The Theory of Observational Relativity
Serial Report 5: Is the Big Bang a Theory in Scientific Sense?

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Abstract: The theory of Observational Relativity (OR), as a new theory of physics, reports its significant findings and new insights in the form of serial reports in F1000Research. Now, OR Serial Report 5 focuses on the Big Bang theory of modern cosmology. Human beings always believe that the universe was bestowed by the Creator: no matter time or space must have a starting point. So, cosmologists have invented the Big Bang model: the universe that human beings rely on for survival originated from a Big Bang 13.8 billion years ago. Einstein's theory of relativity is the most important theoretical basis of modern cosmology, and the invariance of light speed and the doctrine of spacetime curvature play important roles in the Big Bang theory. The Big Bang theory is not only a product of logical deduction and mathematical formulization, but also has empirical evidences such as cosmic expansion and cosmic microwave background radiation. However, the theory of OR has discovered that the speed of light is not really invariant, and spacetime is not really curved. From the broad perspective of the general observational agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$), the theory of OR has clarified that Einstein's theory of relativity, including the special and the general, is that of optical observation adopting the optical agent OA(c) ($\eta=c$), which has the observational locality ($c<\infty$), presenting us with only optical images of the physical world and not representing the objectively physical world. The doctrine of Big Bang, or even the entire modern cosmology, is only a mirage based on such optical images. Since the speed of light is not really invariant, the doctrine of spacetime curvature, the doctrine of cosmic expansion, and Einstein's theory of relativity, including the special and the general, cannot hold true. Can the Big Bang theory still hold up without Einstein's theory of relativity as the theoretical basis? Can the Big Bang theory still hold up without Hubble's doctrine of cosmic expansion as the empirical basis? This article has elucidated for readers from the perspectives of both science and philosophy that the doctrine of Big Bang is not only contrary to science but also contrary to philosophy.

Key Words: Big Bang, cosmological redshift, cosmic expansion, general relativity, invariance of light speed, spacetime curvature, cosmic microwave background radiation.

1 Introduction

The theory of Observational Relativity (OR) [1-4] has generalized and unified Newton's classical mechanics and Einstein's relativity theory. The monograph of OR is divided into two volumes: the 1st volume Inertial OR (IOR) [2] that has generalized and unified Newton's inertial mechanics and Einstein's theory of special relativity; the 2nd volume Gravitational OR (GOR) [3] that has generalized and unified Newton's theory of universal gravitation and Einstein's theory of general relativity.

The theory of OR, as a new theory of human being's physics, reports its significant findings and new insights to readers and physicists in the form of serial reports in F1000 Research [5-8]. Now, OR Serial Report 5 focuses on the Big Bang theory of modern cosmology: the universe may not have truly experienced a Big Bang.

Human beings originally believed that the earth was the center of the universe, with the sun, moon, and stars orbiting around it. So, Ptolemy established the geocentric theory. Human beings always believe that the universe is bestowed by the Creator: time must have a temporally starting point; space must have a spatially starting point. So, physicists and cosmologists have invented the Big Bang model: the universe that human beings rely on for survival originated from a Big Bang 13.8 billion years ago.

Einstein's theory of relativity [9,10] is the most important theoretical basis of modern cosmology, and the invariance of light speed and the doctrine of spacetime curvature play important roles in the Big Bang theory. The Big Bang theory is not only a product of logical deduction and mathematical formulization, but also has empirical evidences such as cosmic expansion and cosmic microwave background (CMB) radiation.

However, from the broad perspective of the general observation agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$), the theory of OR has discovered that human perception of the objective world not only depends on observation but also is constrained by observation. All theories or spacetime models in human being's physics are branded with observation: Newton's classical mechanics is a theory of idealized observation with the idealized agent OA_∞ ($\eta\to\infty$); Einstein's theory of relativity, including the special [9] and general [10], is a theory of optical observation with the optical agent OA(c) ($\eta\to c$). So, in Hawking's words, Newtonian mechanics and Einstein theory of relativity are just two partial theories of the theory of OR.

Newton's idealized agent OA_∞ idealizes the information-wave speed η of OA_∞ as infinity: $\eta\to\infty$. Therefore, OA_∞ has no observational locality, and can be regarded as God's Eye, representing the objectively real physical world. In this regard, Newtonian mechanics is the real portrayal of the physical world.

Einstein's optical agent OA(c) employs light or electromagnetic waves as its observation medium, and naturally, the information-wave speed η of OA(c) is the speed of light c. Therefore, OA(c) has the observational locality ($c<\infty$). So, Einstein theory of relativity only presents us with the optical images of the physical world, not representing the objectively real physical world.

The theory of IOR has clarified that the speed of light is not really invariant; The theory of GOR has clarified that spacetime is not really curved.

The principle of the invariance of light speed is the crucial and only indispensable logical premise of Einstein relativity theory, and the doctrine of spacetime curvature is only a logical consequence of the principle of the invariance of light speed. In fact, both the invariance of light speed and spacetime curvature are optical images of the physical world presented by the optical agent OA(c), which are the observation effects and apparent phenomena caused by the observation locality ($c<\infty$) of OA(c). In this regard, modern cosmology based on Einstein's theory of relativity, including the Big Bang theory, is only a mirage built on the optical images presented by OA(c), not the objective physics reality and real physics existence.

This article will examine the theoretical basis and empirical basis of the Big Bang model mainly from a scientific perspective based on the theory of OR.

If the speed of light is not really invariant, the doctrine of spacetime curvature, the doctrine of cosmic expansion, and even Einstein's theory of relativity, including the special and the general, cannot hold true. So, can the Big Bang theory still hold true without Einstein's theory of relativity as its theoretical basis? And, can the Big Bang model still hold true without Hubble's doctrine of cosmic expansion as its empirical basis?

At the end, this paper will, from a perspective with certain philosophical significance, briefly and concisely discuss the origin of the universe and the doctrine of Big Bang, examining the issues of the Big Bang with empiricism and speculation, with common sense and reason, and with science and philosophy.

2 On the Big Bang Theory

The Big Bang can be simply described as such a doctrine [11,12]: 13.8 billion years ago, the universe's spacetime curled into a point, the so-called singularity of the universe or the Big-Bang singularity; spacetime was in a state of null or nothingness, both space and time had no meaning; all the matter in the universe is piled up and squeezed together, with extremely high density and temperature; suddenly, there was a deafening roar (no one could hear it), a dazzling flash (no one could see it), and all the matter erupted violently outward; thus, the universe was born, time began to flow, space began to expand, and eventually, evolved into the universe we have today.

This is the Big Bang theory.

According to the astronomical observation of cosmological redshift [13,14] and Hubble's doctrine of cosmic expansion [15], up to today, the process of the Big Bang has not yet ended, and the universe is still expanding, even expanding at an accelerated rate.

The Big Bang conforms to mankind's the psychology of seeking curiosity and is highly talked with great relish.

2.1 The Evolutionary History of Big Bang

The doctrine of Big Bang can be traced back to 1922. Let's briefly review the developmental or evolutionary history of the Big Bang model or theory.

In 1922, Russian physicist Alexander Friedmann, by solving Einstein's field equation, for the first time derived a dynamic mathematical solution for the possible expansion or contraction of the universe [16], laying the theoretical foundation for the Big Bang model.

In 1927, Belgian cosmologist Georges Lemaître envisaged that [17], long long ago, the universe was only a primeval atom; afterwards, the primeval atom exploded and gradually evolved today's universe. According to law of indestructibility of matter, Lemaître's primeval atom must have gathered all the matter in the universe today

In 1929, American astronomer Hubble proposed Hubble's Law [13,14]: the spectra of galaxies exhibit redshift, which is proportional to the distances between galaxies and the earth. Accordingly, Hubble inferred that [15] all galaxies are moving away from the earth, just like the scene during a big explosion. This is Hubble's doctrine of cosmic expansion, which provides an excellent footnote to Lemaitre's explosion of primeval atom. Perhaps, Hubble's doctrine of cosmic expansion was designed to cater to Lemaitre's doctrine of primeval atom.

In 1946, American physicist George Gamow officially established the model of the big explosion of the entire universe [18], introducing nuclear physics into the model of cosmic expansion for the first time to explain the origin of elements, linking the abundance of chemical elements to the early non-equilibrium processes of cosmic expansion, and predicting that the early universe must expand extremely rapidly and its nuclear reactions must have to be completed in seconds.

In 1948, Alpher, Bethe, and Gamow established a neutron capture model in their αβγ paper [19], which theoretically predicted the abundance of helium-4 approximately 25%. Later on, Alpher and Herman [20] made theoretical predictions about the temperature of blackbody radiation (so-called cosmic microwave background (CMB) radiation) that may have been left over from the big explosion of the entire universe: CMB is about 5 Kelvin (K); at the same time, the intersection time between matter density and radiation density was calculated: $T_I = 8.6 \times 10^{17}$ seconds, approximately 30 billion years, which can be regarded as a prediction of the age of the universe.

Thus far, the term Big Bang had not yet appeared.

In 1949, British astronomer Fred Hoyle, a supporter of steady-state universe (SSU), referred to the increasingly popular doctrine of big explosion of the entire universe as the Big Bang in a BBC radio program, with the intention of mocking its absurdity. Unexpectedly, the Big Bang later became the official name for the model of the origin of the universe. Perhaps, Hoyle's understanding of the Big Bang stemmed from his intuition and inherent view of nature, in line with human common sense and reason.

