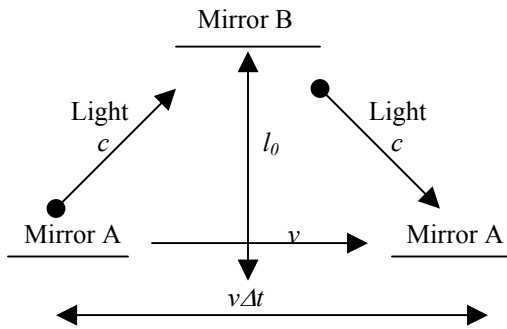


Figure 4. The demonstration of the time dilation. In a moving box at the velocity v of right direction, a light ray emits from mirror A and travels to mirror B (length AB) then reflects back to mirror A (length BA).

As Figure 4 shows, the light ray travels along the line segment AB and then along BA back to mirror A. The distance mirror A in Figure 4 travels between sending and receiving the light ray is $v\Delta t$. The distance the light ray travels is: $AB+BA=2\sqrt{l_0^2 + (v\Delta t/2)^2}$. (1)

The light ray also travels at the speed limit c in the box according to special relativity postulate 2, so

$$AB+BA=c\Delta t \quad (2)$$

Here the equation (2) is subjectively assumed that the light speed is limited to c as the special relativity supposes.

Combining equations (1) and (2) it gets:

$$c\Delta t=2\sqrt{l_0^2 + (v\Delta t/2)^2}$$

$$\Delta t=\frac{2l_0}{\sqrt{c^2 - v^2}} = \frac{2l_0/c}{\sqrt{1 - v^2/c^2}}$$

$$\Delta t=\frac{\Delta\tau}{\sqrt{1 - v^2/c^2}},$$

$$\text{where } \Delta\tau=2l_0/c = \Delta t\sqrt{1 - v^2/c^2}.$$

This result is called "time dilation". The time interval in a moving system, Δt is dilated by a factor of

$$\gamma \equiv \frac{1}{\sqrt{1 - v^2/c^2}}.$$

Two experiments, one in 1971 and the other one in 1977, confirmed the predictions of the time dilation (Kirkpatrick, 1995). Time dilation is an observed phenomenon.

Table 1 gives the calculated values of the adjustment factor for the different speeds of the moving systems.

Table 1. The Values of the Adjustment Factor for Various Speeds

Speeds	Adjustment Factor (γ)
Fastest subsonic jet plane	1.00000000000006
3 times speed of sound	1.00000000000005
50% of speed of light	1.15
80% of speed of light	1.67
99% of speed of light	7.09
99.99% of speed of light	70.7
99.9999% of speed of light	707
The speed of light	∞

9. Lorentz Contraction

If the constancy of the speed limit implies time dilation, it must also affect the measurements of the length of moving objects. This is the Lorentz contraction (Kogut, 2001). It can be described with Figure 5.

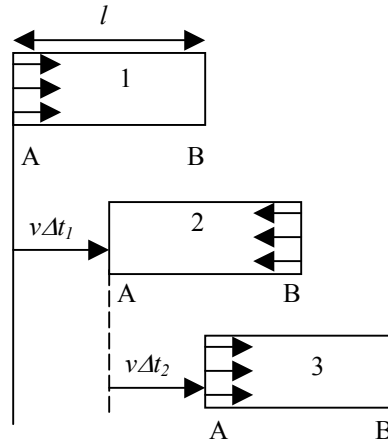


Figure 5. The demonstration of the Lorentz contraction. In a moving box at the velocity v of right direction, a light ray emits from mirror A and travels to mirror B (length AB) then reflects back to mirror A (length BA).

In the first image of Figure 5, light ray leaves mirror A and heads toward mirror B (from left to right). In the second image, the light ray reaches mirror B after a time Δt_1 . Mirror A has moved a distance $v\Delta t_1$ to the right, so $c\Delta t_1=l+v\Delta t_1$. (3)

In the third image of Figure 5, the light ray leaves mirror B and is reflected to mirror A. Between images 2 and 3, a time Δt_2 has passed, so mirror A moves an additional distance $v\Delta t_2$:

$$c\Delta t_2=l-v\Delta t_2. \quad (4)$$

Where the minus occurs because the light ray is moving from mirror B to A while mirror A is moving to the right direction for the $v\Delta t_2$.

$$\Delta t=\Delta t_1+\Delta t_2$$

$$\Delta t = \frac{l}{c - v} + \frac{l}{c + v} \quad (5)$$

$$\Delta t = \frac{2l/c}{1 - v^2/c^2}$$

From $\Delta t = \gamma(2l_0/c)$, it gets

$$l = l_0/\gamma = \sqrt{1 - v^2/c^2} l_0. \quad (6)$$

This is called Lorentz contraction because l is less than l_0 . This result is conducted from the time dilation. It is the observed result.

10. Gravity and Light

According to the special relativity, gravitation alters space. One of the arguments of this is that space is distorted when a gravitational field bends light. Relativity denies the Newtonian space view of the flat-space (Euclidean) and takes the warped space-time view. According to Einstein's general theory of relativity a gravitational field alters time, and the gravitational time dilation is caused (Pickover, 1998). But, according to my opinion, the fact is that the clocks run slower in a gravitational field, rather than the time elapse slower. Light is bent by gravity (Figure 6). The light is wave-particle, so that it is possible for light to move as a curve, rather than straight line only, just like any other object to travel in the three-dimension space with any contrail. This is not space bent, but the light bent. There is no gravitational time dilation existed.

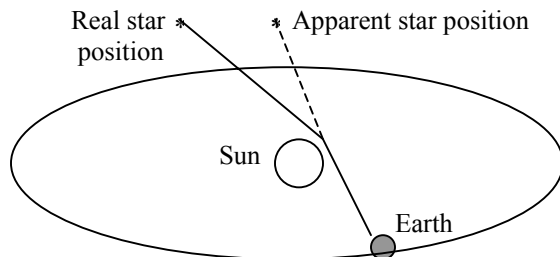


Figure 6. The path of starlight is bent as it passes the sun. This effect has been greatly exaggerated in this drawing.

11. Gravitational Waves

When Einstein proposed his general theory of relativity, he also postulated the existence of gravitational waves. In many ways gravitational waves should be analogous to electromagnetic waves. The acceleration of electric charges produces electromagnetic waves such as light, radio, radar, TV, and x-rays, etc. Gravitational waves should result from the acceleration of mass. Both carry energy through space, and decrease in intensity as the inverse square of the distance from the source. But, the gravitational waves have not been detected yet. Why? First, the gravitational force is 10^{43} times weaker than the electromagnetic force. Second, the detectors are less sensitive in intercepting gravitational waves by at least another factor of 10^{43} . The detection of gravitational

waves is one of the most fundamental challenges of the modern science. Although there is no direct evidence of gravitational waves detected, there is strong indirect evidence for the existence of the gravitational waves. In 1974 Joseph Taylor and Russell Hulse discovered a pair of neutron stars orbiting each other at very close range. Neutron stars normally have masses slightly larger than the mass of our sun but they are only 10 km in diameter. The electrons and protons in neutron stars combine and form neutrons under the condition of high density, and the neutron stars consist almost entirely of neutrons. The two neutron stars Taylor and Hulse observed orbit each other every eight hours and the orbital speed is 0.13% of the light speed. One of the neutron stars is a pulsar that gives a pulse of radiation every 59 milliseconds. These pulses of radiation like a clock that is as good as any atomic clock. This clock allows very precise timings of the orbits and almost 20 years of measurements indicate that the orbital period is decreasing. In fact, it is decreasing at precisely the rate expected from the loss of energy due to gravitational radiation, possibly the gravitational wave. The 1993 Nobel Prize of physics was awarded to Taylor and Hulse for this contribution (Kirkpatrick, 1995).

As a personal opinion, I think that the gravitational waves will be detected directly, and it is only a matter of the development of technology and the improvement of the detecting sensitivity. As it has no evidence to say that the speed of gravitational waves travel with the light speed limitation, the detection of gravitational waves will affect the concepts of the relativity and the nature of time and space.

12. Big Bang

According to the modern cosmological principle, the universe was formed about 15 billion years ago. For the beginning, a tremendous explosion started the expansion of the universe. This explosion is known as the big bang model. At the point of this event all of the matter, energy, time and space were contained at one point. Supposing that there was neither time nor space before the big bang. This occurrence was not a conventional explosion but an event filling all of the space with all of the particles of the embryonic universe rushing away from each other. This phenomenon of galaxies moving farther away from each other is known as the redshift. Redshift says that the light ray will shift to a longer wavelength (red direction) if the light source moves from the observer. The faster the moving, the more the redshift. Light from the farther galaxies has a bigger redshift, which shows that the farther the stars, the fast they are moving. The origin of the big bang theory can be credited to Edwin Hubble. With the redshift observation, Hubble made the conclusion that the universe is continuously expanding. He discovered that a galaxy's velocity is proportional to its distance

from the observer. Galaxies that are twice as far from us move twice as fast. Another consequence is that the universe is expanding in every direction. This observation means that it has taken every galaxy the same amount of time to move from a common starting position to its current position. Just as the big bang theory provided for the foundation of the universe, Hubble's observations provided for the foundation of the big bang theory.

Since the big bang, the universe has been continuously expanding and there has been more and more distance between clusters of galaxies. The big bang theory received its strongest confirmation when Arno Penzias and Robert Wilson, who later won the Nobel Prize in 1978 for the discovery of the cosmic background radiation in 1964 (Lidsey, 2000).

The temperature of the universe at any given time is directly related to the size and age of the universe. It often proves convenient to measure the age of the universe directly in terms of its temperature. A higher temperature corresponds to an earlier time. When the universe was one second old its temperature was about ten billion degree. Matter in the form of atoms would not have been present that time (Lidsey, 2000; Delsemme, 1998). Even most modern cosmologists agree that the big bang model represents an accurate description of the very early universe, at least for the time after about one second, what existed prior to the big bang is completely unknown. Especially, it is unreasonable to believe that there was neither time nor space before the big bang (origin of the universe).

13. Black Hole

According to the general relativity, a black hole is a region of space that has so much mass concentrated in it that there is no way for a nearby object to escape its gravitational pull. Light inside the black hole is bent back on itself and never escapes. Stars begin to collapse and the matter density would gradually increase within the black hole. In the general relativity, gravity is a manifestation of the curvature of space-time. Massive objects distort time and space, so that the usual rules of geometry do not apply anymore. This distortion of space is extremely severe near a black hole. In particular, a black hole has something called an event horizon. This is a spherical surface that marks the boundary of the black hole. Objects can pass in through the horizon, but they cannot get back out. In fact, once anything crosses the horizon, it will be doomed to move inexorably closer and closer to the center of the black hole (Al-Khalili, 2003).

The black hole theory does not show what will happen for the gravitational waves from a black hole. Even the postulate of relativity that makes light speed as the speed limitation keeps matter escaping from the black

hole, whether the speed of gravitational waves obeys this limitation is not clear.

14. Twin Paradox

As I have described in this article, time could be relative and dilative according to relativity from the epistemological point. But, from the ontological angle, time could be neither relative nor dilative. People in different inertial systems can stop their experiments, come together, and compare clocks. They should be able to resolve the question of which clock is really running slower. This makes the apparent paradox, called the twin paradox. Suppose that twins decide to do a time-dilation experiment. One twin gets in a spaceship and flies away from the earth. The spaceship travels out to a distant star and returns to the earth. The twin staying on the earth observes that clocks in the spaceship run slower than on the earth. Therefore, the twin in the spaceship ages more slowly. The twin should return from the journey at a younger age than the one who stays at home. Meanwhile, the twin in the spaceship observes that the clocks on the earth are running slower, as he will see that earth moves from him (relatively). So, the earth-bound twin will age slower and should be the younger age the reunion. Thus, we have a paradox. How can each twin be younger than the other? The answer by the physics now is that the twin in the spaceship is taking the trip and his clock is slower. This is supposed that the situation is not symmetric and the spaceship accelerates to leave or turns around to return. But, if there is no absolute space, it will be no way to define which system is accelerated. The two objects should be relative to be accelerated if no absolute space existed. The fact is that we really feel the accelerate force if we take the trip. So that, the only possible answer is that the absolute reference should be the absolute space. The theory of relativity is wrong in this point.

15. Length Paradox

Suppose that an experimenter takes a pole of 9 m long at 80% of the speed of light relatively to a box of 6 m long. Knowing about the length contraction according to the Lorentz contraction by special relativity, the experimenter proposes that the pole can certainly fit the box when it pass through the box for a while, as the following calculation:

For the pole, original length $l_0=9\text{ m}$, $v=0.8\text{ c}$. For the pole's length l when it moves at v , according to Lorentz contraction [equation (6)]:

$$l = l_0 / \gamma = \sqrt{1 - v^2/c^2} l_0 =$$

$$9 \times \sqrt{1 - (0.8c)^2/c^2} = 9 \times \sqrt{1 - 0.64} = 5.4\text{ (m)}.$$

As $5.4 < 6$, the pole certainly can fit the box when the pole passes through the box for a while.

For the box, it also moves at the speed of $0.8c$ toward the pole (relative moving). According to the Lorentz contraction either, it is impossible for the box to fit the pole at any instant as the box is too small to the pole, as the following calculation:

For the box, original length $l_0=6\text{ m}$, $v'=0.8c$. For the box's length l' when it moves at v' :

$$l' = l_0 / \gamma = \sqrt{1 - v'^2/c^2} l_0 = 6 \times \sqrt{1 - (0.8c)^2/c^2} = 6 \times \sqrt{1 - 0.64} = 3.6 \text{ (m)}.$$

As $3.6 < 6$, the box certainly cannot fit the pole when the box passes through the pole.

For the same event, it is impossible for the pole to fit the box but for the box cannot fit the pole. So that we can get the conclusion that the length cannot contract from the ontological angle and the Lorentz contraction by special relativity is wrong at this point. From ontological point, the length (space) as an objective existence has the absolute meaning and the Lorentz contraction is at the epistemological level.

16. Probability Paradox (Oppugn the Second Law of Thermodynamics)

The first law of thermodynamics is stated as "the energy of the universe is fixed", or "the energy is a function of state", i.e., there is no net energy change in any cyclic process: $\oint dE=0$. The second law of thermodynamics could be formulated in four different ways: (1) Heat cannot flow from a colder body to a hotter one automatically; (2) Entropy must increase; (3) No cyclic process can convert heat entirely to work; (4) In any cyclic process the heat Q transferred to the system from its surroundings at the temperature T must obey an inequality: $\oint dQ/T < 0$ (Hoover, 1999).

The second law of thermodynamics is a statistical result (Savitt, 1990; Uffink, 2001). As an example: take ten billion red liquid particles and ten billion white liquid particles, and arbitrarily mix all the particles in a container. Suppose that there is no interaction between any two of the particles. After a certain time, there is almost no possibility that all the red particles are in a half of the box and all the white particles are in the other half part of the box. It cannot separate the red and white particles without outside energy input. This suppose is depended on all the red particles are same and all the white particles are same, but the red ones and white ones are different. This distinguishability comes from the human eye as we see some particles are red and others are white. The true story is that all the particles are really different. There are twenty billion particles that can be numbered from one to twenty billion. The concept of entropy is an epistemological concept rather than ontological concept. The basic ground for the thermodynamics is to consume that the matter particles are divided into groups with human's idea, but not the

nature itself. According to thermodynamics, the particles belonging to the same group are the same, and those belonging to different category are different. But, the true fact for the nature is that all the particles are different. Any two particles in the universe are different. Even one particle is not the same ones when it is at any two different times. There is no reason to say that the difference between any of two same color particles is smaller than the difference between any of two particles with different color. We say that red particle A is more similar to red particle B than white particle A, and this is depended on the human's intuition. It is certainly possible that red particle A is less similar to red particle B than white particle A. The key point is that we must know that any true existent distribution of the twenty billion particles has the same possibility to appear as the distribution of all red ones are in one half of the container and the all white ones are in the other half of the container.

As a metaphor, let's think about this dilemma: A 20-year-old guy is charged with killing another guy with a knife by cutting the victim's neck publicly. Many people really saw this event and went to court as witnesses. But, the attorney of the killer says in the court: "The cut location was on the 16.5555555555 cm from the top of the victim's head with the 1.3333333333 cm deep and 3.3333333333 cm wide. According to the statistical calculation, it needs about 10^{20} times to make one time cut of this. If my client made the cut one time per second, it needs at least 20 million years to get this cut done ($60 \times 60 \times 24 \times 1000000 = 8.64 \times 10^{10}$). My client is only 20 years old. How could my client do this within his 20 years even if he cut with all his time? This against the second law of thermodynamics and the principle of statistics." Even plenty evidence and witnesses are there to prove this killing, how is the judger going to make the judgment if he respects the statistical theory and the second law of thermodynamics and the science?

The fact is that the basic statistical principles and the second law of thermodynamics are useful tools in human practice, but they are not the true natural existence.

17. Uncertainty Principle

The famous Heisenberg's uncertainty principle states: The more precisely the position (of a subatomic particle) is determined, the less precisely the momentum is known in this instant, and vice versa. According to this argument by the German physicist Werner Heisenberg, we cannot make any measurements on a system of atomic entities without affecting the system. The more precise our measurements, the more we disturb the system. Furthermore, the measured and disturbed quantities come in pairs, the more precisely we determine one half of the pair, and the more we

disturb the other. In other words, the more certain we are about the value of one, the more uncertain we are about the value of the other. This is the essence of the uncertainty principle. Mathematically, it says that the product of the uncertainties of these pairs has a lower limit equal to Planck's constant. For example, the pair of variables that is connected by the uncertainty principle is energy and time: $\Delta E \Delta t > h$ (E is energy, t is time and h is Planck's constant) (Kirkpatrick, 1995). From the description we can see that the uncertainty principle is a mathematical results even with observed supports.

The uncertainty principle is a measurable principle, not an existent principle. It is the epistemological principle rather than the ontological principle. Not to say if it is right or wrong, this uncertainty principle is depended on the ability of human brain and muscle to determine the position and momentum of an object. But, it does not say anything if the position and momentum certainty existing in the same time or not. Even the measurement is principle important for technology and maybe also for science, the real essence of the world is its existence, rather than its measurability. The existence is 0 and 1. This means that all in the natural world only have two conditions: existence and non-existence. It is not the natural fact that a physical object can exist in the probability x : $0 < x < 1$. It must be: $x=0$ or $x=1$. The uncertainty principle does not show the real world.

18. Three-dimensional Time

Suppose that a signal travels in the three-dimensional space with velocity v at any direction that represented by the variable distance s . The distance s to reach any particular point in the three-dimensional space will be the summation of x , y , and z :

$$S^2 = x^2 + y^2 + z^2 \quad (7)$$

$$vt = s \quad (8)$$

Substituting the above:

$$v^2 t^2 = x^2 + y^2 + z^2$$

$$t^2 = (x^2 + y^2 + z^2) / v^2$$

$$t^2 = (x^2 / v^2) + (y^2 / v^2) + (z^2 / v^2)$$

$$t_x^2 = x^2 / v^2$$

$$t_y^2 = y^2 / v^2$$

$$t_z^2 = z^2 / v^2$$

$$t^2 = t_x^2 + t_y^2 + t_z^2 \quad (9)$$

From equation (9) we can see that the time of a signal to travel in the three-dimensional space is three dimensions either. The nature of time could be three dimensions according to the above mathematical calculation. This three-dimensional time concept is obtained from the mathematical calculation rather than the ontological existence. Mathematical results are at the epistemological level. If any mathematical result is in conflict with the possible existence, I persist that the possible existence is true.

19. The Measurement of Time

The modern idea of time is the fourth dimension of the space. We measure the length, width and depth of an object in order to define its place in space, and we now recognize the importance of its fixed position at the time of the measurement.

Three systems of time measurements are in use: (1) universal time (Greenwich Mean Time) – derived from the rotation of the earth on its axis; (2) ephemeris time – derived from the revolution of the earth around the sun; (3) atomic time – derived from the operation of the atomic clocks. Universal time is the mean solar time of the prime meridian on which the city of Greenwich of England is located. The universal time is the basis for the standard time used for the reckoning of civil time. Ephemeris time is the time scale of dynamical astronomy that is used for the precise study of the motion of celestial bodies. Atomic time is the time measurements of the time interval related to the physical phenomena. The time measurement tools are normally called clocks.

There are many kinds of clocks in the human history, such as water clock, sand clock, glass clock, pendulum clock, quartz-crystal clock, atomic clock, etc. The typical method to measure time is the pendulum. A given pendulum completes a certain fixed number of oscillations while the earth rotates once on its axis relative to the stars. A simple pendulum whose length is one meter, for example, always completes 43,047 oscillations while the earth rotates once on its axis (Markowitz, 1988).

The most discussions on time measurement by the relativity are clock. The clock is a man-made tool to measure the time. This is an epistemological concept.

20. Absolute Time and Space

Both the relativity and quantum mechanics are thinking about how to measure the time with a clock and how to measure the space with a ruler. They are at the epistemological (or empiricism) level. To reveal the essence of nature, we need to discuss the time and space from the ontology, or naturalism point. From the ontology angle, the key point is not about how to make the accurate measurements, but how to understand the real nature existence.

If there is no absolute space existing, all the movements including the accelerative movement are relative. But, we really feel the accelerative movements if we take an accelerative carriage and we do not need any moving or static reference to feel this acceleration. How can we feel the acceleration as our experience if there is no absolute reference system to be referenced? Considering the earth or a big star as the reference system is really objective. The light pathway can be curved, but it is the light's pathway is curved, rather than the space is curved. There is no reason to say that

the light ray must travel on a specific surface of a space. We can assume that the phenomenon of light ray curved is the light passes through the continuous surfaces of absolute space when the gravitational force influences the light, rather than the space is curved by the gravitation (Figure 6). Even we agree with the concepts of time dilation and Lorentz contraction, we still should consider them as a linguistic question, rather than the scientific tenet. For the body in an inertial system, the moving is relative. If we do not give a reference, we cannot verify its motion. But, for the accelerated motion, it does not need to define a reference. How do we know the absolute acceleration without an absolute reference? The only possibility is that there is an absolute reference – the absolute space. The size of space can be measured small under a specific physical condition such as an moving object, but the space itself cannot be changed by human observation. The real space is absolute!

Time is a strange being. It is everywhere and is always running. In all literatures, sciences and mythologies time always goes in one direction-forward. According to the relativity time can be zero or stand still at the speed of light. But time never vanishes. It is the current belief that time can be removed and introduced into the universe thereby showing that total universal time is constant. This is a weird concept. People can see the time arrow goes in one direction in the macro-world, but never see it goes vice versa. In the micro-world, according to the quantum calculation, scientists get the two-way time arrow objectively. Why? The reason is that the intelligence of human brain cannot feel the true existence of the micro-world running. This is the science tricking brain. The clocks can run slower under a specific physical condition such as an object moving, but the time cannot elapse slower by human's measurements. Time is the natural existence phenomenon. Nobody can make the time dilate or shrink by his/her measuring activity. The real time is absolute!

21. Timeless World

I have discussed the nature of time and space partly from the epistemological angle depended on the common scientific notions. Now, let's think about the timeless world concept from the ontological angle.

For the past, where is it now? For the future, where does it stay? These questions have been asked in the whole history of human society (Hawking, 1988, 2002). I am convinced of the timeless world naturally. In my view, everything in the universe will never change. Time and motion are nothing more than illusions. In the universe, every moment of every individual's life - birth, death, and anything in between - exists forever. Everyone is eternal. That means each and every one of us is immortal. The universe has neither past nor future.

All the things in the past, present, and future exist forever. The concepts of past, present and future are depended on the human brain. The total universal time is constant. It is a matter of experimentally proven fact that this seemingly universal flow of time does not exist. Lapses of time, as they are measured by the recurrence of periodic events, are not impervious to everything but rather depend upon the relative motion of the two systems whose periodicities are being compared and the positions of the systems are in a gravitational field.

A ship with over-light speed can catch the image of the past events. This happens only because the light goes out but not because there is the real past time. This is just like what we see a movie tape with the reversed direction. The fact is that everything exists already and forever. We see that there are past and future because we are living in our time arrow. This is the absolute time. The key question for us is how to testify that the past still exists and the future has existed already.

22. Determinism

Classic Newtonian mechanics and the newer quantum mechanics have been sources of many debates about the role of cause and effect in the natural world. With Newton's law of motion came the idea that specifying the position and momentum of a particle and the forces acting on it allowed the calculation of its future motion (Roberts, 2003). Everything is determined. It was like that the universe is an enormous machine. Since the universe has been made of existence condition, its future is predetermined. This idea is known as the Newton's mechanical determinism. This notion must also be extended to living organisms. Newton's mechanical determinism has been criticized by the relativity and the quantum theories.

Even though humans could not determine the positions and momenta of all the objects at a specific time, according to the Heisenberg's uncertainty principle, and there are limitations of the abilities for the human intelligence to know the future of the world, the nature knows the future. The future is predetermined by nature. All things in the future are real existence in the future according to the timeless world tenet, no matter we can pre-know or not. For natural existence fact, we must say that the "determinism (predetermine)" is true, not the "prophetism (precognition)" is true. Everything of the world in future is there – somewhere in future, no matter whether we do know the detail or not.

Time, space, memory and mind are related. To talk about this I want to mention the old Zen parable of the three Buddhist monks who were arguing about a waving flag. The first monk said that the flag was moving, not the wind. The second monk said that the wind was moving, not the flag. Then the third monk smiled and said: "It is neither the wind nor the flag that is moving - it is your minds". This provided a hint for the nature of

our knowledge. The principles and theories we created, such as the relativity, the uncertainty principle, the second law of thermodynamics and the probability theory, etc., all are the moving of our mind. Maybe we will never know the complete functions and future of the universe with our limited ability. But the nature does know. The natural determinism is the natural existence that is not depended on our knowledge or our abilities.

23. Discussions and Conclusions

A lot of discussions on the topics of nature of time and space have been made and the relativity and the quantum theories were challenged (Butterfield, 2003; Hawking, 2001; Hoover, 2003; Morrision, 1999; Myrvold, 2003).