In 1965, Penzias and Wilson accidentally detected CMB radiation at a temperature of 3.5K (later corrected to 3K) [21], which is considered important evidence of the Big

Bang theory. Nowadays, more precise measurement has determined the temperature of CMB to be 2.725±0.001K.

The timing of the Big Bang or the age of the universe should be a key issue in the Big Bang model.

However, the Big Bang theory, including the work of Alpher and Herman [20], seems to have never had truly theoretical predictions about the time of the Big Bang. It is only indirectly inferred based on measurements such as CMB temperature, Hubble constant, light element abundance, and stellar age, relying on astronomers' independent observation and measurement of these physical quantities.

1920-1940s, at that time, the measured value of the Hubble cosmological constant was significantly higher: H_0=500 km/s/Mpc. The Hubble time $1/H_0$ calculated based on this is only 2 billion years, even less than the age of the earth. But Alpher and Herman's estimate in 1948 was around 30 billion years [20]. Later, with the improvement of observation and measurement, the estimated age of the universe based on observations hovered between 13 billion and 15 billion years.

In 2003, based on precise measurements of CMB radiation by the WMAP satellite, cosmologists estimated the time of the Big Bang to be 13.7 billion years [22]. In 2016, based on the Hubble constant H_0=67~70km/s/Mpc measured by the Planck satellite, cosmologists estimated the time of the Big Bang to be 13.82 billion years [23], which is considered the most accurate determination today of the time of the Big Bang or the age of the universe at present.

But, the question is, are the 13.82 billion years based on theoretical predictions from the Big Bang model or on actual measurement from astronomical observation?

After 2020, there has been a new controversy regarding the age of the universe [24-29].

Actually, such discussion on the age of the universe or the time of Big Bang is already no longer important, or even meaningless.

2.2 The Outline of Big Bang

When and how did the Big Bang take place? What physical processes did the Big Bang experience? How did the universe evolve after the Big Bang? Which important mathematical formulae are there in the Big Bang theory have? What are the mathematical and physical significances of the Big-Bang singularity that caused the big explosion of the entire universe?

It is said that only from the perspective of the Friedman equation can we truly understand the magnificent Big Bang chronology of 13.8 billion years.

2.2.1 The Mathematical Model of Big Bang

The mathematical model of Big Bang mainly includes [16-20]: 1. FLRW metric; 2. Friedmann's equation system; 3. the equation of state.

FLRW Metric

According to the first hypothesis of cosmology, i.e., the cosmological principle, the universe is uniform and isotropic on a sufficiently large scale. By solving Einstein's field equation, the FLRW (Friedmann-Lemaître-Robertson-Walker) metric is determined to satisfy this principle:

$$\begin{cases} g_{00} = 1 \\ g_{11} = -a(t)^2/(1-kr^2) \ \ (k = \kappa/R_0^2) \\ g_{22} = -a(t)^2 r^2 \\ g_{33} = -a(t)^2 r^2 \sin^2\theta \\ g_{\mu\nu} = 0 \quad (\mu \neq \nu) \end{cases} \tag{1}$$

where $a(t)$ is the scale factor of the universe, k the curvature parameter, κ the spacetime curvature, and R_0 the curvature radius.

Substitute the FLRW metric $g_{\mu\nu}$ into the Einstein line-element equation:

$$\begin{aligned} ds^2 &= g_{\mu\nu}dx^\mu dx^\nu \quad (\mu,\nu = 0,1,2,3) \\ &= c^2dt^2 \\ &\quad -a(t)^2\left(\frac{dr^2}{1-kr^2} + r^2(d\theta^2 + \sin^2\theta d\varphi^2)\right) \end{aligned} \tag{2}$$

where ($x^0=ct$, $x^1=r$, $x^2=\theta$, $x^3=\varphi$) is the spherical coordinate form of the 4d coordinate framework of Minkowski spacetime, and c the speed of light.

The scale factor $a(t)$ of the FLRW metric (Eqs. (1-2)) is a dimensionless value that plays an important role in the Big Bang model, endowed with the great historical responsibility by the Big Bang theory and condenses the entire history of cosmic expansion: during the Big Bang, the recession, redshift, and temperature drop of all galaxies are the geometric projections of $a(t)$ monotonically increasing.

Naturally, the value of $a(t)$ is set by the designers of the Big Bang model:

(1) The Big-Bang singularity: $t\to 0$, $a(t)\to 0$;

(2) The past after the Big Bang: $a(t)<1$;

(3) Today after the Big Bang: $a(t)=1$.

Motion Equations: Friedmann's equation system

By substituting the FLRW metric (Eqs. (1-2)) into the Einstein's field equation, the Friedmann equation system can be obtained, including:

1) Friedmann Equation

$$H^2(t) = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a(t)^2} + \frac{\Lambda}{3} \tag{3}$$

where $H(t)$ is the Hubble parameter, G the gravitational constant, ρ the total energy density, P the intensity of pressure, and Λ the cosmological constant.

2) Acceleration Equation

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3c^2}(\rho + 3P) + \frac{\Lambda}{3} \tag{4}$$

where P the intensity of pressure.

3) Cosmic Fluid Equation

$$\dot{\rho} + 3H(\rho + P) = 0 \tag{5}$$

which is the adiabatic expansion fluid equation, expresses the conservation of energy in the thermal history of the universe, and can be derived from the Friedmann equation (Eq. (3)) and the acceleration equation (Eq. (4)).

The Equation of State

In order to close the system of equations, it is necessary to establish the pressure-density relationship of cosmic components, in which the mathematical relationship between the intensity of pressure P and energy density ρ is the equation of state:

$$P = \omega\rho \tag{6}$$

where ω is the parameter of the state equation and known as the master switch of evolution of the universe.

According to cosmologists, the larger the value of ω, the faster the expansion rate of the universe, and the faster the density of matter or energy dilutes with expansion:

(1) For radiation and relativistic particles (photons or neutrinos): $\omega=1/3 \rightarrow \rho \propto a^{-4}$;

(2) For non-relativistic matter (neutrons or dark matter): $\omega \approx 0 \rightarrow \rho \propto a^{-3}$

(3) For dark energy and Phase cosmological constant: $\omega=-1 \rightarrow \rho=$ constant.

Hot History Scale: temperature-time relationship

For the radiation dominated early universe expansion process, the density of matter or energy is $\rho \propto T^4$ where T is temperature. According to the Friedmann equation, the Hubble parameter $H \propto T^2$ and $H \sim 1/t$ where t is time.

So, the temperature-time relationship of Big Bang is

$$T(t) = \left(\frac{3c^2}{32\pi Ga}\right)^{1/4} t^{-1/2} = \frac{1.52 \times 10^{10}}{\sqrt{t}}\ \mathrm{Ks}^{1/2} \tag{7}$$

It should be noted that in the dynamic model of the Big Bang theory, the scale factor $a(t)$, the cosmological constant Λ, and the state-equation parameter ω can be freely set and adjusted by cosmologists. In this way, the designers and cosmologists of the Big Bang model can control the universe to expand or contract, quickly or slowly.

2.2.2 The Physical Process of Big Bang

The mathematical relationships of the Big Bang model (Eqs. (1-7)) outlines a timeline for the Big Bang, roughly as follows.

The Timeline of Big Bang:

0–10^{-44}s | Quantum Gravity Era: The temperature of the universe reached infinity and the virtual spacetime exploded.

10^{-44}–10^{-36}s | Planck Era: 5.4×10^{-44} seconds marked the beginning of the phase transition of super unification, the formation of real spacetime (vacuum field), the production of matter particles (leptons and quarks inseparable), and the phase transition temperature was 10^{32} K.

10^{-36}–10^{-32}s | Grand Unification Era: 10^{-36} seconds marked the beginning of the phase transition of grand unification, characterized by inflation, asymmetry of matter and antimatter, separation of quarks and leptons, and the phase transition temperature was 10^{28} K.

10^{-32}–10^{-6}s | Quark-Lepton Era: 10^{-12} seconds marked the beginning of the phase transition of electroweak unification, and the phase transition temperature was 10^{16} K.

10^{-6}–1s | Hadron-Lepton Era: At 10^{-6}, quarks were confined, hadrons formed, and the phase transition temperature was 10^{12} K; 10^{-4} seconds marked that leptons and their antiparticles began to dominate, neutrinos decoupled, and the phase transition temperature was 10^{11} K.

1s–2×10^5 years | Radiation Era and Nucleosynthesis Era: At 1 second, electrons and positrons annihilated, marked the beginning of radiation era; helium nuclei formed between 4 seconds and 30 minutes, and the phase transition temperature was 10^{10} K; at 2×10^5 years, photons decoupled and hydrogen atoms began to, and the phase transition temperature was 4000 K.

2×10^5–10^9 years | Galaxy Era: Primitive galaxies formed, and galaxies gradually evolved.

10^9–5×10^9 years | Star Era: Stars appeared, and heavy elements began to form; planets appeared, and molecules began to form.

5×10^9–1.5×10^{10} years | Today: Human beings have observed cosmic expansion and 3K cosmic background radiation, as well as dark energy and accelerated expansion, and have established a cosmological model based on Einstein's general theory of relativity and particle physics.

Of course, the timeline of the Big Bang exists in many different versions, and it keeps changing with unceasingly mending and patching the Big Bang model.

It should be pointed out that the various eras in the timeline of the Big Bang are not purely the product of theoretical deduction of the Big Bang mathematical model (Eqs. (1-7)), but the interpretation based on quantum field theory. To some extent, it is somewhat far fetched to link the Big Bang theory with immature quantum field theory.

2.3 The Theoretical Basis of Big Bang

There are two principles as the logical premises of the Big Bang theory:

(1) The cosmological principle: on a large scale, the universe is uniform and isotropic;

(2) The principle of universality: the laws of physics have universal applicability.

However, as a product of modern cosmology, the crucial theoretical basis for the Big Bang model is Einstein's theory of relativity.

In 1917, Einstein applied his theory of general relativity to cosmology and celestial motion [30]. This is regarded as a sign of the establishment of modern cosmology or relativistic cosmology, and a sign of cosmology moving from philosophical speculation to becoming a science that can be computable and verifiable [31,32].

This has two implications:

(1) Modern cosmology is the relativistic cosmology founded by Einstein;

(2) Modern cosmology, including its Big Bang theory, is based on Einstein's theory of relativity.

In the Big Bang theory, the principle of the invariance of light speed as the logical premise of Einstein's theory of relativity and the doctrine of spacetime curvature as the logical consequence of the principle of the invariance of light speed play important roles.

2.3.1 Big Bang and Spacetime Curvature: On the Universe Singularity

According to the doctrine of Big Bang, before the Big Bang, the spacetime and matter of the universe curled into a point, the so-called Big Bang singularity of the universe: spacetime infinitely curved, both space and time were in a state of non-existence, both the density and temperature of matter were extremely high or even infinite; it was this extreme state that led to the Big Bang.

In the FLRW metric (Eqs. (1-2)), the singularity of the universe suggests that the time $t\to 0$ and the scale factor of the universe $a(t)\to 0$. Then,

(1) The matter density ρ was an infinity: $\rho\propto 1/a^3\to\infty$;

(2) The temperature T was an infinity: $T\propto 1/a\to\infty$;

(3) The spacetime curvature R was an infinity: $R\propto 1/a^2\to\infty$;

(4) The Hubble parameter H was an infinity: according to motion equations (Eqs. (2-4)), $H\to\infty$.

So, $a(t)=0$ mathematically marks the time $t=0$ when matter density, temperature, and curvature of the universe all tended toward infinity.

Naturally, at the time $t=0$, the curvature radius of spacetime is zero: $R_0=1/R=0$, and the space was null ($\Omega_{UNI}\to 0$), becoming one point. Cosmologists regard it as the starting point for space and time in the universe.

This is the Big-Bang singularity of the universe.

In the FLRW metric of the Big Bang theory (Eqs. (1-2)), the Big-Bang singularity of the universe occurs at the moment $t=0$. It is not a point in space, but the starting point of the universe, i.e., the starting point of the space and time of the universe envisioned by the designers of the Big Bang model: the time T_{UNI} of the universe began to flow from zero ($t=0$); the space Ω_{UNI} of the universe began to expand from zero ($R_0=0$).

In fact, the Big-Bang singularity and even the Big Bang theory are derivatives of Einstein's field equation and Schwarzschild singularity.

In 1915, based on his special theory of relativity [9], Einstein established his theory of general relativity [10], which can be referred to as the curvature doctrine of gravitational spacetime. The representative equation of it is naturally Einstein's gravitational-field equation:

$$G_{\mu\nu}\equiv R_{\mu\nu}-\frac{1}{2}g_{\mu\nu}R=-\kappa_E T_{\mu\nu} \tag{8}$$

where $G_{\mu\nu}$ is called the Einstein tensor, the Ricci tensor $R_{\mu\nu}$ is the spacetime curvature, R the Gaussian curvature, $g_{\mu\nu}$ the spacetime metric, $T_{\mu\nu}$ the energy-momentum tensor, and κ_E the field-equation coefficient.

It is Einstein's field equation that gives rise to the concept of the curvature of gravitational spacetime.

Einstein once tried to add a cosmological term $\Lambda g^{\mu\nu}$ with a suitable cosmological constant Λ in his field equation so that the universe could remain static, avoiding expansion or contraction. Actually, in a certain sense, it is the cosmological constant Λ that gave rise to the Big Bang theory: by appropriately selecting Λ, the universe not only could remain static, but also could expand or contract.

Initially, Einstein could only rely on the way of weak-field approximation to solve his field equation for static spherically-symmetric gravitational spacetime, obtaining an approximate solution. In 1916, German astronomer Schwarzschild obtained the first exact solution, namely the Schwarzschild metric $g_{\mu\nu}(c)$ [33]:

$$\begin{cases} g_{00}=1-2GM/c^2r \\ g_{11}=-(1-2GM/c^2r)^{-1} \\ g_{22}=-r^2 \\ g_{33}=-r^2\sin^2\theta \\ g_{\mu\nu}=0 \quad (\mu\neq\nu) \end{cases} \tag{9}$$

It is worth noting that, according to the theory of OR, the Schwarzschild metric $g_{\mu\nu}=g_{\mu\nu}(c)$ is the metric observed with the optical agent OA(c). By substituting the Schwarzschild metric $g_{\mu\nu}(c)$ into Einstein's line-element equation, one obtains

$$\begin{aligned} \mathrm{d}s^2 &= g_{\mu\nu}\mathrm{d}x^\mu\mathrm{d}x^\nu \quad (\mu,\nu=0,1,2,3) \\ &=\left(1-\frac{2GM}{c^2r}\right)c^2\mathrm{d}t^2-\left(1-\frac{2GM}{c^2r}\right)^{-1}\mathrm{d}r^2 \\ &-r^2\mathrm{d}\theta^2-r^2\sin^2\theta\,\mathrm{d}\varphi^2 \\ &(x^0=ct,\ x^1=r,\ x^2=\theta,\ x^3=\varphi) \end{aligned} \tag{10}$$

where, like in the case of the FLRW metric (Eqs. (1-2)), ($x^0=ct$, $x^1=r$, $x^2=\theta$, $x^3=\varphi$) is the spherical coordinate form of the 4d coordinate framework of Minkowski spacetime.

There two singularities in the Schwarzschild metric $g_{\mu\nu}(c)$ (Eq. (9)) or the line-element equation (Eq. (10)):

(1) The event-horizon singularity $r=2GM/c^2$ of black holes, where r is the event-horizon radius;

(2) The gravitational-center singularity $r=0$.

If you envision all matter in the universe gathers at the gravitational center, then the Schwarzschild singularity $r=0$ is no longer a point in gravitational spacetime, but rather the singularity of the universe: the entire universe, including the spacetime and matter of te, contracts into such a singularity, spacetime is infinitely curved and the curvature radius tends toward zero: $R_0\to 0$. This is equivalent to the scale factor $a(t)$ in the FLRW metric (Eqs. (1-2)) being set to zero by the designers of the Big Bang model: $a(t)=0$.

It is thus clear that, as the solutions to Einstein's field equation, both the FLRW metric (Eqs. (1-2)) and the Schwarzschild metric (Eqs. (9-10)) embody Einstein's doctrine of spacetime curvature, which indicates that Einstein's doctrine of spacetime curvature plays a significant role in the Big Bang theory.

As clarified by the theory of OR, spacetime is not really curved; due to the observational locality ($c<\infty$) of the optical agent OA(c), the optical images you observe with OA(c) must be inevitably curved or deformed.

2.3.2 Big Bang and the Invariance of Light Speed: On Observation Agents

The theory of OR has discovered that [1-4] all theories and spacetime models in human being's physics must be linked to a certain observation system (P,$M(\eta)$,O) or a specific observation agent OA(η), and inevitably involve three issues: 1. who the observer O is; 2. what the observed object P is; 3. who is transmitting the information about P to O, or what the observation medium $M(\eta)$ or the observation agent OA(η), where η is the speed transmitting observed information $M(\eta)$ by or OA(η).

So, what is the observation agent of the Big Bang?

Like Einstein's theory of relativity, the Big Bang theory is that of optical observation which adopts the optical observation agent OA(c).

As shown by Eqs. (1-7), in the Big Bang theory,

(1) The observer O is the mankind;

(2) The observed object P is the universe;

(3) The observation agent OA(η) with medium $M(\eta)$ is the optical observation agent OA(c) with medium $M(c)$ (light or electromagnetic waves) transmitting observed information about P to O at the speed c of light in vacuum [7,8].

By comparing the FLRW metric (Eqs. (1-2)) of the Big Bang model with the Schwarzschild metric (Eqs. (9-10)), we know that both the Big Bang theory and Einstein's relativity adopt the 4d coordinate framework of Minkowski spacetime with the definition equivalent to the optical observation agent OA(c) in the theory of OR [1-4]:

$$\mathrm{OA}(c) \triangleq \begin{cases} X^{4\mathrm{d}}(c)\colon \begin{Bmatrix} x^0 = ct \\ x^1 = x, x^2 = y, x^3 = z \end{Bmatrix} \\ \mathrm{d}s^2 = g_{\mu\nu}\mathrm{d}x^\mu \mathrm{d}x^\nu \end{cases} \tag{11}$$

where OA(c) is the optical agent, that is, an optical observation system that employs light or electromagnetic interaction as the observation medium; $X^{4\mathrm{d}}(c)$ is the 4d spacetime (x^0,x^1,x^2,x^3) observed with OA(c), $x^0=ct$ is the spatialization of 1d time t, (x^1,x^2,x^3) is the 3d space, and $g_{\mu\nu}$ is the spacetime metric.