Motion is everywhere in the universe. In one second, a human heartbeat takes place and the earth moves about 30 km around the sun, and a beam of light travels 300,000 km (7 times around our earth). In addition, the earth rotates on its axis at almost 1,600 km and revolves around the sun at approx 100,000 km per hour. This entire solar system is moving toward the star Vega at about 19 km per second and our Milky Way galaxy is traveling toward the Great Andromeda galaxy at about 80 km per second.

Space is defined by saying where a thing may come to be or has been. It is the separator of objects. Time is a similar separator of chronological events (when things have been or may come to be). The whole universe is an entity connected by the space-time field. The whole universe is one thing.

There are two aspects for the concept of time and space: One is the measured time and space (subjective, epistemology), and the other is the physical time and space (objective, ontology, physical entity). As the space expands, it is no reason to say that the space expands or the ruler shrinks, neither to say that time dilates or contracts. The only accepted natural fact is that we get the message of something sometimes getting bigger (so called expanding or dilating) and sometimes becoming smaller (so called shrinking or contracting).

To describe the universe on the largest scale, Einstein weaved time and space together into the very fabric of the universe. As a result in the general relativity, there is no invisible framework, no clock ticking outside the universe against which to measure events. How could there be? Time and space joined together cause weird consequences: Space and time curve around stars and other massive bodies and make light bend away from straight-line paths. Does time seem to slow down or even come to a full stop near the black holes? The concepts on these topics by modern science are at the idealist point.

The mistakes of the relativity are to consider that all the existence is relative but the light/light speed is absolute. Light is only a form of electromagnetic

radiation existing in the universe with the wave and particle properties. From this point, as any other forms of the existence, light cannot be the standard to judge the nature of time and space. All the existences in the universe are existing, including all the energy, matter, moving, space, time, etc. The existence is absolute, no matter someone observing/measuring it or not. After Albert Einstein died on April 18, 1955, the universe still exists absolutely. The existence is not depended on whether Heisenberg could measure it precisely or not.

We have no way to ontologically recognize all the past, present, or future existence. The contemporary intelligent people could monitor the instantaneous state of the processing of inputs by the brain. However, what perceived has been delayed in the perceiving process because in the course of this perceiving procedure, a finite amount of time is taken to encode and process the inputs. The processed information is transferred to a tape called memory, which is often modified in the process of accessing. From epistemology, we consider that the future is modifiable by intervention in real time, while the past is not. The human brain, by a process of participation, transforms visual inputs in the form of light waves into the objective reality. We see the world through our eyes and we think about the world with our brain cells (Brown, 1998). Light rays are the bridge from the body to the spirit through the tunnel of the mind. Furthermore, we can also feel the real world and measure the world with our skin, nose, tongue, hand, etc. All the physical parts of our body can be used to feel and measure the world. So, making the light as the absolute reference is totally wrong. We trust our observations but we know that the world we observe is the observed world, and sometimes it is not the real existed world. Even we must depend on our observations, but we should think about what it really is (Rose, 1998).

According to the big bang theory, time began with the big bang, an explosion of a singularity (Earman, 1999). The theory is very vague on the how, when, where, and why of that singularity. Was it located in space? If so, space has no beginning and space must be absolute. Some scientists consider the big bang to be a rapid expansion of space. If space can expand, then it is in motion, and thus it cannot be a dimension that defines motion. If we say the beginning of the universe, we need to ask "beginning of what?" According to the modern cosmology, the concept of time has no meaning before the beginning of the universe. It did not exist then. So that we can see that the modern cosmological concept on the time and space is wrong. Linear time is based on a historical perspective of events that rush ahead, one following the other, in a straight line. The passage of light is an event. Events occur in time and space. Time and space measure the when and where of

events. Light passes through space during a time span. It is not the passage of light through space creates time.

Ontologically, the time and space can neither contract nor expand. If we really want to say that time and space can contract or expand, we must create other words to define the concepts of those kinds of “time” and “space”, rather than the time and space we have defined already. The modern physics and cosmology, such as the relativity and the quantum theory, are defining the contraction/expansion of time/space with the linguistic tricks, rather than the scientific philosophy.

Contemporary astrophysics says that it has significant evidence revealing that the universe is open (expanding only, not oscillating). When this conclusion is combined with other types of cosmological observations, it would seem that the universe originated at a singularity (an absolute temporal boundary) approximately 15 billion years ago. This intends to give conclusions about a causative power outside of space-time asymmetry (i.e., a Creator), and the nature of space-time and causality (Spitzer, 2001).

If we say that the universe is finite, we must ask and answer what is the outside of the universe. Although this is an ancient question, it is still the question that nobody can answer reasonably. “Nothing” is not the satisfied answer to the outside of the universe of the finite model.

Although the quantum information theory that combines physics, computer science and information theory has succeeded in harnessing the special features of the sub-atomic world to devise fast algorithms, to decipher unbreakable codes, and to teleport quantum states (Hagar, 2003), and this gives quantum theory new features, the quantum theory still conflicts with the real physical existence.

Correspondence to:

Hongbao Ma
B326 Clinical Center
Department of Medicine
Michigan State University
East Lansing, MI 48824, USA
Telephone: 517-432-0623 (O); 517-355-7880 (H)
Email: hongbao@msu.edu

References

Al-Khalili J. Black holes wormholes & time machines. Institute of Physics Publishing, Bristol, United Kingdom. 2003:78-107.
Barbour J. The End of Time – The next revolution of physics. Oxford University Press. New York City, New York. 2000:11-3.
Brown JW. Foundations of cognitive metaphysics. *Process Studies* 1998;27(1-2):79-92.
Butterfield J, Isham C. Spacetime and the philosophical challenge of quantum gravity, in *Physics Meets Philosophy at the Planck Scale: Contemporary Theories*, in *Quantum Gravity*, Callender C (ed), Cambridge University Press, Cambridge, Britain. 2001:33-89.

Callender C. Philosophy of space-time physics, in *The Blackwell Guide to the Philosophy of Science*, Machamer P (ed), Blackwell Press, Cambridge, Britain. 2002:173-98.

Delsemme A. Our cosmic origin: From the big bang to the emergence of life and intelligence. Cambridge University Press. Cambridge, United Kingdom. 1998:28-37.

Dowe P. The coincidences of time travel. *Philosophy of Science*. 2003;70(3):574-89.

Earman J, Eisenstaedt J. Einstein and singularities. *Studies in History and Philosophy of Modern Physics*. 1999;30B(2):185-235.

Folger T. From here to eternity- Imagine a universe with no past or future, where time is an illusion and everyone is immortal. *Discover* 2000;21(12):54-61.

Hagar A. A Philosopher looks at quantum information theory. *Philosophy of Science* 2003;70(4):752-75.

Hawking SW. A brief history of time: from the big bang to black holes. Bantam Books, New York, NY, USA. 1988:16-25.

Hawking SW, Penrose R. The nature of space and time. Princeton University Press. Princeton, NJ, USA. 1996:3-36.

Hawking SW, Penrose R. The nature of space and time. *International-Studies-in-Philosophy* 2001;33(4):126-7.

Hawking SW, Thorne KS, Novikov I, Ferris T, Lightman A. The future of spacetime. W. W. Norton & Company, Inc., New York, NY, USA. 2002:57-62.

Hoover KD. Nonstationary time series, cointegration, and the principle of the common cause. *The British Journal for the Philosophy of Science* 2003;54(4):527-51.

Hoover WG. Time reversibility, computer simulation, and chaos. World Scientific Publishing Co. Pte. Ltd. River Edge, NJ, USA. 1999:41-2.

Hyperdictionary. <http://www.hyperdictionary.com/dictionary/time>. 2003.

Kirkpatrick LD, Wheeler GF. *Physics*. Saunders College Publishing. New York, NY, USA. 1995:274-83.

Kogut JB. *Introduction to relativity*. Harcourt/Academic Press. Burlington, MA, USA. 2001:12-20.

Lidsey JE. The big bang. Cambridge University Press. Cambridge, United Kingdom. 2000:55-65.

Markowitz W. Time. In *Collier's Encyclopedia*. Macmillan Educational Company. New York, NY, USA. 1988;22:318-25.

Monk NAM. Conceptions of space-time: Problems and possible solutions. *Studies in History and Philosophy of Modern Physics*. 1997;28B(1):1-34.

Morrison W. Must the past have a beginning? *Philo*1999;2(1):5-19.

Myrvold WC. Relativistic quantum becoming. *The British Journal for the Philosophy of Science* 2003;54(3):475-500.

New Webster's Dictionary, Weston, FL, USA. 2003:161,173.

Peskin ME, Schroeder DV. *An introduction to quantum field theory*. Addison-Wesley Publishing Company. New York, NY, USA. 1995:781-800.

Pickover CA. *Time: A traveler's guide*. Oxford University Press. New York, NY, USA. 1998:25-33.

Roberts JT. Leibniz on force and absolute motion. *Philosophy of Science* 2003;70(3):553-73.

Rose S. *Lifelines*. Oxford University Press. New York City, New York. 1998:136-41.

Savitt SF. Epistemological time asymmetry. *Proceedings of the Biennial Meetings of the Philosophy of Science Association* 1990;317-24.

Spitzer RJ. Indications of creation in contemporary astrophysics. *Ultimate Reality and Meaning*. 2001;24(3):209-54.

Uffink J. Bluff your way in the second law of thermodynamics. *Studies in History and Philosophy of Modern Physics*. 2001;32B(3):305-94.

Webster's New Universal Unabridged Dictionary. Barnes & Noble Publishing, Inc. New York, NY, USA. 2003:1827,1984.

Zeh HD. The physical basis of the direction of time. Springer-Verlag. New York, NY, USA. 1992:8-11.

Mankind May Be Impossible to Manufacture out Any Artificial Real Gravitational Black Hole (BH) Forever

---- Part 3 of “New Concepts to Big Bang and Black Holes”^{[6][7]}----
----A incidental comment to BBC News about artificial BH on 3/17 /2005----

Dongsheng Zhang

Graduated in 1957 From Beijing University of Aeronautics and Astronautics. China.

Permanent address: 17 Pontiac Road, West Hartford, CT 06117-2129, U. S. A.

Email: ZhangDS12@hotmail.com

Nov./2005

Abstract: Recently, many scientists in different countries did some alarmist talks to “artificial black holes”.

Probably, those scientists only depended upon their unreal image to talk about “artificial black hole”. They might not conscientiously study the characteristics of a real gravitational BH, and not calculated out the exact values of various parameter of a real gravitational BH in detail. Most scientists hankered after new modern theories, such as string theory, but almost neglect to apply classical theories, such as Hawking’s formulas about BHs in calculations of BHs. However, BH is the product of classical theories, it can be correctly explained only by classical theories. Some experimental scientists probably made up news about manufacturing artificial BHs for their special purpose. Thus, they did not apply the suitable formulas to calculate out correct value of every parameter of a real gravitational BH so that they might consciously or unconsciously obscured the principal differences between a real gravitational BH and non-BH with specious arguments.

The calculated fundamental formulas in this article originate from GTR and Hawking about theory of BH, through qualitatively analyses and detailed calculations to various parameters of different real BHs, this article will show that, any “artificial BH ” will have no possibility to be manufactured out by mankind forever.

Key Words: artificial black hole, real gravitational black holes, calculations to various parameters of black hole,

Introduction: Previously, some Russian scientists had advertised to produce artificial bombs of mini BHs or so-called Otone, mass of 1 Otone = mass of 40 atoms = $40 \times 1.67 \times 10^{-24} \text{g} \approx 10^{-22} \text{g}$. Russian scientist Alexander Trofeimonko pointed out that, mini black holes could be manufactured out in laboratory as a “bomb of black hole”, which could kill billion people. They said, it will be the century of “Otone” after 50 ~60yrs. They also advocated that, mini BHs inside earth would ignite volcanic eruption, and mini BHs would lead to spontaneous combustion in human body, etc.^[1] In January 2001, English theoretical physicist Wolf Leonhart declared that he with his colleagues would make a black hole in a laboratory.^[1]

On 3/17/2005, BBS reported that in RHIC—Relative Heavy Ion Collider sited at the Brookhaven National Laboratory in New York, “fire ball” caused by the collision of two gold-nuclei, which speed of smashing collision approached light speed, was striking similar with a micro black hole.^{[2][3][4]} When the gold nuclei smashed into each other, they were broken down into particles called quarks and gluons. They

formed a ball of plasma about 300 times hotter than the surface of the Sun.^{[2][3][4]} The maker of “fire ball”, Prof. Horatiu Nastase of Brown University in Providence of Rhode Island wrote: “We calculate the soliton (black hole) temperature, and get 175.76MeV, compared to the experimental value of the “fireball” `freeze-out` of about 176 MeV, its lifetime is about 10^{-24}s . ”^{[2][3][4]} He said: “There is something unusual about it. Ten times as many jets were being absorbed by the fireball as were predicted by calculations.”^{[2][3][4]}

English famous cosmologist, Martin Reez predicted in his book <The Last Century> that, the first one of 10 greatest catastrophes on earth in future would be “artificial black hole”.^[2]

Some Greek and Russian Scientists proposed in 2003 that countless short-lived micro BHs were produced from the collision of the universal rays with high energy to particles or molecules of our atmosphere, its mass was about $10 \times 10^{-6} \text{g}$, its lifetime was about 10^{-27}s . In addition, they pointed out that the new Super Hardon Collider of European Particle-physical Laboratory will work in 2007, and will have strong power enough to

manufacture out about ten thousand micro BHs every day.^[5]

1. Black hole (BH) and formulas for calculating various parameters of BH

According to the definition of GTR (general theory of relativity), black holes were objects, in which light would be bound by the extremely curved time-space and could not escaped out. Hawking discovered Hawking's radiation emitted out from BH and got formulas to calculate Hawking's radiation. Those theories and formulas are the calculated foundations in this article.