The Minkowski 4d coordinate framework, known as Minkowski spacetime, is a formalized tool specifically designed by Minkowski for Einstein's special relativity [34,35]. Initially, Einstein did not believe that Minkowski spacetime was necessary or of significant importance to his theory of relativity. However, when he was researching his theory of general relativity, Einstein realized that it was necessary for his theory to be based on the 4d coordinate framework of Minkowski spacetime. So, he extended Minkowski spacetime from the inertial spacetime of special relativity to the gravitational spacetime of general relativity, and held Minkowski spacetime in high regard. Einstein once said: “We should limit ourselves to a 4d space and the transformation group of continuous real coordinate.”

Minkowski spacetime is a 4d differential manifold with the definitions the spacetime metric $g_{\mu\nu}$ (μ,ν=0,1,2,3) and the line element ds, and thereby is metric spacetime.

Originally, as a 4d coordinate framework of inertial spacetime, the metric of Minkowski spacetime $g_{\mu\nu}=\eta_{\mu\nu}$ is a constant metric, representing flat inertial spacetime where $\eta_{\mu\nu}$ is referred to as Minkowski metric with the following two common forms:

(1) The Cartesian coordinate form
$\eta_{\mu\nu}$=diag(+1,–1,–1,–1);

(2) The spherical coordinate form
$\eta_{\mu\nu}$=diag(+1,–1,$-r^2$,$-r^2\sin^2\theta$).

Einstein extended the 4d coordinate framework of Minkowski spacetime from special relativity to general relativity, where the metric $g_{\mu\nu}$ is no longer the flat Minkowski metric $\eta_{\mu\nu}$, but rather the curved 4d spacetime metric $g_{\mu\nu}=g_{\mu\nu}(x^\alpha)$, that is, a function of the 4d spacetime coordinates x^α (α=0,1,2,3). Both the coordinate frameworks adopted by the FLRW metric (Eqs. (1-2)) of the Big Bang theory and the Schwarzschild metric (Eqs. (9-10)) are the spherical coordinate form of the 4d coordinate framework of Minkowski spacetime.

It is worth noting that, as clarified by the theory of OR, the time coordinate axis $x^0=ct$ in the 4d coordinate framework of Minkowski spacetime (Eq. (11)) represents the invariance of light speed in optical observation.

It is thus clear that the Big Bang theory, like Einstein's theory of general relativity, adopts the optical agent OA(c) and the 4d coordinate framework of Minkowski spacetime (Eq. (11)), in which the principle or hypothesis of the invariance of light speed plays the crucial role.

The theory of OR has clarified that [1-4] the speed of light is not really invariant; and so, due to the observational locality ($c<\infty$) of OA(c), one never can perceive or observe the motion of matter at superluminal speeds with the optical agent OA(c).

2.4 The Empirical Basis of Big Bang

The designers of the Big Bang model and cosmologists firmly believe that, although no one hear the deafening sound of the Big Bang and see the dazzling flash of the Big Bang, the empirical evidences provided by astronomical observations regarding the evolution of the universe and celestial bodies are sufficient to prove that a Big Bang marking the birth of the universe must have occurred 13.8 billion years ago.

The so-called empirical basis of the Big Bang theory primarily involves three major evidences as follows.

(i) Hubble's Law: Cosmological Redshift and Cosmic Expansion

The doctrine of cosmic expansion, as the most important empirical evidence of the Big Bang originated from Hubble's Law [13,14].

In 1929, American astronomer Edwin Hubble discovered the phenomenon of cosmological redshift: astronomical observation showed that the spectra of galaxies exhibit a redshift phenomenon, and the redshift amount is proportional to the distance between the galaxy and the earth. Based on this, Hubble hypothesized that, similar to the Doppler effect, the cosmological redshift is caused by the recession of galaxies relative to the earth, and that, the farther a galaxy is from the earth, the faster it recedes.

This is Hubble's Law, which represents Hubble's doctrine of cosmic expansion.

According to Hubble's interpretation [15], the recession of galaxies implies that the universe is expanding, just as the scene that appears after a Big Bang.

Hubble's doctrine of cosmic expansion provided the empirical basis for the Big Bang theory, which can be regarded as the most crucial empirical evidence for the Big Bang. On the one hand, Hubble interpreted the cosmological redshift as a sign of cosmic expansion to align with Lemaitre's explosion of primeval atom [17]; on the other hand, Hubble's law or doctrine of cosmic expansion [13-15] inspired Gamow [18] and Alpher and Bethe [19] to formally establish the original Big Bang model based on Friedmann's [16] work.

(ii) The Radiation of CMB

In 1948, Alpher and Herman made a theoretical prediction for the blackbody radiation that might have been left over from the Big Bang, that is, the radiation of Cosmic Microwave Background (CMB): the residual temperature left in the present-day universe by the Big Bang should be 5K [20].

The radiation of CMB is regarded as the afterglow of the Big Bang.

In 1965, Penzias and Wilson accidentally discovered a ubiquitous and uniform microwave noise, which was believed to be exactly the afterglow of the Big Bang predicted by Alpher and Herman. The residual temperature measured by Penzias and Wilson was 3.5K (later revised to 3K) [21]. For this discovery, Penzias and Wilson were awarded the Nobel Prize in Physics in 1978. Now, precise measurements have determined the radiation temperature of CMB to be 2.725 ± 0.001K.

The radiation of CMB is regarded as one of the important empirical evidences for the Big Bang model, second only to Hubble's theory of cosmic expansion. Based on the radiation of CMB and time-reversal processing, cosmologists believed that the universe must have experienced an extreme high-temperature in its early stage.

(iii) Element Synthesis: On the Abundance of Light Elements

In 1948, Gamow, Bethe, and Gamow predicted in their αβγ paper [19] that, in the first few minutes after the Big Bang, about 75% of hydrogen (H), 24% of helium (He), and trace amounts (<1%) of lithium (Li) and other light elements were synthesized through nuclear fusion reactions. Their predictions for the abundances of hydrogen and helium seemed to be in excellent agreement with actual observations.

However, the predictions of the Big Bang theory for lithium were far from actual observations. This is the primordial lithium problem in the Big Bang theory [36].

It is worth our pondering that, whenever they discover the Big Bang theory does not align with an astronomical phenomenon, the designers of the Big Bang model and cosmologists do not doubt or deny the Big Bang theory, but rather embark on a new round of mending and patching the Big Bang model. Currently, cosmologists are exploring various approaches, such as introducing the so-called supersymmetry hypothesis and new physics, in an effort to paper over the anomalous abundance of lithium-6 and lithium-7 [37-38].

2.5 Questioning of the Doctrine of Big Bang

The Big Bang is listed as BP-15 among the fifteen big puzzles in human being's physics in the monograph of OR.

In essence, the Big Bang is an issue on the origin of the universe. However, the origin of the universe is a philosophical issue, but not a scientific issue.

Due to the cause-effect chain of logic with no beginning and no ending, and due to the observational locality of human perception and observation, human being's science never can answer such ultimate questions about the origin of the universe. If one attempts to employ science to solve the problem of the origin of the universe, then he or she must inevitably fall into the dilemma or paradox of the first cause. Ultimately, the so-call scientific theory must inevitably evolve into a myth or even superstition.

However, the human mind is limited and cannot accommodate the eternal and infinite universe. Therefore, mankind always wants to give the universe a first cause. For this reason, mankind created God, who then created the universe and human beings. Mankind always wants to give time a starting point, at which time began to flow from a state of rest, and to give space a starting point, at which space began to expand from a state of null. So, cosmologists try to employ science solve the philosophical problem of the origin of the universe, and have invented the theory and model of Big Bang.

We have no reason to doubt the Big Bang designers and cosmologists' spirit of pursuing science.

However, the doctrine of Big Bang is not a strictly scientific theory. To some extent, as indicated by the subtitle of Baidu Encyclopedia in China, it is “A Doctrine on the Origin of the Universe Consistent with Religion”. In fact, even as a scientific model, the Big Bang is also not a strictly theoretical model, but more like a phenomenological model. To accommodate a vast array of astronomical phenomena, cosmologists have to unceasingly mend and patch the Big Bang model.

The theory of OR has already discovered that [1-4] the physical phenomena of the universe presented to mankind through astronomical observations are far from the physical essence of the universe.

Physics, as a natural science, is both empirical and speculative. The Big Bang model must withstand the test of both empiricism and speculation. Likewise, a questioning of the Big Bang theory must also withstand the test of both empiricism and speculation: either questioning its theoretical basis by logical speculation, or questioning its empirical basis by observation and experiment.

Since cosmologists regard the Big Bang as a scientific model, this article will first examine the Big Bang model from a scientific perspective based on the theory of OR with the general observation agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$): Sec. 3 and Sec. 4 examines the theoretical basis; Sec. 5 examines the empirical basis.

To facilitate readers in examining the theory and model of Big Bang from a scientific perspective alongside with the author, this section lays some groundwork and preparation for the Sections 3-5 in advance.

(i) The Speculative: Questing the Theoretical Basis of Big Bang

In his book A Brief History of Time [39], Stephen Hawking ever said: “Mathematics cannot really handle infinite numbers. At singularity, the theory itself breaks down or fails.”

The theory of OR refers to all the singularities in the theories or models of physics as the Hawking singularities, including [6]:

(1) The Lorentz singularity in Einstein's special relativistic factor $\gamma_S=1/\sqrt{(1-v^2/c^2)}$: inertial speed $v=c$;

(2) The Schwarzschild singularity in Einstein's general relativistic factor $\gamma_G=1/\sqrt{(1+2\chi/c^2)}$: Newton's gravitational potential $\chi=-c^2/2$;

(3) The Big-Bang singularity in the FLRW metric: the radius of spacetime curvature $R_0=1/R=0$.