Only Schwarzschild's BHs (no charges, no rotating and spherical symmetry), which are real gravitational BHs, will be studied in this article below.

In my former article "New Concepts to Big Bang and Black holes —Part two",^[6] author pointed out clearly that, BH would be the simplest object in nature, the relationships between its various parameters are simple and single value, once the value of a parameter is given, the values of all other parameters would be solely decided with the first one. In that article, author further demonstrated that, any BH had no possibility to exist in nature, if its mass was less than 10^{-5} g.^{[6][7]}

For a formed real gravitational BH, the formulas of its various parameters are below, if M_b —mass of a BH, R_b —its Schwarzschild's radius, T_b --temperature on Event Horizon, ρ_b --density on Event Horizon, G --gravitational constant, κ -- Boltzmann's constant, h —Plank's constant, M_\odot --mass of sun $\approx 2 \times 10^{33}$ g, C —light speed,

According to the definition of GTR and Hawking's theory about BH, to a real gravitational black hole, formulas (1a), (1b), (1c) and (1d) below should not be violated.

$$R_b = 2GM_b/C^2 \text{ or } C^2 = 2GM_b/R_b \quad [6][7][8] \quad (1a)$$

(1a) is the necessary condition for existence of any real gravitational BH.

According to Hawking's formula about BH,

$$T_b = (C^3/4GM_b) \times (h/2\pi\kappa) \approx 0.4 \times 10^{-6} M_\odot / 10^{27} / M_b \quad [6][7][8] \quad (1b)$$

According to Hawking's another formula about BH, the lifetime of a BH is decided by the energy

emitting out Hawking's radiation from BH in unit time,

$$\tau_b \approx 10^{-27} M_b^3 \text{ (s)} \quad [6][7][8] \quad (1c)$$

It can be seen from (1a), (1b) and (1c),

$$\tau_b \propto 1/T_b^3.$$

Particle and radiation at extremely high temperature (energy) would have three forms of energy (E_1, E_2, E_3), in some special states or conditions, they might be identical and transform between each other.

$$E_1 = m_p C^2, \quad E_2 = \kappa T, \quad E_3 = Ch/\lambda \quad (1d)$$

$$M_b = 4\pi\rho_b R_b^3/3 \quad (1e)$$

It can be seen that, R_b, T_b, τ_b, ρ_b , are all simple and single functions of M_b .

For convenient calculation, formula (1a) can be altered to

$$M_b/R_b = C^2/2G \approx 0.675 \times 10^{28} \text{g/cm} \approx 10^{28} \text{g/cm} \quad (1aa)$$

Formulas (1a)×(1b) is equal to

$$T_b \times R_b = (C^3/4GM_b)(h/2\pi\kappa)(2GM_b/C^2) = Ch/4\pi\kappa \approx 0.1154 \text{ cmk} \quad (1ba)$$

2. The collision of two gold-nucleons with approaching light speed in RHIC of New York cannot become a real gravitational micro BH at all

(A). To a particle m_o of speed v , its total energy E can be expressed as below, m_o —static mass of a particle,

$$E = m_o v^2/2 + m_o C^2 \quad [9] \quad (2a)$$

Suppose 2 gold-nucleons (Au) had formed a "fireball" in the collision in RHIC with speed v , v approached to light speed C , M_{oau} —mass of a Au, then,

$$2M_{oau} = 197 \text{ H} \times 2 = 2 \times 197 \times 1.66 \times 10^{-24} \text{g} = 6.58 \times 10^{-22} \text{g}$$

From (2a), the total energy-matters E_{au} of the formed "fireball" gotten from RHIC would be,

$$E_{au} = 2M_{oau} v^2/2 + 2M_{oau} C^2 \approx 3M_{oau} C^2 = 1.5 \times 6.58 \times 10^{-22} \times (3 \times 10^{10})^2 = 0.89 \text{erg} = 6.242 \times 10^{11} \times 0.89 \text{eV} = 555 \text{GeV} = 555 \times 10^9 \times 4.46 \times 10^{-26} \text{kW} \cdot \text{h} = 2.5 \times 10^{-14} \text{kW} \cdot \text{h} \quad (2b)$$

In ideal state, the highest temperature T_{au} of "fireball", $T_{au} = E_{au}/\kappa \approx 10^{17} \text{k}$ (2c)

E_r —energy expended by RHIC for collision of 2 gold-nucleons (i.e. for $6.58 \times 10^{-22} \text{g}$),

$$E_r = E_{au}/3 \approx 185\text{GeV} = 0.8 \times 10^{-14} \text{kWh} \quad (2d)$$

It shows that, **if mankind could successively manufacture a BH of mass = m_0 with collision of particles on a Colliders, mankind should expend energy $E_r \approx m_0 C^2/3$, terrible costs!**

$$E_r \approx m_0 C^2/3 \quad (2e)$$

Thus, if M_{bau} was a new formed real gravitational BH, its values of various parameters should be:

$$M_{bau} = 3M_{0au} = 3 \times 197 \times 1.67 \times 10^{-24} \text{g} = 9.87 \times 10^{-22} \text{g},$$

$$\text{From (1aa), } R_{bau} = M_{bau}/0.675 \times 10^{28} = 1.5 \times 10^{-49} \text{cm},$$

$$\text{From (1ba), } T_{bau} = 0.1154/R_{bau} = 0.77 \times 10^{48} \text{k},$$

$$\text{From (1c), } \tau_{bau} \approx 10^{-27} M_{bau}^3 (\text{s}) = 10^{-27} \times (9.87 \times 10^{-22})^3 \approx 10^{-90} \text{s}$$

$$\text{From (1d), } E_{bau} = \kappa T = 1.38 \times 10^{-16} \times 0.77 \times 10^{48} = 10^{32} \text{erg}$$

$$\text{From (1e), } \rho_{bau} = 3M_{bau}/(4\pi R_{bau}^3) \approx 0.7 \times 10^{125} \text{g/cm}^3$$

It can be seen that, above values of R_{bau} , T_{bau} , E_{bau} and τ_{bau} as a real gravitational micro BH had no possibility to appear in nature, because above values greatly exceed the beginning values of Plank's Era (Plank's mass $m_p = 10^{-5} \text{g}$, Plank's time $t_p = (Gh/2\pi C^5)^{1/2} = 0.539 \times 10^{-43} \text{s}$, Plank's length $l_p = t_p \times C = (Gh/2\pi C^3)^{1/2} = 1.6 \times 10^{-33} \text{cm}$,).^[7] The deep interior of Plank's Era might not be known and not detected by mankind at all forever.

Assume "fireball" made in RHIC was still a BH after absorbing 10 times jets of particles as called by Prof. Nastase, values of various parameters of such BH (M_{10}) are respectively changed into different values below.

$$M_{10} = 10M_{0au} = 10 \times 9.87 \times 10^{-22} \text{g} = 9.87 \times 10^{-21} \text{g},$$

$$R_{10} = 1.5 \times 10^{-48} \text{cm}, T_{10} = 0.77 \times 10^{47} \text{k}, \tau_{10} \approx 10^{-87} \text{s}.$$

It can be seen that practical values of "fireball" detected by Prof. Nastase is still too far away from a real gravitational BH.

(B). The almost same temperature value of that "fireball" or so-called BH calculated out and got from experiment by Prof. Horatiu Nastase was 176MeV, its lifetime was about 10^{-24}s , the surface temperature of "fireball" was about $T_{sur} = 300 \times 5,800$ (surface temperature of Sun) $\approx 1.74 \times 10^6 \text{k}$. They are far away from values of a real

gravitational micro BH above. Thus, **"fireball" was not a real gravitational BH at all.**

First, lifetime 10^{-24}s of "fireball" in RHIC showed that "fireball" is not a real gravitational BH at all. To a real gravitational BH, if its lifetime is 10^{-24}s , correspondingly, its mass $M_{.24}$ should be about 10g, because according to (1c), $10^{-24} \approx 10^{-27} \times M_{.24}^3$, $\therefore M_{.24} \approx 10 \text{g}$.

Then, what does lifetime 10^{-24}s of "fireball" mean? It may mean that, gold nuclei after collision rapidly formed a "fireball" and instantly decomposed into particles other than integrating a real BH, because the disappearance of a BH would be bound to follow a burst of strong explosion and to emit γ -rays of extremely high energy. The relatively quiet disappearance of "fireball" express that, the energy of "fireball" is not so high to become a real BH needed by the same mass.

If distance $d_{au} = 10^{-24} C$ (light speed) $= 10^{-24} \times 3 \times 10^{10} \approx 3 \times 10^{-14} \text{cm}$, hence, $d_{au} = 3 \times 10^{-14} \text{cm}$ may be approximately considered as the distance of the closest protons in gold-nuclei, or the distance of two closest gold-nuclei jetted from RHIC with approaching light speed, thus, lifetime 10^{-24} of "fireball" only shows the time from the beginning collision of the first pair of gold-nuclei to second pair of gold-nuclei, and to other 10 times gold-nuclei non-stop jetted from RHIC. That process is complete difference with a real micro BH to engulf energy-matters from outside. The existence of "fireball" could keep in 10^{-24}s only due to more gold-nuclei continuously jetted by RHIC. Therefore, lifetime 10^{-24} of "fireball" just indicate that "fireball" is not a real micro gravitational BH.

Second, what does 176MeV of soliton (black hole called by Prof. Nastase) got in experiment and calculated by Prof. Nastase mean? Let E_{pk} is the kinetic energy of a proton in gold nuclei, and $E_{pk} = m_{pro} v^2/2 < m_{pro} C^2/2 = 1.67 \times 10^{-24} \times (3 \times 10^{10})^2/2 = 7.5 \times 10^{-4} \text{erg} = 7.5 \times 10^{-4} \times 6.242 \times 10^{11} \text{eV} = 47 \times 10^7 \text{eV} = 470 \text{MeV}$,
 $\therefore E_{pk} < 470 \text{MeV}$.

After collision, E_{pk} would not be completely altered into heat energy, greater part of E_{pk} transformed into other energies, such as radiation, so, **176MeV measured by Prof. Nastase are just**

heat energy transformed from partial kinetic energy of every particle in collision. The process of manufacturing real BH should accumulate most energy-matters, however, greater part of energy has to lose in collision in RHIC. If “fireball ” was a real BH, heat energy of 176MeV could not be measured by Prof. Nastase. **A real gravitational BH should have no way to be detected. A detected object is not a real BH.** It has conversely proved that “fireball” is not a real BH at all. Temperature T_{pro} corresponding to heat energy 176MeV should be: $T_{pro} = 176\text{MeV}/\kappa = 176 \times 10^6 \times 1.602 \times 10^{-12} / (1.38 \times 10^{-16}) = 2 \times 10^{12}\text{k}$

Third, what does the surface temperature ($T_{sur} = 1.74 \times 10^6\text{k}$) of “fireball” mean? Temperature on the surface of our Sun is about 5,800k, so, $T_{sur} = 1.74 \times 10^6\text{k}$ was temperature on the surface of “fireball”. It shows that, before or after collision of protons, interactions between protons or gold-nuclei exerted heat movement and formed a ball of blazing gas, i.e.”fireball”, because the practical collision was a process, **all protons in gold-nuclei of two sides had no way to participate in collision at the exact same time**, its wave length

$$\lambda_{sur} = Ch/\kappa T_{sur} = 3 \times 10^{10} \times 6.63 \times 10^{-27} / (1.38 \times 10^{-16} \times 1.74 \times 10^6) = 8 \times 10^{-7}\text{cm}.$$

According to $\lambda_{sur} = 8 \times 10^{-7}\text{cm}$, “fireball” should emit x-rays and become a real “fire ball”.

Fourth, assume “fireball” were a real BH, it could not endanger anything as well as mankind, because its lifetime was just 10^{-90}s , if it could move with light speed C , it only went 10^{-80}cm . However, the real lifetime of “fireball” was 10^{-24}s as Prof. Nastase’s said, it could only move 10^{-14}cm with light speed C , 10^{-14}cm is just the distance between two closest nucleons in any atom.

In a word, object produced by the collision of 2 gold-nuclei (Au) in RHIC was not a real gravitational micro BH at all, but just a “fireball” of mixed quarks and gluons, because a real BH could have no visibility and not be detected except Hawking’s radiation, besides, the death of a real BH should have a burst of very strong explosion and emit γ -ray bursts with high frequency. However, visibility, very long lifetime and quiet disappearance of “fireball” have proved that,

“fireball” produced by Prof. Nastase in RHIC had no any similar with a real gravitational BH.

(C). It can be known with the same reasons and calculations that, micro BH Otone advocated by Russian scientists would have more impossibility to be manufactured out by mankind forever, because mass of Otone is equal to mass of 40 atoms $\approx 1/10M_{bau}$. It is said, assume Otone is a real BH, its temperature would be higher and its lifetime shorter than above collision of gold-nuclei in RHIC.