In Hawking's words, at the Hawking singularities, the theories or models in physics have become invalid: Einstein's theory of special relativity becomes invalid at the Lorentz singularity; Einstein's theory of general relativity becomes invalid at the Schwarzschild singularity.

So, according to Hawking's doctrine of singularity, the Big Bang theory has already broken down or failed at the Big Bang singularity.

It is worth noting for physicists that the mathematical singularity of a theory or model in physics is exactly the blind spot of the theory or model. Actually, not only that, the closer a theory or model in physics is to a Hawking singularity, the farther it deviates from the physical reality and scientific truth.

In his book A Brief History of Time [39], regarding the Big-Band singularity, Hawking also said: "For years, my early work with Roger Penrose seemed to be a disaster for science. It showed that the universe must have begun with a singularity, if Einstein's general theory of relativity is correct. That appeared to indicate that science could not predict how the universe would begin."

Hawking seemed to be somewhat conflicted and hesitant. Hawking's ambivalence might lie in the fact that, on one hand, he supported Einstein; but on the other hand, he opposed the singularity. However, one thing is clear in Hawking's words: whether the Big Bang theory is correct or not depends on whether Einstein's theory of general relativity, which serves as the theoretical basis of Big Bang, is correct or not.

As clarified in Sec. 2.3, Einstein's theory of relativity is the most important theoretical basis for the Big Bang model, in which the principle of the invariance of light speed that serves as Einstein's logical premise, and the doctrine of spacetime curvature that is one of Einstein's logical corollaries, both play important roles.

In this regard, since what Einstein's theory of relativity describes is only the optical image of the physical world, since the speed of light is not really invariant, since spacetime is not really curved, can the Big Bang theory still hold true?

The theory of OR has proven that [1-4] Newton's classical mechanics is a theory of idealized observation, its idealized agent OA_∞ can be referred to as God's Eye, representing the objective and real physical world; whereas Einstein's relativity theory is a theory of optical observation, its optical agent OA(c) presents to us only the optical image of the physical world, not the objective physical reality and real physical existence. All the relativistic effects in Einstein's theory of relativity, including the special and the general, are observational effects and apparent phenomena caused by the observational locality ($c<\infty$) of the optical agent OA(c): the speed of light is not really invariant; spacetime is not really curved.

So, the doctrine of Big Bang, which is based on Einstein's theory of relativity, is merely a mirage built on the optical image presented by the optical agent OA(c), that is, a scientific myth, not the scientific truth.

Thus far, in terms of theoretical basis, the conclusion of this article seems to have been formed: The doctrine of Big Bang is only a scientific myth, not the scientific truth.

Let us treat this section as a prologue. Regarding the theoretical basis of the Big Bang theory, Sec. 3 focusing on the relationship between the Big Bang and the invariance of light speed and Sec. 4 focusing on the relationship between the Big Bang and the doctrine of spacetime curvature will provide detailed statements.

(ii) The Empirical: Questing the Empirical Basis of Big Bang

According to the theory of OR, the so-called empirical evidences supporting the Big Bang theory, such as cosmological redshift, the radiation of CMB, the abundance of light elements, the large-scale structure of the universe, the evolution and distribution of galaxies, primordial gas clouds, are merely the optical astronomical phenomena presented by the optical observation agent OA(c), not the objective physical reality, let alone representing the essence of the physical world. They may have infinitely many possible interpretations or answers, and are not the evidence materials specifically prepared for the Big Bang.

To a certain extent, Hubble's Law or Hubble's doctrine of cosmic expansion serves as the most crucial empirical basis for the Big Bang model.

Hubble's doctrine of cosmic expansion originates from Hubble's law; whereas Hubble's law originates from the phenomenon of cosmological redshift. Without cosmological redshift, there would be no the doctrine of galaxy recession; without galaxy recession, there would be no Hubble's doctrine of cosmic expansion. Consequently, the radiation of CMB, the abundance of light elements, and even all the so-called empirical evidences for the Big Bang, must lose their substantial significance as evidence for the doctrine of Big Bang.

So, can the Big Bang theory still hold true?

In any case, cosmic redshift is undeniable.

However, based on the theory of OR, this article will clarify that cosmic redshift does not necessarily suggest that galaxies are receding; even if galaxies are receding, it does not suggest that the universe is expanding; even if the universe is expanding, it does not suggests there was a big bang in the universe; and even if there was a big bang in the universe, it does not suggests that a new universe was born, nor does it suggest that time began to flow from a state of rest and space began to expand from a state of null.

In the monograph on OR, the author proposed the law of light propagation [1-4] to replace Hubble's law [13,14]. From the perspective of the theory of OR, based on human common sense and reason, Sec. 6 will re-examine Hubble's law and Hubble's doctrine of cosmic expansion, and reinterpret the phenomenon of cosmological redshift.

3 The Speed of Light is not Really Invariant

Common sense and reason tell us that the motion of matter follows Galileo's law of speed addition. However, Einstein's motion of matter follows the relativistic law of speed addition, and in particular, the speed of light c plus a speed v remains the speed of light c, which is Einstein's principle of the invariance of light speed.

As clarified in Sec. 2, Einstein's theory of relativity is the most important theoretical basis for the Big Bang theory. In particular, Sec. 2.3.2 has clarified that the principle of the invariance of light speed plays the crucial role in the Big Bang theory.

If the principle of the invariance of light speed is invalid, or in other words, if the speed of light is not really invariant, then can the Big Bang theory still hold true?

Physicists, including Stephen Hawking, seem to only focus on the effect of spacetime curvature for the Big Bang theory, thus only regard Einstein's theory of general relativity as the theoretical basis of the Big Bang model. For the logical premises of Einstein's theory of general relativity, they pay attention only to the principles of equivalence and covariance, yet forget about the principle of the invariance of light speed.

Actually, the principles of equivalence and covariance are merely auxiliary logical premises, serving as the logical shortcuts that Einstein specially paved for his theory of general relativity. However, the principle of the invariance of light speed is the only indispensable logical premise for Einstein's theory of relativity, including the special and the general. All relativistic effects in Einstein's theory of relativity, including the inertial or the gravitational, are the logical consequences of the principle of the invariance of light speed.

This section examines the theoretical basis of the Big Bang model, and by focusing on the issue of the invariance of light speed, examines the logical rationality and theoretical validity of the Big Bang theory.

3.1 Observation Agents and 4d Spacetime Coordinates

The theory of OR has discovered that [1-4] human perception and cognition of the objective world are both dependent on and constrained by observation. In human being's physics, all theoretical systems or spacetime models are linked to specific observation media or specific observation systems, and must certainly be branded by observation without exception.

This is the name origin of Observational Relativity.

As stated in Sec. 2.3.2, according to the theory of OR, a theory or model of physics must be linked to a certain observation system $(P, M(\eta), O)$ or $\mathrm{OA}(\eta)$, involving the observed object P, the observer O, and the observation medium $M(\eta)$ for transmitting observed information about P to O, in which η is a significant physical quantity, that is, the speed of $M(\eta)$ transmitting observed information.

The theory of OR has introduced an important concept: Observation Agent.

Observation Agent [1-4]: An observation agent $\mathrm{OA}(\eta)$ is an observation system $(P, M(\eta), O)$, where the observation medium $M(\eta)$ transmits the information about the observed object P to the observer O at a speed η; the matter wave of $M(\eta)$ transmitting observed information is referred to as the information wave of $\mathrm{OA}(\eta)$, and the matter particles constituting the information wave are referred to as the informons of $\mathrm{OA}(\eta)$.

In theory, any form of matter motion can serve as an observation medium $M(\eta)$ to transmit information about observed objects to observers. Any matter wave, not just light, can serve as the information wave of an observation agent $\mathrm{OA}(\eta)$, and in particular, can have any information-wave speed η, not just the speed of light c.

In theory of OR, an observation agent $\mathrm{OA}(\eta)$ serving as an observation system $(P, M(\eta), O)$ is of profound connotation and broad denotation.

Based on the principle of general correspondence, the theory of OR has generalized Minkowski's 4d spacetime coordinate framework from the optical observation agent $\mathrm{OA}(c)$ (Eq. (11)) to the general observation agent $\mathrm{OA}(\eta)$, and defines it as [1-4]

$$\mathrm{OA}(\eta) \triangleq \begin{Bmatrix} X^{4\mathrm{d}}(\eta)\colon \begin{Bmatrix} x^0 = \eta t \\ x^1 = x, x^2 = y, x^3 = z \end{Bmatrix} \\ \mathrm{d}s^2 = g_{\mu\nu}\mathrm{d}x^\mu \mathrm{d}x^\nu \end{Bmatrix} \tag{12}$$

where $\mathrm{OA}(\eta)$ is the general observation agent ($0<\eta<\infty$; $\eta\to\infty$), η the speed of the information wave of $\mathrm{OA}(\eta)$, $X^{4\mathrm{d}}(\eta)$ the 4d observed spacetime (x^0,x^1,x^2,x^3) of $\mathrm{OA}(\eta)$, $x^0=\eta t$ the spatialization of 1d time t, (x^1,x^2,x^3) the 3d space that may adopt Cartesian coordinates (x,y,z) or spherical coordinates (r,θ,φ), $g_{\mu\nu}$ the spacetime metric.

Like Minkowski's spacetime, the observed spacetime $X^{4\mathrm{d}}(\eta)$ of $\mathrm{OA}(\eta)$ is a 4d differential manifold that defines the spacetime metric $g_{\mu\nu}$ $(\mu,\nu=0,1,2,3)$ and the line element $\mathrm{d}s$, and thereby is metric spacetime.

It is worth noting that, in the 4d spacetime coordinate framework of OR (Eq. (12)), the spatialized time coordinate axis $x^0=\eta t$ represents the invariance of information-wave speeds for the general observation agent $\mathrm{OA}(\eta)$: if an observer employs $\mathrm{OA}(\eta)$ as his or her observation agent to perceive or observe the physical world, then the speed η of the information wave of $\mathrm{OA}(\eta)$ must be his or her observational limit that cannot be exceeded.

Perhaps, you can now understand why the speed of light is invariant and cannot be exceeded in Einstein's theory of relativity.

However, unlike Einstein's principle of the invariant of light speed, the invariance of information-wave speeds in the theory of OR is not a hypothesis, nor does it originate from the definition in Eq. (12). Instead, it is a logical consequence: a theorem of the theory of OR.

3.2 The Theorem of the Invariance of Information-Wave Speeds

The author repeatedly emphasizes that [1-4] the theory of OR is not designed or manufactured; it is only a discovery, an unexpected scientific discovery.

The theory of OR has discovered that the speed of light is not really invariant. The so-called invariance of light speed is only an observational effect and apparent phenomenon caused by the observational locality ($c<\infty$) of the optical agent OA(c). If an observer employs OA(c) as the observation agent to perceive or observe the physical world, then the speed of light c must not be exceeded observationally. In other words, the speed of light c is the observational limit of the optical agent OA(c). Only under the case of adopting the optical agent OA(c) does the speed of light appears to be invariant.

3.2.1 The Original Intention of OR: to Give Photons a little bit of Rest Mass

The author holds the natural view of dialectical materialism: the universe is a contradictory unity of spacetime and matter; spacetime is a contradictory unity of space and time; matter is a contradictory unity of mass and energy.

In a certain sense, Einstein's theory of relativity excellently interprets the natural view of dialectical materialism. However, Einstein's hypothesis of the invariance of light speed leads to two specious inferences:

(1) The speed of light is the ultimate speed in the universe, which cannot be exceeded;

(2) The rest mass of a photon is zero.

According to Einstein's mass-speed relation:

$$m=\frac{m_o}{\sqrt{1-v^2/c^2}}\quad\left(\lim_{v\to c}m=\infty\ \text{ or }\ \lim_{v\to c}m_o=0\right)\qquad(13)$$

as the speed v of a matter object P reaches the speed of light c, either its rest mass m_o is zero, or its relativistic mass m is infinitely large.

According to the principle of physical observability, an infinite physical quantity is unimaginable and unobservable. So, Einstein could only set the rest mass m_o of the photon to zero.

It is puzzling that, according to Einstein's relativistic mass-speed relation, the identical observed object P appears to have different relativistic masses to different observers. Therefore, people subconsciously believe that the relativistic mass m is unreal, and only the rest mass m_o is the objective and real mass of P, that is, the inherent mass of matter. So, the absence of rest mass for photons is tantamount to the absence of mass for photons.

Matter with only energy and no mass contradicts the author's natural view of nature of dialectical materialism. So, it became the original intention for the theory of OR to give a photon a little bit rest mass.

Driven by their Inherent view of nature, many physicists, including the great Feynman, de Broglie and Schrödinger, are reluctant to accept Einstein's hypothesis that photons have no rest mass. Experimental physicists have been attempting to determine the rest mass of photons through observations and experiments.

Unlike determining the rest mass of photons through observations and experiments, the author attempts to theoretically endow photons with a slight amount of rest mass, and establish a new model of mass-speed relation so that photons have the rest mass of their own [6].

3.2.2 The Axiom System of OR: from the Ultimate Speed Λ_U to the Information-Wave Speed η

The ultimate speed of the universe is defined as the upper limit of the speed of matter motion in the universe.

The author had originally envisaged that the ultimate speed of the universe might not be the speed of light c, but should be defined as Λ_U: the speed at which the frequency of a matter wave approaches infinity. Although the frequency of light is extremely high, it is still finite. According to the definition of Λ_U, the speed of light c might be slightly less than the ultimate speed of the universe: $c<\Lambda_U$. In this case, a photon could acquire its own rest mass m_o:

$$m_o=m\sqrt{1-c^2/\Lambda_U^2}>0\ \ (c<\Lambda_U,\ 0<m<\infty)\qquad(14)$$

Yet the question remains: What exactly is the ultimate speed Λ_U of the universe?

The author originally believed that Λ_U, not c, would be invariant and the ultimate speed of the universe that would be unsurpassed and inaccessible for any matter wave or body, including light or the photon.

Based on this idea, the author embarked on establishing an axiom system, hoping to deduce a spacetime transformation model and endow photons with the rest mass.

Compared to Einstein's theory of special relativity, the theory of Inertial OR (IOR) has more basic logical premises or a more basic axiom system [1-4]:

The First: The Principle of Physical Observability

The Second: The Conditions of Wave-Particle Duality

(1) The Principle of Frequency-Speed Relation
(2) The Definition of the Ultimate Speed
(3) The Principle of OR Speed Addition

The Third: The Definition of Time

For the detailed statement on the axiom system of OR, see Chapter 2 of the 1st volume IOR in the Monograph of Observational Relativity [1-4].

The author originally believed that the ultimate speed Λ_U of the universe is an inaccessible speed for all forms of matter motion. However, under the inaccessible condition of Λ_U, the logical deduction of the theory of OR could not proceed. Therefore, in the axiom system of OR, the definition of the ultimate speed Λ_U had to abandon the inaccessible requirement of Λ_U.

Thus, the problem seemed to have come full circle: photons still could not acquire rest mass. The author could only temporarily set aside the issue of photon rest mass.

At this point, the established axiom system gave the author a hunch that Einstein's theory of special relativity and de Broglie's theory of matter waves might be unified under the axiom system of OR [40]. This prompted the author to continue deducing the OR spacetime transformation based on the already established axiom system.

The logical deduction and theoretical derivation of OR spacetime transformation needed a physical quantity with a clear physical significance, that is, the speed of the spacetime information of the observed object P relative to the observer O, which was tentatively denoted as η.

Based on the axiom system of OR, from the definition of time as a first principle to the invariance of time-frequency ratio, and from the invariance of time-frequency ratio to the time transformation and space transformation, the logical deduction and theoretical derivation for the OR spacetime transformation had led to an interesting conclusion [1-4]: $\Lambda_U=\eta$!

This suggested that the universe does not have the so-called ultimate speed at all. The so-called invariant or insurmountable ultimate speed of the universe, denoted as Λ_U, is actually the speed η at which the information on observed objects is transmitted by the observation medium $M(\eta)$, depending on the observation agent OA(η) adopted by observers.

So, the theorem of the invariance of the information-waves speeds is established.

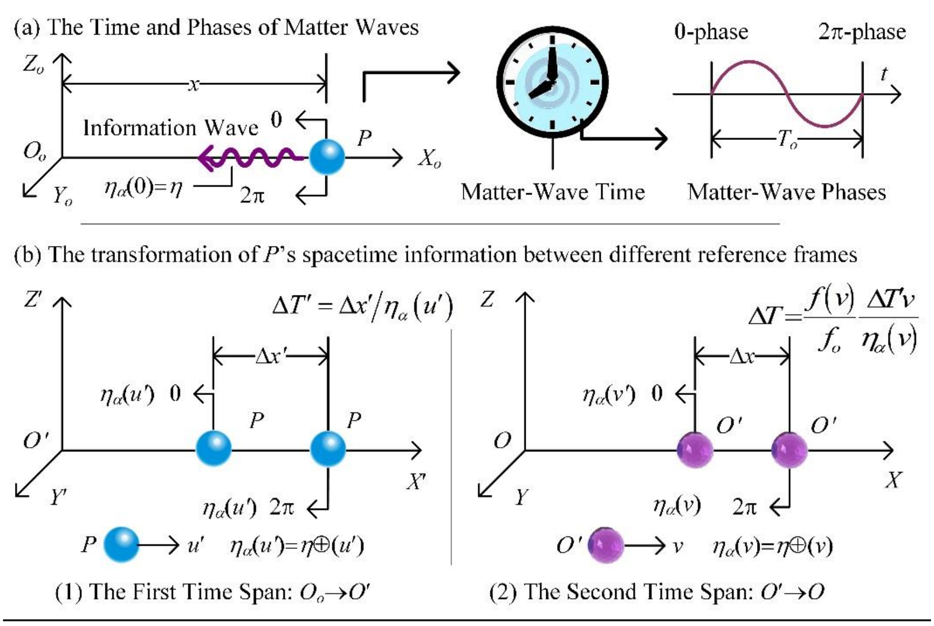

Figure 1 The Transformation View of Inertial Spacetime

Annotation (a) The Phase and Time of Information Waves: The time required for the spacetime information of different phases of the observed object P to travel from P to the proper observer O_o in the proper spacetime O_o is the same; but may be different to the observed spacetime of O or O'.

Annotation (b) The Transformation of the Spacetime Information of P between Different Reference Frames: (1) the first time span $O_o \to O'$; (2) the second time span $O' \to O$.

3.2.3 On the Invariance of Time-Frequency Ratio

In the axiom system of OR, only the definition of time is the only indispensable logical premise for the theory of OR; the principle of physical observability can be regarded as a basic principle universally implied by all theories in human being′s physics, and the conditions of wave-particle duality can be replaced by the principle of simplicity or the principle of relativity.

Time is the most basic physical concept and physical quantity. The definition of time can be regarded as the most basic logical premise or first principle of OR.