(D). It can be seen from (2b), assume a bomb of artificial BH had been made out, its explosive total energy was E_{au} , but the expended energy in laboratory was $2M_{oau}v^2/2 \approx 1/3E_{au}$, it was the worst business for producer of BH.

(E). About energy of RHIC: It can be seen from above calculation, the energy of RHIC for the collision of 2 gold-nucleon is $1/3E_{au} \approx 1/3 \times 0.89\text{erg} \approx 0.3\text{erg} \approx 0.3 \times 6.242 \times 10^{11}\text{eV} \approx 1.87 \times 10^{11}\text{eV} \approx 187\text{GeV}$. It is rather high to RHIC.

(F). Assume M_{bau} became a real micro BH, could it exist in a long time? From above calculation, its lifetime was just 10^{-90}s , only if it could engulf energy-matters from its surrounding within time of 10^{-90}s , it would vanished certainly. $10^{-93} \times C = 3 \times 10^{-80}\text{cm}$, it is said, if energy-matters depart from M_{bau} beyond $3 \times 10^{-80}\text{cm}$, M_{bau} would have no way to grow up and vanish instantly.

(G). Could BH $M_{bu} = 10^{-5}\text{g}$,^[7] (i.e. $10 \times 10^{-6}\text{g}$), which is equal to BHs at the genesis of our universe, be manufactured artificially by the new Super Hardon Collider (SHC) of European Particle-physical Laboratory in 2007 or exist in atmosphere of our earth? No way, SHC will only manufacture a little bigger and more “fireballs” than RHIC. Short-lived micro BHs had no way to appear in our atmosphere, even if the energy of universal particle was high to 10^{11}GeV ^[11], but it only became a little bigger “fireball”, because its mass is still too small.

From (2c), if energy E_{bu} is needed by artificially manufacturing a $M_{bu} = 10^{-5}\text{g}$, as a result, $R_{bu} = 10^{-33}\text{cm}$, $T_{bu} = 10^{32}\text{k}$, that state has been on the border of Plank’s Era. $E_{bu} \approx 10^{-5}C^2/2 = 4.5 \times 10^{15}\text{erg} = 3 \times 10^{18}\text{GeV}$.

(H). Mankind can't triumph over nature

“Fireball” made in RHIC by Prof. Nastase had no possibility to become a real gravitational BH. Mankind would have no way to attain energy of every particle high to (3×10^{18} GeV), which only appeared at the genesis of our universe forever. Such high energy was the result of gravitational collapse of our whole universe in its past life or could be considered as a God's masterwork.

3. The necessary condition of existence and growth for a new-born micro BH, as assuming that an artificial real gravitational BH had been manufactured out

(A). A new-born micro BH, whether it is an artificial or a natural, always had too much high temperature and too much shorter lifetime, hence, the necessary condition of growth for a new-born

Form 1							
Objects	ρ_0 (g/cm ³),	$d_p \leq d_{bp}$ (cm),	M_{b1} (g),	τ_b (s),	R_b (cm),	E_{eV} (eV),	E_{kwh} (kWh)
Atoms	10^1	10^{-8}	700	3.43×10^{-19}	10^{-25}	2×10^{26} GeV	9×10^9
White dwarf	10^6	10^{-10}	150	3.38×10^{-21}	2.25×10^{-26}	4×10^{25} GeV	1.7×10^9
Neutron star	10^{15}	10^{-13}	15	3.38×10^{-24}	2.25×10^{-27}	4×10^{24} GeV	1.7×10^8

Values of M_{b1} calculated from formula (3a) or (3b) on above form 1 were just a fictitious necessary condition for a new-born BH to have a possibility to engulf some energy-matters from outside in its lifetime. However, **Energy-matters of outside just felt the gravity of the new-born BH but had no more time to be surely engulfed, besides, the new-born micro BH was rapidly losing its energy-matters with Hawking's radiation. Therefore, M_{b1} were all still too small, their lifetime were all too short.**

Furthermore, the energy E_{eV} needed by Colliders for producing new-born BH is too much great. Now, energy of the strongest accelerator in the world is just less than 10^4 GeV, but the energy of micro BH of mass = 10^{-5} g (i.e. single particle) at the genesis of our universe was 10^{19} GeV,^[7] which might not be attained by mankind forever. The ability of mankind to manufacture a micro “artificial BH” would not exceed God's will at all.

micro BH (its mass = M_{b1}) is that, in its lifetime, its gravity at least could reach to energy-matters of its surrounding. τ_b —lifetime of BH, C —light speed, d_{bp} —distance from new-born micro BH to particles outside BH, then,

$$\tau_b C > d_{bp} \tag{3a}$$

From (1c),

$$M_{b1} > 10^9 (d_{bp}/C)^{1/3}, \text{ or, } M_{b1} > 3.2 \times 10^5 d_{bp}^{1/3} \tag{3b}$$

Assume an artificial BH M_{b1} has been successfully manufactured in a laboratory, 9.87×10^{-22} g was a M_{b1} is heavy enough and d_{bp} is short enough for increase in mass of M_{b1} . It is said, assume new-born M_{b1} instantly shoot or fall into some object, (such as atoms, white dwarf or neutron star in form 1) in which the distance d_p between two closest particles must be less or equal to d_{bp} . For comparison, three different objects will be offered. E_{eV} , E_{kwh} —energy needed by manufacturing a corresponding artificial BH,

(B). The real speed V_p of a particle of object under the gravitational effect to lash at new-born BH M_{b2} has no possibility to attain light speed C , hence, M_{b2} must much heavier than M_{b1} , and then might engulfed some particles from outside, (3a) should be modified as below,

$$\tau_b V_p > d_{bp} \tag{3c}$$

According to laws in physics, if a new-born BH shoot into an object, distance S —between particle of object and BH of M_{b2} , $a = GM_{b2}/d_{bp}^2$, a —Accelerating speed, G —gravitational constant, from (1c) and

$$V_p^2 = 2aS \approx 2ad_{bp} \text{ and } S = at^2/2 \tag{3d}$$

$$\text{So, } M_{b2}^{7/2} > 10^{27} \times d_{bp}^{3/2} / (2G)^{1/2} \tag{3e}$$

For example, let $d_{bp} = 10^{-8}$ cm = distance of atoms, **$M_{b2} \approx 1.8 \times 10^5$ g, so, $M_{b2} \gg (M_{b1} = 700$ g)** (on form 1), because $V_p \approx (2ad_{bp})^{1/2} \approx 1.6 \times 10^3$ cm, $V_p \ll C$. Thus, L_{eV} needed by Colliders for producing new-born bigger BH would be increased about 1,000 times than L_{eV} in form 1.

In case $M_{b2} \approx 1.8 \times 10^5 \text{g}$, its $\tau_b \approx 10^{-27} M_b^3 = 10^{-27} \times (1.8 \times 10^5)^3 = 5.8 \times 10^{-12} \text{s}$. If object has much matters enough for being absorbed by M_{b2} , how much matters are absorbed in the whole lifetime of M_{b2} ? From (3d), $S = at^2/2 = (GM_b/S^2) \times (\tau_b)^2/2$, $S = 0.58 \times 10^{-8} \text{cm}$, if density of object $\rho_o = 10 \text{g/cm}^3$, M_o is mass of object absorbed by M_{b2} , hence,

$$M_o = 4\pi\rho_o S^3/3 = 0.8 \times 10^{-23} \text{g}.$$

As a result, $M_o \ll M_{b2}$, if M_{b2} shot into an big object, only its partial mass of ($M_o = 0.8 \times 10^{-23} \text{g}$) is engulfed by M_{b2} . So, M_{b2} has still no way to grow up, but just can prolong its lifetime a very little. In reality, $M_o = 0.8 \times 10^{-23} \text{g}$ is more than mass engulfed really by M_{b2} , because M_{b2} is gradually decrease in its mass with emitting Hawking's radiation.

In case M_{b2} was shot in a neutron star, its density is 10^{15}g/cm^3 , so, $M_o < 10^{-8} \text{g}$. M_{b2} could not grow up yet.

(C). For the growth of a new-born BH, it needs more strict condition, the energy-matters engulfed by BH from outside object must be more than the energy-matters emitted by BH in the same time.

Assume a new-born BH M_{b3} is formed, its lifetime $\tau_b = 10^{-27} M_{b3}^3$, $d\tau_b = 10^{-27} \times 3M_{b3}^2 dM_{b3}$, $dM_{b3}/d\tau_b = 10^{27}/(3M_{b3}^2)$ (3f)

Assume outside object $M_o = 4\pi\rho_o R_o^3/3$, let $\rho_o =$ constant = density of M_o , R_o —radius of M_o ,

$$dM_o/dt = 4\pi\rho_o R_o^2 dR_o/dt \quad (3g)$$

The growing condition of new-born BH (M_{b3}) must be:

$$d M_{b3}/ d\tau_b < dM_o/dt \quad (3h)$$

$$\text{So, } 10^{27}/(3M_{b3}^2) < 4\pi\rho_o R_o^2 dR_o/dt \quad (3i)$$

To find out dR_o/dt , from (3d), $S = at^2/2$, $S^{1/2} = (GM_b/2S^2)^{1/2}t$, suppose $M_{b3} =$ constant (really $M_{b3} \neq$ constant, so, M_{b3} should be bigger),

$$S^{3/2} = (GM_b/2)^{1/2}t, \quad 3S^{1/2}dS/2 = (GM_{b3}/2)^{1/2}dt, \quad \text{hence, } dS/dt = (GM_{b3}/2)^{1/2}2/(3S^{1/2}) \quad (3j)$$

dR_o/dt of (3i) may be considered to be equal to dS/dt of (3j), so, from(3i) and (3j),

$$10^{27}/(3M_{b3}^2) < 4\pi\rho_o R_o^2 (GM_b/2)^{1/2}2/(3R_o^{1/2}),$$

after simplifying,

$$M_{b3}^{5/2} > 10^{27}/[8\pi\rho_o R_o^3 (G/2)^{1/2}] \quad (3k)$$

Let $R_o = 100 \text{cm}$, $\rho_o = 10 \text{g/cm}^3$, hence,

$$M_{b3} \gg 1.366 \times 10^{10} \text{g}.$$

Above calculations may indicate that, if a formed new-born BH of $M_{b3} > 1.366 \times 10^{10} \text{g}$ could be shot into a metal ball M_o of radius $R_o = 100 \text{cm}$, and its density $\rho_o = 10 \text{g/cm}^3$, M_{b3} would become bigger and prolong its lifetime τ_b until all mass of metal ball absorbed by M_{b3} , because energy-matters emitted from M_{b3} were less than matters of M_o absorbed from the metal ball.

Let's check up the result below.

Let $M_{b3} = 2 \times 10^{10} \text{g} > 1.366 \times 10^{10} \text{g}$ below.

In case $M_{b3} = 2 \times 10^{10} \text{g}$, its lifetime $\tau_b = 10^{-27} M_{b3}^3 = 8,000 \text{s}$, its Schwarzschild's radius $R_b = M_{b3}/0.675 \times 10^{28} = 2.96 \times 10^{-18} \text{cm}$, absorbed mass of metal ball $M_o = 4\pi\rho_o R_o^3/3 = 4.2 \times 10^7 \text{g}$, time t is needed by BH to absorb metal ball, $R_o = at^2/2$, $a = GM_{b3}/R_o^2$, so, $t = 0.387 \times 10^2 \text{s} = 38.7 \text{s}$.

However, $\tau_b - t = 8,000 - 38.7 = 7961.3 \text{s}$, the rest mass M_{br} of M_{b3} corresponding to the rest lifetime ($\tau_b - t$) is $7961.3 = 10^{-27} M_{br}^3$, so, $M_{br} = 1.997 \times 10^{10} \text{g}$, if M_{bd} is the decreased mass of BH in the period $t = 38.7 \text{s}$, hence,

$$M_{bd} = M_{b3} - M_{br} = 2 \times 10^{10} - 1.997 \times 10^{10} = 3 \times 10^7 \text{g}, \text{ as a result, } M_{bd} (3 \times 10^7 \text{g}) < M_o (4.2 \times 10^7 \text{g}).$$

If M_o is bigger than $4.2 \times 10^7 \text{g}$, it can be completely engulfed by M_{b3} within longer time.

All above calculation are approximate, they may be considered as estimated calculations and qualitative analyses, because the state and structure of BHs have almost be unknown.

(D). Assume a new-born BH M_{b4} has been manufactured by a collider or an accelerator, what conditions could ensure the growth of M_{b4} ? For the growth of M_{b4} , matters continuously shot in a row by a accelerator should be more than energy-matters emitted from M_{b4} at the same time.

$$\text{From (3f), } d M_{b4}/d\tau_b = 10^{27}/(3M_{b4}^2) \quad (3l)$$

Suppose M_d —mass shot by a accelerator, m_p —mass of a particle in M_o , n —total numbers of shot particles, l_p —distance between two closest particles, l —length of n particle in a row, hence,

$$M_o = m_p n, \quad d M_o = m_p dn = (m_p/l_p) dl$$

$$\therefore dM_o/dt = (m_p/l_p) dl/dt$$

let $dl/dt \approx$ light speed C , so,

$$d M_o/dt \approx C m_p/l_p \quad (3m)$$

For the growth of M_{b4} , $d M_{b4}/d\tau_b < d M_o/dt$, as a result,

$$10^{27}/(3 M_{b4}^2) < C m_p/l_p \quad (3n)$$

Let $m_p = 3.29 \times 10^{-22}$ g (mass of a gold-nucleon), $l_p \approx 10^{-13}$ cm, $\therefore M_{b4} > 0.18 \times 10^{13}$ g.