Definition Time [1-4]: Suppose there are a periodic signal source T_P and an observer O armed with a specific observation agent OA(η); T_o and f_o are the intrinsic period and frequency of T_P. If O observes N periods of T_P in the duration of Δt with OA(η), then $\Delta t=NT_o=N/f_o$, and Δt is referred to as the observed time of T_P relative to O or OA(η). In particular, if Δt is the observed value when O and T_P are relatively stationary in the free spacetime S_F or OA(η) is the idealized agent OA_∞, then Δt is referred to as the intrinsic time and denoted as $\Delta\tau$ ($=N_oT_o=N_o/f_o$), where N_o is the period number in the duration of the intrinsic $\Delta\tau$ when P is stationary in the free spacetime S_F.

The definition of OR time has a direct corollary: the invariance of time-frequency ratio.

The Invariance of Time-Frequency Ratio [1-4]: Suppose there are a periodic signal source P and an observer O in the observed spacetime $X^{4d}(\eta)$ of the observation agent OA(η); f_o is the intrinsic frequency of P. According to the definition of time, define P as the standard clock, then the ratio of the observed time-element dt of P relative to O to the observed frequency f of P relative to O, dt/f, is an invariant, and identically equal to the ratio of the intrinsic time-element dτ of P to the intrinsic frequency f_o of P, that is, dτ/f_o:

$$\frac{\mathrm{d}t}{f}=\frac{\mathrm{d}\tau}{f_o} \quad or \quad \Gamma(\eta,v)=\frac{\mathrm{d}t}{\mathrm{d}\tau}=\frac{f}{f_o} \tag{15}$$

where v is the speed of P relative to O.

(Proof: omitted)

The invariance of time-frequency ratio is an important observational property of time.

It should be pointed out that, as a direct corollary of the definition of OR time, the frequency in time-frequency ratio invariance refers to the observed frequency of the clock, not the observed frequencies of other periodic phenomena; the invariance of time-frequency ratio is a relativistic effect on the observed time, rather than the Doppler effects of other periodic phenomena.

The theory of Inertial OR (IOR) was born in 2017 [41]. In fact, the invariance of time-frequency ratio in the case of the optical agent OA(c) had already been established in Einstein's special theory of relativity and the classical theory of quantum.

For the detailed proof and related statements of the invariance of time-frequency ratio, please refer to Sec. 2.3.2 of Chapter 2 of the 1st volume IOR in the Monograph of Observational Relativity [1,4].

3.2.4 The Deduction of the Theorem of IIWSs

Based on the invariance of time-frequency ratio, the spacetime transformation relation of the general observation agent OA(η), that is, the general Lorentz transformation, can be deduced. What the logical deduction first leads to is the Theorem of the Invariance of Information-Wave Speeds (IIWSs).

For different inertial observers or observation systems O and O' of the general observation agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$), we need to consider the spacetime transformations of two directions: the $O'\Rightarrow O$ and the $O\Rightarrow O'$.

Firstly, we deduce the $O'\Rightarrow O$.

Actually, the $O'\Rightarrow O$ refers to the issue of how the observer O observes the motion of the object P through the observer O', where the motion speed of P relative to O' is u', and the motion speed of O' relative to O is v.

As depicted in Fig. 1(b), the $O'\Rightarrow O$ needs to be divided into two spans of time:

(1) The First is $O_o\to O'$: to transform the information on P from the proper spacetime O_o of P to O';

(2) The Second is $O'\to O$: to transform the information on P from O' to O.

The First Span of Time: $O_o\to O'$ (Fig. 1(b1))

The observed object P at rest in O_o moves at the speed u' relative to O', and the spacetime information of P is transmitted from P to O'.

Considering the effect of speed addition, the speed η_α of the information wave that transmits the spacetime information of P should be the intrinsic speed η of the information wave of the observation agent OA(η) plus the observed speed u' of P in O': $\eta_\alpha(u')=\eta\oplus u'$. During the observed time-element $\mathrm{d}t'$ of O', P moves a distance of $\delta x'=u'\mathrm{d}t'$ along the X' axis. Therefore, as depicted in Fig. 1(a), as the information on time is transmitted from P to O', the final phase (2π) of the proper time-element $\mathrm{d}t$ takes a little more or less time $\delta\mathrm{d}t'$ than the initial phase (0):

$$\delta\mathrm{d}t'=\frac{\delta x'}{\eta_\alpha(u')}=\frac{u'\mathrm{d}t'}{\eta_\alpha(u')}\quad\left(\eta_\alpha(u')=\eta\oplus u'\right)\tag{16}$$

where $\oplus$ represents the law of wave-like speed-addition.

The Second Span of Time: $O'\to O$ (Fig. 1(b2))

The observer O' at rest in its coordinate system O', movs at the speed v relative to O. Thus, according to the invariance of time-frequency ratio (Eq. (15)) derived from the definition of OR time, it should hold valid for the second time span that

$$\mathrm{d}t=\frac{f(\eta,v)}{f_o}\mathrm{d}t'\quad(\mathrm{d}t'=\mathrm{d}\tau)\tag{17}$$

where $f(\eta,v)$ is the frequency of O' observed by O, depending on the information-wave speed η of the observation agent OA(η) and the motion speed v of O' relative to O, and f_o is the intrinsic frequency or reference frequency of the standard clock.

During this time span, O' is the observed object of O, and the spacetime information of O' is transmitted to O. Considering the effect of speed addition, the speed η_α of the information wave that transmits the spacetime information of O' should be the intrinsic speed η of the information wave of the observation agent OA(η) plus the speed v of O' in O: $\eta_\alpha(v)=\eta\oplus v$. According to Eq. (17), from the view of O', the observed time difference $\delta\mathrm{d}t'$ (Eq. (16)) of O' should be $(f(\eta,v)/f_o)\delta\mathrm{d}t'$. During this period, O' moves a distance of $\delta x=v(f(\eta,v))/f_o)\delta\mathrm{d}t'$ along the X axis. Therefore, the time difference $\delta\mathrm{d}t'$ in O' is transformed into the time difference $\delta\mathrm{d}t$ in O:

$$\delta\mathrm{d}t=\frac{\delta x}{\eta_\alpha(v)}=v\frac{f(\eta,v)}{f_o}\frac{\delta\mathrm{d}t'}{\eta_\alpha(v)}\quad\left(\eta_\alpha(v)=\eta\oplus v\right)\tag{18}$$

Thus, according to Eq. (17), as well as Eq. (14) and Eq. (16), the observed time-element $\mathrm{d}t$ of O should be

$$\begin{aligned}\mathrm{d}t&=\frac{f(\eta,v)}{f_o}\mathrm{d}t'+\delta\mathrm{d}t\\&=\Gamma(\eta,v)\left\{\mathrm{d}t'+\frac{v\mathrm{d}x'}{\eta_\alpha(u')\eta_\alpha(v)}\right\}\\&\qquad(\mathrm{d}x'=u'\mathrm{d}t',\ \Gamma(\eta,v)=f(\eta,v)/f_o)\end{aligned}\tag{19}$$

Secondly, we deduce the $O\Rightarrow O'$.

Actually, the $O\Rightarrow O'$ refers to the issue of how the observer O' observes the motion of the object P through the observer O, where the motion speed of P relative to O is u, and the motion speed of O relative to O' is $-v$.

Naturally, following the same logic as deducing the spacetime transformation of the $O'\Rightarrow O$, and also dividing it into two spans of time:

(1) The First is $O_o\to O$: to transform the information on P from the proper spacetime O_o of P to O;

(2) The Second is $O\to O'$: to transform the information on P from O to O'.

then we can deduce that

$$\begin{aligned}\mathrm{d}t'&=\Gamma(\eta,v)\left\{\mathrm{d}t-\frac{v\mathrm{d}x}{\eta_\alpha(u)\eta_\alpha(v)}\right\}\\&\qquad(\mathrm{d}x=u\mathrm{d}t,\ \eta_\alpha(u)=\eta\oplus u)\end{aligned}\tag{20}$$

Now, based on the wave-particle duality conditions in the axiom system of OR, combined with Eq. (19) and Eq. (20), one can prove the invariance of information-wave speeds. For the detailed deduction and proof, please refer to Sec. 3.1 and Sec. 3.2.1 of Chapter 3 of the 1st volume IOR in the Monograph of Observational Relativity [1,4].

Here, for simplicity and to verify the validity of the logical deduction, the wave-particle duality conditions are substituted by Galileo's principle of relativity. Following such a different logical path, one also can prove the invariance of information-wave speeds.

According to the principle of relativity, by comparing Eq. (19) with Eq. (20), one can see that

$$\eta_\alpha(u) = \eta_\alpha(u') \quad \text{or} \quad \eta \oplus u = \eta \oplus u' \tag{21}$$

in which the arbitrariness of u and u' implies that there exists a constant η_o, and for any speeds, including v, u and u', it holds that $\eta_\alpha(u)=\eta_\alpha(u')=\eta_\alpha(v)=\eta_o$, or

$$\forall v \ \ \eta_\alpha(v) = \eta \oplus v = \eta_o \tag{22}$$

Naturally, if the speed $v=0$, then

$$\eta = \eta_\alpha(0) = \eta \oplus 0 = \eta_o \tag{23}$$

It is thus clear that this constant η_o is exactly the intrinsic speed η of the information wave of the observation agent OA(η). In other words, the information-wave speed η of OA(η) is observationally invariant relative to OA(η): η is the same or invariant for any inertial observer or reference system (whether O or O').