4. Analyses and conclusions

Different real gravitational BHs, bigger or smaller, are calculated on above paragraphs, they are: $M_{bau} = 9.87 \times 10^{-22}$ g, $M_{bu} = 10^{-5}$ g, $M_{b1} = 15 \sim 700$ g, $M_{b2} \approx 1.8 \times 10^5$ g, $M_{b3} = 2 \times 10^{10}$ g, $M_{b4} > 0.18 \times 10^{13}$ g, but no one can be artificially manufactured out in future. Why? Analyses and demonstrations are seen below.

(A). All calculations in this article are on the basis of formulas (1a), (1b) and (1c), which originate from GTR and Hawking's theory about BH as well as the application of thermodynamics, author had got already many principal conclusions on the past article—"New Concepts to Big Bang and Black holes, Both had No Singularity at All".^{[6][7]} Some important conclusions can be accurately applied in this article to solve greatly difficult problems about artificial BHs.

First, the relationships between each other of various parameters of a BH are single and sole correspondence. It is said, **to a real gravitational BH, whether it is natural or artificial, if a certain value of a parameter has been determined, such as its mass M_b , the sole and certain values of all other parameters are respectively and solely determined by M_b from formulas (1a), (1b) and (1c). There would be no any two different BHs, which could have the same value of only one parameter, but have the different value of all other parameters.**

Second, owing to that, lights in BH could not shake off the very strongly gravitational trammel of BH, a real gravitational BH had no way to emit out any information, which could be directly detected by external world. Of course, BH emits Hawking's radiation, but right now, it cannot be detected yet. Therefore, if any so-called "BH" included artificial BH was advocated by some people either in the past or in future to have been

directly detected, it would not be a real gravitational BH at all.

Third, real micro gravitational BHs of (mass = 10^{-5} g = M_{bu}) formed our new-born Universe at its genesis. **$M_{bu} = 10^{-5}$ g was, and still will be, the heaviest particle and the minimum BH in our universe.**^{[7][6]} Energy E_{bu} of every M_{bu} , $E_{bu} = 10^{19}$ GeV,^[7] it was the greatest energy for a particle (BH) in our universe, and cannot be reached by mankind forever. It is said, mankind will absolutely have no way forever to reach energy $> 10^{19}$ GeV in one collision to manufacture out an artificial BH (particle), which mass $\geq 10^{-5}$ g.

Could mankind manufacture out any smaller artificial BH, which mass $< 10^{-5}$ g) in future with smaller energy than E_{bu} (i.e. $< 10^{19}$ GeV)? No way, according to formula (1b), for a BH of mass $< 10^{-5}$ g, its temperature must be $> 10^{32}$ k. On the contrary, suppose its $E_{bu} < 10^{19}$ GeV, i.e. its really temperature = $E_{bu}/k < 10^{32}$ k. Thus, the created particle of (mass $< 10^{-5}$ g) would not be a real gravitational BH at all. It's really a pity that many modern scientists are still attempting to manufacture out micro BHs of (mass $\ll 10^{-5}$ g) with strong collider according to such incorrigible idea.

Fourth, theories of BH are built up on the foundations of gravity and stability of protons (quarks). It is said, in a real gravitational BH, its composition and state are protons and accordance with GTR as well as Hawking's theory. In a BH of $M_{bu} = 10^{-5}$ g, its $R_{bu} = 10^{-33}$ cm, $T_{bu} = 10^{32}$ k, $\tau_{bu} = 10^{-43}$ s. Those states are at the border of Plank's Era,^{[7][11]} which is the limit of our real physical world. As assuming that, a real gravitational artificial BH of (mass $< 10^{-5}$ g) could be manufactured, its temperature $> 10^{32}$ k, its Schwarzschild's radius $< 10^{-33}$ cm, its lifetime $< 10^{-43}$ s. It shows that, **in a BH of mass $< 10^{-5}$ g, its physical states has entered a complete Plank's Era,^[11] i.e. Plank's quantum states, it is another unknown physical world. In that world, protons (quarks) have not existed, the present gravitational theory may have lost its some important effects, can some present important theories and formulas about BH be applied?**

That world has neither been detected nor demonstrated by a correct theory of common sense, thus, any real gravitational BH of (mass $< 10^{-5}$ g) might not appear and exist in Plank's Era (another physical world) at all. In string theory, the size of strings are smaller than 10^{-33} cm, so, the researched object and foundation of string theory are Plank's physical world, but not our real world of (BH's size $> 10^{-33}$ cm), thus, those scientists hankered after new modern theories seem to write out the insufficient prescriptions for solve problems of BH of our physical world. Whether in the past or in future, if any formed particle (its mass $\ll 10^{-5}$ g) with high energy (temperature) is a detected collision on collider (for example, on RHIC), values of its parameters would have no possibility to accord with formulas (1a), (1b) and (1c), because its temperature had no way higher, and its Schwarzschild's radius had no way smaller than what a real gravitational BH should have. Therefore, the greater collider of higher energy in future can only manufacture out greater or more "fireball", but not a real gravitational BH at all.

Now that any smaller real BHs of (mass $< 10^{-5}$ g) could not be manufactured out by any Collider in future, it would only be a small "fireball" and be impossible to become a bigger BHs of (mass $> 10^{-5}$ g) with sustained jetting particles in a collider, because the lifetime of "fireball" was still too short, even if "fireball" could become a little bigger, it would not have enough gravity inside to become a real BH at all, just because "fireball" was not a real BH, particles in "fireball" after collision would be instantly ejected back and dispersed each other, and the caused "fireball" must be immediately disintegrated.

Fifth, furthermore, even if at the collision of 2 gold-nuclei in RHIC, all protons in gold-nuclei of each side **did not collide at the exactly same time**, hence, lifetime 10^{-24} s of a formed "fireball" in RHIC might really only reflect the time of sustained collision of protons in 2 gold-nuclei, but not be the lifetime of a real gravitational BH

(B). It may be a fundamental principle that, the collision produced by objects of any two non-BHs

would have no possibility to become a real gravitational BH. **No matter whether a star-formed BH or any much smaller BH, their most common characteristic is that, plasma in BH would have extremely high density**, on the layer of radius of same curvature, the heat pressure should keep balance with gravity. However, gravity is a very even central force, the heat state of extremely high density on every layer should be even and approximately ideal state. Thus, any BH could only be formed by the gravitational collapse of a large amount of matters in nature, but not by the collision of two objects with high speed, just as the collision of two bodies of movement with high speed could not form an even body.

In a word, the process of forming a real BH is an accumulative process of energy-matters, but any collision of particles with the highest speed can only let accumulated energy-matters before collision to be instantly diffused after collision, thus, manufacturing a real BH with any collision of the highest speed is principally impossible.

(C). For getting an artificial BH, the sole way for scientists may be to put very high circular pressure to original materials as to be able to attain the extremely high density needed by an artificial BH in its Schwarzschild's radius. Can mankind overcome all difficulties to do so?

Assume high pressure to manufacture a real gravitational BH could be reached. Might mankind probably expend smaller energy to get bigger BH? How can the limit of high pressure be got by mankind in remote future?

$$P = n\kappa T = \rho\kappa T/m_p \quad [6][9] \quad (4a)$$

$$E_p \approx M_b \times GM_b/R_b = M_b \times C^2/2 \quad (4b)$$

In above formula (4a), T—temperature on Event Horizon, n—numbers of particles in unit volume, κ -- Boltzmann's constant, ρ --density, m_p —mass of particle in BH, let $m_p =$ mass of a proton = 1.66×10^{-24} g, E_p —expanded energy, C—light speed.

Pressures P (atm) are calculated by different BHs on its Event Horizon (Border) on form 2.

The pressure in the core of our sun is about 3×10^{11} atm,^[10] so, mankind may have no way to

manufacture any artificial BHs with high pressure needed in form 2 in remote future.

Form 2

Mass of M_b (g)	R_b (cm)	T_b (k)	τ_b (s)	ρ_b (g/cm ³)	P (atm)	E_p (eV)	E_p (kwh)
$M_{bau} = 10^{-21}?$ *	$10^{-49}?$	$10^{48}?$	$10^{-90}?$	$10^{125}?$	$10^{175}?$	$10^2 G?$	$10^{-15}?$
$M_{bu} = 10^{-5}$,	10^{-33}	10^{32}	10^{-43}	10^{94}	10^{128}	$10^{18} G$	10
$M_{b1} = 15$,	10^{-27}	10^{26}	10^{-24}	10^{80}	10^{108}	$10^{24} G$	10^7
$M_{b2} = 10^5$	10^{-23}	10^{22}	10^{-12}	10^{74}	10^{98}	$10^{28} G$	10^{11}
$M_{b3} = 10^{10}$	10^{-18}	10^{17}	10^3	10^{64}	10^{83}	$10^{33} G$	10^{16}
$M_{b4} = 10^{15}$ **,	10^{-13}	10^{12}	10^{18} (10^{10} yrs)	10^{53}	10^{67}	$10^{38} G$	10^{21}

* M_{bau} made in RHIC was a “fireball” and had no way to attain above various values needed by a fictitious gravitational BH. All values are hypothetical and just for reference.

** Energy for manufacturing any M_b with high pressure \approx total energy emitted by sun in 3 minutes.

(D). Even if an micro artificial BH could be manufactured by mankind in future, how might it be controlled? For example, assume that, an artificial BH of $M_{bu} = 10^{-5}$ g or $M_{b1} = 15$ g had been successfully manufactured out, how could its short-lived lifetime τ_b and very high temperature T_b be controlled? It is said, such short-lived micro BHs have no way to exist and to grow up. For bigger BHs, such as M_{b3} or M_{b4} , they might have possibility to grow up, but their needed energy might not be reached by any collider forever.

Black holes (BH) were produced from gravitational collapse of massive mass in nature, they had no possibility to be produced from collision of particles with extremely high speed in collider or produced in machines of extremely high pressure. Therefore, mankind may not be able to manufacture out any artificial BHs at all. All declarations or propaganda about artificial BH were alarmist talks in the past and must not be trusted in future.

If theories, formulas, demonstrations and calculations used in this article have no theoretically mistakes and can be passed by the experimental examinations in future, it will conversely prove that, those new concepts in author’s former article (New Concepts to Big Bang And Black Holes—Both Had No Singularity at All) may be all right.

----The End----

Reference:

- [1]. Micro BHs existed in earth everywhere. Weapon made by a micro BH could kill a billion people. <http://www.seawolfnet.com/forum/recommend-show.php3?id=5566&page=&history-url> 12/18/2002
- [2]. The Epoch Times, 3/25~27/2005, P.O.Box 381426, Cambridge, MA 02238-1426
- [3]. Horatiu Nastase: The RHIC fireball as a dual black hole, <http://arxiv.org/abs/hep-th/0501068>
- [4]. BBC NEWS | Science/Nature | Lab fireball ‘may be black hole’, Thursday, 17 March, 2005, 11: 30 GMT <http://news.bbc.co.uk/1/hi/sci/tech/4357613.stm>
- [5]. Scientists proposed that there would be countless short-lived micro BHs in atmosphere of our earth. <http://tech.sina.com.cn/other/2003-12-15/1811268554.shtml>
- [6]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 2). Nature and Science, 3(1), or debate-001, 2004, ISSN:1545-0740, Published by Marsland Company, P.O.Box 753, East Lansing, Michigan, MI 48826 U.S.A. Or <http://www.sciencepub.org/nature/debate>
- [7]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 1) Nature and Science, 2(4), or debate-001, 2004, ISSN:1545-0740, Published by Marsland Company, P.O.Box 753, East Lansing, Michigan, MI 48826 U.S.A.. Or <http://www.sciencepub.org/nature/debate>
- [8]. Wang, Yong-Jiu: Physics of Black Holes; Hunan Normal University Publishing House, China. 2000.
- [9]. Xiang, Yi-huo: The Physical Instructions of University. Publishing House of Qinghua University, Beijing, China.1999
- [10]. John & Gribbin: Companion to The Cosmos, ISBN 7-5443-0145-1, Hainan Publishing House, China, 2001, 9.
- [11]. He, Xiang-tao: Observational Cosmology. Science Publishing House. Beijing, China. 2002.

New Explorations to Hawking Radiation With Classical Theories

---- Part 4 of "New Concepts to Big Bang and Black Holes"^{[1][2]}----

Dongsheng Zhang

Graduated in 1957 From Beijing University of Aeronautics and Astronautics. China.

Permanent address: 17 Pontiac Road, West Hartford, CT 06117-2129, U. S. A.

Email: ZhangDS12@hotmail.com

Feb./2006

Abstract: In part 1 and part 2 of "New Concepts to Big Bang and Black Holes"^{[1][2]} (abbr. is NCBBBH), it had been pointed out that, "the Hawking theory about BH (**Black Hole**) extricates the crisis of pure GTR (General Theory of Relativity) about Singularity in BH^[2]", and "Just from Hawking theories of BHs, it has been known that BHs could always change its energy-matters with its surroundings^[2]". It has been a common knowledge that BHs can plunder energy-matters from outside with its very strong gravity, but almost nobody knows how to emit out Hawking radiation from BHs to outside. Normally, Hawking radiation may be formally explained with Uncertainty Principle of Quantum Mechanics, which recognized that a pair of virtual particles would be suddenly born out from vacuum, then annihilate and disappear at once^[3]. The abstruse problems of that explanation are: why the energy gotten from BH by a fled particle is just equal to the energy of another one captured by BH and exactly equal to the energy of a particle (i.e. Hawking radiation) on the instable Event Horizon of any BH, in addition, the existence of so-called "particles of negative energy" has not had any observational evidence yet, and so-called "virtual energy" has not had a reliable numerical value right now in any theory and experiment. In this article, through calculations to different BHs with laws of classical theories, the characteristics of Hawking radiation may be firstly and better explained and exposed by classical theories. The important contribution of this article is to have truly discovered the secret of BHs to emitting Hawking radiations, i.e. any Schwarzschild BH might almost simultaneously emit 6 Hawking radiations together to outside from two opposite directions of 3 dimensions of itself. [Nature and Science. 2006;2(3)(debate001):1-5].

Key Words: Hawking radiation, characteristics of Hawking radiation, checks to Hawking radiation with classical theories.

Introduction: Why could BHs, from which even lights had no way to escape out, emit Hawking radiation? What are the characteristics of Hawking radiation?

In this article, the calculated fundamental principles and formulas all come out from NCBBBH^{[1][2]}, i.e. originate from classical theories (GTR, Hawking theory about BH and thermodynamics etc). Through further detailed calculations and qualitatively analyses to three following different real gravitational BHs already studied in NCBBBH, the characteristics of Hawking radiation may be more easily exposed and conceived with classical theories.

(i). BHs of ($m_t = 10^{-5}g$)^{[1][2]}: From part 1 of NCBBBH, it can be seen that, all BHs of ($m_t = 10^{-5}g$) were **minimum gravitational BHs (MGBH)**. They only appeared at the genesis of our universe and formed our present universe. They would be impossible to appear again in all lifetime of our universe.

(ii). BHs of ($m_{om} \approx 10^{15}g$)^[2]: In part 2 of NCBBBH, any BH of ($m_t = 10^{15}g$) is a mini BH

and has only existed in star-formed BH. **They are all middle-sized BHs.**

(iii). BH of ($M_u = 10^{56}g$)^{[1][2]}: In part 1 and 2 of NCBBBH, BH of ($M_u = 10^{56}g$) is a real **maximum BH**, which is just our present universe.

1. Formulas for calculating parameters of real gravitational black holes (RGBH)

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

$$R_b = 2GM_b/C^2, \text{ or } C^2 = 2GM_b/R_b^{[1][2]} \quad (1a)$$

According to GTR, (1a) is the necessary condition for existence of any RGBH.

According to Hawking formulas about BH,

$$T_b = (C^3/4GM_b) \times (h/2\pi\kappa) \approx 0.4 \times 10^{-6} M_\theta / \approx 0.8 \times 10^{27} / M_b(k) \quad [4][1][2] \quad (1b)$$

$$\tau_b \approx 10^{-27} M_b^3 (s) \quad [4][1][2] \quad (1c)$$

Other formulas are cited below:

$$E_1 = m_p C^2, \quad E_2 = \kappa T, \quad E_3 = Ch/\lambda \quad (1d)$$

$$M_b = 4\pi\rho_b R_b^3/3 \quad (1e)$$

$$R_b = 3h/(2\pi C m_s) \quad [2] \quad (1f)$$

For any formed RGBH i.e. **Schwarzschild's BH**, its various parameters in above formulas are below: if M_b —mass of a formed RGBH, then, R_b —its Schwarzschild's radius, T_b —temperature on Event Horizon, ρ_b --density on Event Horizon, G --gravitational constant, κ -- Boltzmann's constant, h —Plank's constant, C —light speed, m_{sr} —mass of Hawking radiation emitted out from BH, m_s —mass of a particle in BH, τ_b —lifetime of a RGBH, E_1 —energy of mass m_p , E_2 –energy of a particle, E_3 – energy of a radiation, λ --wavelength of a radiation, ν --frequency of a radiation.

For convenient calculation, formula (1a) can be altered into:

$$M_b/R_b = C^2/2G \approx 0.675 \times 10^{28} \text{ g/cm} \quad (1aa)$$

2. The further analyses and modification to formula (1f) -- $R_b = 3h/(2\pi C m_s)$

Formula (1f) above comes from formula (13bd), which is derived in section (B) of paragraph 13 in part 2 of NCBBBH according to the balance between the central gravity of a BH and its heat pressure to a particle m_s at any point in a BH. **In this article, m_{sr} are only defined on or closely linked to Event Horizon (boundary) of any BH, ($m_{sr} = m_s$)** is just on Event Horizon, they may be conceived either in mass of a particle or in equivalent mass of radiation owing to the duality of waves and particles. In the process to derive formula (1f) in NCBBBH, m_s had been supposed to be a single particle. However, in reality, m_s might be the sum of ($m_s = n \times m_{sr}$) emitted out simultaneously as Hawking radiations from Event Horizon (boundary). m_{sr} —a radiation on Event Horizon,

$$\text{Suppose } m_s = n \times m_{sr}, \text{ and let } n = 6 \quad (2a)$$

From (1f) and (2a)

$$R_b m_{sr} = h/(4\pi C) \quad (2b)$$

Why would let $n = 6$? Let's look back to formulas (5e) and (5g) in paragraph 5 of part 1 of NCBBBH,

$$\text{From (5e), } m_p = (hC/8\pi G)^{1/2} = 10^{-5} \text{ g} \quad [6][1]$$

$$\text{From (5g), } l_p = t_p \times C = (Gh/2\pi C^3)^{1/2} \quad [6][1]$$

In (5g), t_p is Plank time, so, m_p is analogous to m_{sr} , and l_p is analogous to R_b .

$$\text{As a result, } m_p \times l_p = h/(4\pi C) \quad (2c)$$

Thus, (2b) \equiv (2c)

Therefore, it can be seen from formulas (1f) and (2b) or (2c), on Event Horizon of a BH, **a real m_{sr} is solely confined by R_b i.e. M_b of a BH.**

$$M_b m_{sr} = hC/(8\pi G) = 1.187 \times 10^{-10} \text{ gg} \quad (2d)$$

From (2d), in case M_b is a given value, m_{sr} on Event Horizon is thus gotten an exact value. Correspondingly, from formula (1d),

$$m_{sr} = \kappa T_b / C^2 = h/C\lambda_{sr} = h\nu_{sr}/C^2 \quad (2e)$$

(i). If $m_s > m_{sr}$, hence, $M_b m_s > 1.187 \times 10^{-10} \text{ gg}$: m_s is either the mass of a particle or the equivalent mass of radiation in BH. $m_s > m_{sr}$ is showed that, m_s is heavier than m_{sr} , i.e. $m_s = \kappa T_s / C^2$ ($T_s > T_b$), or $m_s = h/C\lambda_s$ ($\lambda_s < \lambda_{sr}$), so, m_s can only exist inside Event Horizon and has no way to flee out from Event Horizon.

(ii). If $m_s < m_{sr}$, $M_b m_s < 1.187 \times 10^{-10} \text{ gg}$: m_s cannot exist inside BH. **In reality, particles and radiations of ($m_s < m_{sr}$) would be impossible to exist in any BH, because all BHs were formed at the state of extremely high energy and temperature.** If by any chance some $m_s < m_{sr}$ appeared in a BH, they would flee out from Event Horizon as Hawking radiation.

(iii). If $m_s = m_{sr}$, $M_b m_s = M_b m_{sr} = 1.187 \times 10^{-10} \text{ gg}$, what will happen? In reality, energy of m_{sr} either as a moving particle or as a vibrant radiation would not have an exact same value, but only have an instantaneous value at any instant, because m_{sr} certainly has **energy-fluctuation** on or closely linked to Event Horizon. Any tiny decrease in instantaneous temperature and in kinetic energy of m_{sr} at state of the lowest energy would lead increase in its tiny potential energy and decrease in R_b . Conversely, a little instantaneous smaller R_b would let more reduction of kinetic energy of m_{sr} and finally let m_{sr} flee out from Event Horizon. That is the real reason why all BHs could emit energy-matters to outside and shrink its size. That is a reasonable explanation to Hawking radiation with classical theories.

(5e)

3. More calculations and further analyses

(i). Suppose n_i are total numbers of particles and radiations in a BH of M_b , so,

$$n_i = M_b / m_{sr} = M_b C^2 / \kappa T_b \quad (3a)$$

A. To $m_t = 10^{-5}g$:

$$n_i = m_t / m_{sr} = 10^{-5} / 1.187 \times 10^{-5} = 0.89 \approx 1$$

$$n_i = m_t C^2 / \kappa T_b = 10^{-5} \times 9 \times 10^{20}$$

$$/ (1.38 \times 10^{-16} \times 0.8 \times 10^{32}) = 0.815 \approx 1$$

B. To $m_{om} = 10^{15}g$:

$$n_i = m_{om} / m_s = 10^{15} / (1.187 \times 10^{-25}) = 0.84 \times 10^{40}$$

$$n_i = m_{om} C^2 / \kappa T_b = 10^{15} \times 9 \times 10^{20}$$

$$/ (1.38 \times 10^{-16} \times 0.8 \times 10^{12}) = 0.813 \times 10^{40}$$

C. To $M_u = 10^{56}g$:

$$n_i = M_u / m_s = 10^{56} / (1.187 \times 10^{-66}) = 0.84 \times 10^{122}$$

$$n_i = M_u C^2 / \kappa T_b = 10^{56} \times 9 \times 10^{20}$$

$$/ (1.38 \times 10^{-16} \times 0.8 \times 10^{-29}) = 0.815 \times 10^{122}$$

The same results (values) of n_i calculated with two different formulas in three BHs clearly shows that, all theories and laws, especially (2d) about BHs applied in this article are almost fully correct.

(ii). λ_{sr} --Wavelength of radiation m_{sr} on or closely linked to Event Horizon, v_{sr} —frequency of radiation m_{sr} ,

$$\text{From (2e), } \lambda_{sr} = h / (m_{sr}C) = C / v_{sr} \quad (3b)$$

$$\text{In case } m_{sr} \approx 10^{-5}g, \quad \lambda_{sr} = 2.2 \times 10^{-32}cm$$

$$\text{In case } m_{sr} = 1.187 \times 10^{-25}g, \quad \lambda_{sr} = 1.86 \times 10^{-12}cm$$

$$\text{In case } m_{sr} \approx 1.187 \times 10^{-66}g, \quad \lambda_{sr} = 1.86 \times 10^{29}cm$$

(iii). From formula (1c), $\tau_b \approx 10^{-27} M_b^3 (s)$,

$$d\tau_b \approx 3 \times 10^{-27} M_b^2 dM_b \quad (3c)$$

Let $dM_b = \text{one } m_{sr}$, hence, $d\tau_b$ is the needed time of emitting a Hawking radiation m_{sr} .

$$\text{To } m_t = 10^{-5}g, \quad d\tau_b \approx 3 \times 10^{-42}s$$

$$\text{To } m_{om} = 10^{15}g, \quad d\tau_b \approx 3.6 \times 10^{-22}s$$

$$\text{To } M_u = 10^{56}g, \quad d\tau_b \approx 3.6 \times 10^{19}s \approx 10^{12}yrs$$

4. Some other more important conclusions

Form 1

	m_t	m_{om}	M_u	formulas
mass of BH,	$10^{-5}g$	$10^{15}g$	$10^{56}g$	
R_b (cm)	1.5×10^{-33}	1.5×10^{-13}	1.5×10^{28}	(1aa)
T_b (k)	0.8×10^{32}	0.8×10^{12}	0.8×10^{-29}	(1b)
τ_b (s, yrs)	$10^{-42}s$	$10^{10}yrs$	$10^{133}yrs$	(1c)
ρ_b (g/cm ³)	7×10^{92}	7×10^{52}	7×10^{-30}	(1e)
m_{sr} (g)	1.187×10^{-5}	1.187×10^{-25}	1.187×10^{-66}	(2d)
n_i	1	10^{40}	10^{122}	(3a)
λ_{sr} (cm)	2.2×10^{-32}	1.86×10^{-12}	1.86×10^{29}	(3b),(4a)
$d\tau_b$	$3 \times 10^{-42}s$	$3.6 \times 10^{-22}s$	$10^{12}yrs$	(3c)
v_{sr} (s ⁻¹)	1.4×10^{42}	1.6×10^{22}	1.6×10^{-19}	(4b)
v_r (s ⁻¹)	0.3×10^{42}	0.28×10^{22}	0.28×10^{-19}	(4c)

Values listed in form 1 above are results calculated according to all relative formulas.

(i). From formulas (2b) and (3b),

$$\lambda_{sr} = 4\pi R_b \quad (4a)$$

Formula (4a) above indicates:

In case any radiations m_s of ($\lambda_s < 4\pi R_b$) in BH, they had no chance to flee out from BH.

In case any radiations m_s of ($\lambda_s > 4\pi R_b$), it had no chance to exist in BH.

In case a radiation m_{sr} of ($\lambda_{sr} = 4\pi R_b$), it only was at the state of the lowest energy (i.e. trough) to have the chance to flee out from BH through Event Horizon as Hawking radiation. Moreover, the **Event Horizon of any BH is not a rigid shell, but a virtual spherical surface with radius R_b** , it cannot obstruct radiations m_{sr} , which energy are locating at the trough of energy-fluctuation, to go away easily from Event Horizon. That is the real reason for any BH to emit Hawking radiation and then to shrink its size R_b . Otherwise, BHs would be eternal monstrosities in nature.

Thus, emitting Hawking radiation is only the spontaneous action of any BH and is the inevitable outcome caused by the regulative motion of matter in any BHs, it cannot be either stopped, induced or brought by any exterior natural forces. Therefore, no matter whether a pair of “virtual particles” in vacuum would come out or not, all BHs could emit their Hawking radiations as usual.

Checking up values of R_b and λ_{sr} on form 1, it can be clearly seen that formula (4a) is fully right.

(ii). Owing to emitting Hawking radiations m_{sr} and even **energy-fluctuation** of m_{sr} , the Event Horizon (R_b) of any BH would always cause a shrink frequency v_r . The coincidence between shrink frequency v_r of R_b and vibrant frequency v_{sr} of radiations m_{sr} is analogous to some resonance and is more beneficial to m_{sr} at the state of the lowest energy to flee out as Hawking radiations.

Let v_{sr} = frequency of m_{sr} on Event Horizon,

$$v_{sr} = C / \lambda_{sr} \quad (4b)$$

$$\text{To } m_t = 10^{-5}g, \quad v_{sr} = 1.4 \times 10^{42}s^{-1}$$

$$\text{To } m_{om} = 10^{15}g, \quad v_{sr} = 1.6 \times 10^{22}s^{-1}$$

$$\text{To } M_u = 10^{56}g, \quad v_{sr} = 1.6 \times 10^{-19}s^{-1}$$

Let v_r = shrink frequency of R_b due to emitting a single m_{sr} .

From formula (3c), $d\tau_b$ is the needed time to emit a single m_{sr} , then, $v_r = 1/d\tau_b$,

$$v_r = 1/d\tau_b = 1/3 \times 10^{-27} M_b^2 m_{sr} \quad (4c)$$

$$\text{To } m_t = 10^{-5} \text{g}, \quad v_r = 0.3 \times 10^{42}$$

$$\text{To } m_{om} = 10^{15} \text{g}, \quad v_r = 0.28 \times 10^{22}$$

$$\text{To } M_u = 10^{56} \text{g}, \quad v_r = 0.28 \times 10^{-19}$$

Comparing calculated values above between v_{sr} of (4b) and v_r of (4c), it can be seen that,

$$v_{sr} = n v_r = 6 v_r, n = 6, \quad (4e)$$

From formula (4c), v_r just indicates that, shrink frequency v_r of R_b only cause from a single Hawking radiation m_{sr} emitted out from BH. However, from formulas (2a), (2b) and (2d), it is defined that, any BH would simultaneously emit 6 m_{sr} together, but not a single m_{sr} . Thus, in formula (4c), the value of v_r gotten by emitting a single m_{sr} in time of $d\tau_b$ should be changed by 6 m_{sr} simultaneously emitted together in the same time of $d\tau_b$, so, a new shrink frequency v_r of R_b should become $v_r = 6 v_r = v_{sr}$. Thus, formula (4e) is still right, and on form 1, values of v_{sr} are just equal to values of $(6 \times v_r)$.

Schwarzchild's BH is a perfect ball-body; it would have many radiations with the same frequency on or closely linked to Event Horizon, they could simultaneously flee out together at the state of their instantaneously lowest energy. Therefore, **Hawking radiations originated from resonance between emitting ($n \times m_{sr}$) Hawking radiations from BH and shrinkage of Schwarzchild's radius R_b with emissions of Hawking radiations.**

Under the condition of emitting n Hawking radiations (i.e. $n \times m_{sr}$) together, let λ_{srn} —a pretended overlapped wavelength of $(n \times m_{sr})$, so,

$$\lambda_{srn} = \lambda_{sr} / n \quad (4f)$$

From (2b), (3b) and (4a),

$$\lambda_{srn} = 4\pi R_b / n \quad (4g)$$

$$\text{In case } n = 6, \lambda_{srn} = 2\pi R_b / 3 \approx 2R_b \quad (4h)$$

(iii). When a BH took in energy-matters or emitted out Hawking radiations, its R_b would have some increase or decrease. Correspondingly, λ_{sr} of radiations in BH would be changed a little more, because $d\lambda_{sr} = 4\pi dR_b$, it is just red shift caused by gravity. The change ($d\lambda_{sr}$) of λ_{sr} of a radiation

is linear, but the change (dR_b) of R_b for a BH may indicate the change of spherical surface of a BH.

(iv). On form 1, at M_u column, on Event Horizon of our universe, $m_{sr} = 1.187 \times 10^{-66}$ g, its $\lambda_{sr} = 1.86 \times 10^{29}$ cm, probably, m_{sr} might be gravitons to have been sought by scientists for many decades, if gravitons would have really existed all the time.

(v). The explorations to mysterious number “6” appeared in this article

The mysterious number “6” has appeared in this article many times and will be studied below.

In formula (2a), $n = 6$. It means that, any BH would simultaneously emit 6 Hawking radiations m_{sr} together. (2b) = (2c) and the correctness of same values of n_i calculated from (3a) have showed that ($n = 6$) is undoubtedly right and convincing.

In formula (4e), $n = 6$. In calculated values of all other BHs except minimum BH of ($m_t = 10^{-5}$ g), ($v_{sr} = 6v_r$) are right, it means that, **shrinkage of R_b come from 6 m_{sr} emitted together by a BH at the same time.** In reality, emission of 6 m_{sr} would hardly be realized at a really exact same instant, and would be always a little former or later, then, R_b would certainly shrink 6 times in the same period $d\tau_b$ with emitting 6 m_{sr} , thus, the shrink frequency v_r of R_b should become ($6v_r = v_{sr}$). The correctness of values of ($6v_r = v_{sr}$) on form 1 has fully proved that, formulas (4c) and (4b) originated from different theories can get a same result. However, minimum BH of ($m_t = 10^{-5}$ g) is a solely exception, its $v_{sr} \neq 6 v_r$, because the upshot of minimum BH as a single particle without 6 m_{sr} would be a smashing explosion.

In formulas (4g) and (4h), in case $n = 6$, the pretended overlapped wavelength λ_{srn} of 6 Hawking radiations m_{sr} is equal to $2\pi R_b / 3 \approx 2R_b$.

The above same result of ($n = 6$) from many different formulas (2b),(2c),(3a) and (4e) appeared in above conditions many times precisely indicate that, **any BHs except minimum BH of ($m_t = 10^{-5}$ g) would always simultaneously emit out ($n = 6$) Hawking radiations together as to keep some resonance between Hawking radiations emitted by BH and shrinkage of R_b , as to let Hawking**

radiations have opportunity to flee out at the state of the smallest instantaneous energy from Event Horizon of any BH.

Why must any BH always simultaneously emit 6 Hawking radiations? Any Schwarzschild BH is a spherical-symmetrical body; for keep the balance and stability of a BH at emitting Hawking radiations in all time, any BH must symmetrically and almost simultaneously emit out 6 Hawking radiations together to two opposite direction of 3 dimensions of itself.

The further verification to emitting 6 m_{sr} together from BH: if all calculated values about ($n = 6$) have no any mistakes, those values should precisely accord with following formula.

$$m_{sr}C^2 = \kappa T_b \quad (4i)$$

$$To\ m_t = 10^{-5}g, m_{sr}C^2 = 9 \times 10^{15}, \kappa T_b = 11 \times 10^{15}$$

$$To\ m_{om} = 10^{15}g, m_{sr}C^2 = 1.07 \times 10^{-4}, \kappa T_b = 1.1 \times 10^{-4}$$

$$To\ M_u = 10^{56}g, m_{sr}C^2 = 1.07 \times 10^{-45}, \kappa T_b = 1.1 \times 10^{-45}$$

(vi). The further analyses to minimum BH of ($m_t = 10^{-5}g$)

From formula (2d), $M_b m_{sr} = hc / (8\pi G) = 1.187 \times 10^{-10}gg$, it can be seen that, ($m_t \approx 10^{-5}g \approx m_{sr}$) is just a result of approximate calculation. The precise calculations and analyses are cited below.

Formula (2d) is deduced from (2a), i.e. m_{sr} in (2d) is just one of 6 m_{sr} emitted from a BH at the same time. Thus, to the minimum or final BHs of ($m_t \approx 10^{-5}g$), there are only two possible results.

First. If $M_b = 6 m_{sr}$, from (2d), $M_b^2 = 6hc / (8\pi G) = 6 \times 1.187 \times 10^{-10}gg = 7.122 \times 10^{-10}g$, so,

$$M_b = 2.667 \times 10^{-5}g, m_{sr} = M_b / 6 = 0.445 \times 10^{-5}g \quad (4j)$$

Formula (4j) expresses that, minimum BH of ($M_b = 2.667 \times 10^{-5}g$) is completely composed by 6 Hawking radiations of ($m_{sr} = M_b / 6 = 0.445g$). Its final fate either might violently explode as Hawking radiations or further collapse into a whole minimum BH of ($M_b = 2.667 \times 10^{-5}g$).

$$\text{From formula (3a), } n_i = M_b / m_{sr} = M_b C^2 / \kappa T_b$$

$$M_b / m_{sr} = 2.667 \times 10^{-5}g / 0.445 \times 10^{-5}g = 6$$

$$M_b C^2 / \kappa T_b = 2.667 \times 10^{-5}C^2 / (\kappa \times 0.3 \times 10^{32}) = 5.7$$

$$\text{Verifications: } m_{sr}C^2 = 4.05 \times 10^{-15}, \kappa T_b = 4.1 \times 10^{-15}$$

Second. Above whole minimum BH of ($M_b = 2.667 \times 10^{-5}g$) would just be a single particle of the highest energy. Thus, all BHs of ($M_b = 2.667 \times 10^{-5}g$) could only violently explode at the highest

temperature of $10^{32}k$ only appeared at the genesis of our universe.

$$\text{Verifications: } m_{sr}C^2 = 24 \times 10^{-15}, \kappa T_b = 4.1 \times 10^{-15}$$

Two different results of minimum BH ($M_b = 2.667 \times 10^{-5}g$) above might have more important significance to the evolution of our universe at its genesis, but hardly exert any influence to calculated values and conclusions in this article.

It displays from calculated values that, the first result seems more correct than the second one.

(vii). In this article, many new formulas, (2b), (2d), (3a), (4a), (4c) and (4g) have been derived out. All calculated values on form 1 have exactly proved that, the **macroscopical explanations to all characteristics of BHs, included Hawking radiation, with classical theories and formulas are surely effective, correct and identical.** The observational evidences and examinations to (2b), (2d), (4a) and (4g) will be remained in future.

(viii). **In future, examinations of correctness to formula (2d) may be easier taken. Once the correctness of formula (2b) could be checked up by observational evidences, all classical theories and formulas applied in this article and in NCBBBH as a complete system to macroscopically solve problems about BHs would be reliably verified.**

----The End----

Reference:

- [1]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 1).
- [2]. Dongsheng Zhang: New Concepts to Big Bang And Black Holes—Both Had No Singularity at All (Part 2) Two articles above were published on magazine “Nature and Science”, 2(3), 2(4),3(1), or debate-001, 2004, ISSN:1545-0740, Published by Marsland Company, P.O.Box 753, East Lansing, Michigan, MI 48826 U.S.A. Or <http://www.sciencepub.org/nature/debate-001> <http://www.sciencepub.org/nature/0203> and 0204 <http://www.sciencepub.org/nature/0301>
- [3]. John & Gribbin: Companion to The Cosmos, ISBN 7-5443-0145-1, Hainan Publishing House, China, 2001, 9.
- [4]. Wang, Yong-Jiu: Physics of Black Holes; Hunan Normal University Publishing House, China. 2000.
- [5]. Formula (13bd) in Part 2 of NCBBBH i.e. [2].
- [6]. He, Xiang-tao: Observational Cosmology. Science Publishing House. Beijing, China. 2002.

Nature and Science

Call for Papers

The international academic journal, “*Nature and Science*” (ISSN: 1545-0740), is registered in the United States, and invites you to publish your papers.

Any valuable papers that describe natural phenomena and existence and reports that convey scientific research and pursuit are welcome, including both natural and social sciences. Papers submitted could be reviews, objective descriptions, research reports, opinions/debates, news, letters, and other types of writings that are nature and science related.

Here is a new avenue to publish your outstanding reports and ideas. Please also help spread this to your colleagues and friends and invite them to contribute papers to the journal. Let's make efforts to disseminate our research results and our opinions in the worldwide for the benefit of the whole human community.

Papers in all fields are welcome.

Please send your manuscript to editor@sciencepub.net; naturesciencej@gmail.com

For more information, please visit: <http://www.sciencepub.org>

Marsland Press
P.O. Box 21126
Lansing, Michigan 48909
The United States
Telephone: (517) 349-2362
Email: editor@sciencepub.net; naturesciencej@gmail.com
Website: <http://www.sciencepub.org>