Thus, the theory of OR has had an important theorem:

Theorem of the Invariance of Information-Wave Speeds (TIIWs) [1-4]: From the perspective of an observer adopting an observation agent OA(η), the speed η of the information wave of OA(η) is observationally invariant, that is, $\forall v \ \eta\oplus v=\eta$.

3.3 Can the Doctrine of Big Bang Hold up without the Invariance of Light Speed?

The invariance of information-wave speeds has revealed the essence of the invariance of light speed.

Unlike Einstein's principle of the invariance of light speed, the invariance of information-wave speeds is not a hypothesis but a theorem in the theory of OR. It is a logical consequence of the OR axiom system and has the following direct corollaries.

Corollary 3.1 The Ultimate Speed of the Universe: There is no invariant and unsurpassable ultimate speed in the universe; the so-called ultimate speed Λ_U of the universe is actually just the speed η of the information wave of a certain observation agent OA(η).

Corollary 3.2 The Observational Limit: If an observer O observes the motion of matter with an observation agent OA(η), then the speed η of the information wave of OA(η) is the observationally limit of O, which is observationally invariant and unsurpassable for O.

Corollary 3.3 The Invariance of Light Speed: The invariance of light speed is only a special case of the invariance of information-wave speeds, which holds true if and only if light or electromagnetic interaction $M(c)$ serves as the observation medium $M(\eta)$, or the optical agent OA(c) serves as the observation agent OA(η).

Thus, the invariance of light speed is no longer a principle or hypothesis, but rather a corollary and special case of the theorem of the invariance of information-wave speeds in the theory of OR.

So, the speed of light is not really invariant!

In fact, both Einstein's invariance of light speed and the invariance of information-wave speeds in the theory of OR are only a kind of observational effect and apparent phenomenon caused by the observational locality ($\eta<\infty$) of the observation agent OA(η), rather than the objective and inherent property of matter motion.

The theory of OR has clarified that [5] the theorem of the invariance of information-wave speeds in theory the of OR is not only a product of logic and theory, but also has empirical evidences, supported by observations and experiments.

Einstein's principle of the invariance of light speed was originally just a hypothesis, stemmed from the Michelson-Morley experiment [42]. Actually, however, the Michelson-Morley experiment is not a support for Einstein's hypothesis of the invariance of light speed, but rather a support for the theorem of the invariance of information-wave speeds in the theory of OR.

Indeed, in the Michelson-Morley experiment, the speed of light exhibited an invariant phenomenon: the speed of light plus the earth's orbital speed around the sun seemed still to be the speed of light. However, that was merely a phenomenon. In the Michelson-Morley experiment, light served as not only the observed object of Michelson and Morley, but also the medium that transmitted the observed information to Michelson and Morley. So, the observation agent OA(η) adopted by Michelson and Morley is exactly the optical agent OA(c) ($\eta=c$), the information wave of OA(c) is light, and the information-wave speed of OA(c) is the speed of light c. Naturally, in the Michelson-Morley experiment, the speed of light exhibited a sort of observational invariance.

So, in the Michelson-Morley experiment, the invariance of light speed is only a phenomenon, but the invariance of information-wave speeds is the essence.

Cosmologists and designers of the Big Bang model fail to recognize that the speed of light is not really invariant. They fail to realize that Einstein's theory of relativity, including the special and the general, is only a partial theory, an optical-observation theory, not representing the objective and real physical world. The principle of the invariance of light speed is the only indispensable logical premise for Einstein theory of relativity, including the special and the general. Now, without the principle of the invariance of light speed, Einstein's theory of relativity, including the special and the general, no longer holds true.

Thus, the Big Bang model based on Einstein's theory of relativity, including the FLRW metric (Eqs. (1-2)) and Friedmann equations (Eqs. (3-5)) based on the 4d coordinate framework of Minkowski spacetime and the principle of the invariance of light speed, no longer holds true.

So, the doctrine of Big Bang is merely an illusion, a mirage constructed upon optical images.

4 Spacetime is not Really Curved

Common sense and reason tell us that space and time are independent of each other: time flows quietly, unrelated to space; space exists eternally, unrelated to time. However, Einstein told us that time is also space and space is also time. Thus, we have the concept of spacetime.

In particular, Einstein told us that spacetime could be curved: matter determined how spacetime was curved; the curved spacetime determined how matter moves.

As clarified in Sec. 2, Einstein's theory of relativity is the most important theoretical basis for the Big Bang theory. In particular, Sec. 2.3.1 has clarified that the doctrine of spacetime curvature plays the crucial role in the Big Bang theory.

Now, according to theorem of the invariance of information-wave speeds in the theory of OR, we have come to understand that the speed of light is not really invariant. Without the principle of the invariance of light speed, Einstein's theory of relativity, including the special and the general, cannot hold true.

Without Einstein's theory of general relativity, can the doctrine of spacetime curvature still hold true? If spacetime is not really curved, or in other words, if Einstein's doctrine of spacetime curvature is not valid, then can the Big Bang theory still hold true?

This section continues examining the theoretical basis of the Big Bang model, and by focusing on the issue of spacetime curvature, continues examining the logical rationality and theoretical validity of the Big Bang theory.

4.1 Observation Agents and the Doctrine of Spacetime Curvature

To a large extent, it was the doctrine of spacetime curvature derived from Einstein's theory of general relativity that gave rise to the Big Bang theory. Now, from the perspective of the general observation agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$), the theory of OR has revealed the essence of Einstein's spacetime curvature.

The general observation agent OA(η) of the theory of OR has generalized and unified Newton's idealized agent OA_∞ and Einstein's optical agent OA(c), and as a 4d spacetime coordinate framework as defined in Eq. (12), has generalized and unified the coordinate system of Cartesian spacetime and the coordinate system of Minkowski spacetime.

If $\eta\to c$, then the general observation agent OA(η) (Eq. (12)) converges to the optical agent OA(c), and the 4d spacetime $X^{4\mathrm{d}}(\eta)$ observed with OA(η) converges to the Minkowski spacetime $X^{4\mathrm{d}}(c)$ [1-4]:

$$\lim_{\eta\to c}\mathrm{OA}(\eta)=\mathrm{OA}(c) =\begin{Bmatrix} X^{4\mathrm{d}}(c):\begin{Bmatrix} x^0=ct \\ x^1=x, x^2=y, x^3=z \end{Bmatrix} \\ \mathrm{d}s^2=g_{\mu\nu}(c,x^\alpha)\mathrm{d}x^\mu\mathrm{d}x^\nu \end{Bmatrix} \tag{24}$$

In Einstein's theory of special relativity, the metric $g_{\mu\nu}$ of the 4d spacetime $X^{4\mathrm{d}}(c)$ observed with the optical agent OA(c) is constant, that is, the Minkowski metric $\eta_{\mu\nu}=\mathrm{diag}(+1,-1,-1,-1)$. So, the inertial spacetime in Einstein's theory of special relativity is flat and not curved.

In Einstein's theory of general relativity, the metric $g_{\mu\nu}=g_{\mu\nu}(c,x^\alpha)$ of the 4d spacetime $X^{4\mathrm{d}}(c)$ observed with the optical agent OA(c) depends on the spacetime coordinates x^α (α=0,1,2,3) and the speed c of the information wave of OA(c), and is not constant. So, the gravitational spacetime in Einstein's theory of general relativity is curved and not flat.

The theory of OR has clarified that [1-4] spacetime is not really curved. The curvature of gravitational spacetime in Einstein's theory of general relativity is not the objective physical reality, but rather an observational effect and apparent phenomenon, caused by the observational locality ($c<\infty$) of the optical agent OA(c), akin to the wide-angle lens effect of an optical camera, making spacetime appear somewhat curved and distorted.

According to the theory of OR, the 4d observed spacetime $X^{4\mathrm{d}}(\eta)$ of the general observation agent OA(η) has a spacetime metric $g_{\mu\nu}=g_{\mu\nu}(\eta,x^\alpha)$, which essentially depends on the speed η of the information wave of OA(η), rather than the spacetime coordinates x^α (α=0, 1,2,3). So, the curvature of spacetime depends on the observation agent OA(η): from the perspective of different observation agents, gravitational spacetime must exhibit varying degrees of curvature; the higher the speed η of the information wave of OA(η), the smaller the curvature of gravitational spacetime, and the flatter the spacetime must be. It is thus clear that the so-called spacetime curvature is not the objective physical reality.

In particular, if $\eta\to\infty$, then the general observation agent OA(η) (Eq. (12)) converges to Newton's idealized agent OA_∞, and the 4d spacetime $X^{4\mathrm{d}}(\eta)$ observed with OA(η) converges to the Cartesian spacetime $X^{4\mathrm{d}}(\infty)$ [1-4]:

$$\lim_{\eta\to\infty}\mathrm{OA}(\eta)=\mathrm{OA}_\infty =\begin{Bmatrix} X^{4\mathrm{d}}(\infty):\begin{Bmatrix} x^0=\eta t\ \ (\eta\to\infty) \\ x^1=x, x^2=y, x^3=z \end{Bmatrix} \\ \begin{cases} \mathrm{d}t=\mathrm{d}\tau \\ \mathrm{d}l^2=\mathrm{d}l^2+\mathrm{d}l^2+\mathrm{d}l^2 \end{cases} \end{Bmatrix} \tag{25}$$

where $\mathrm{d}\tau$ is the objectively real time (proper time), dt the observed 1d time, and dl the observed 3d space; OA_∞ is the idealized agent, the speed η of the information wave of OA_∞ is idealized as infinity, with no observational locality, representing the objective and real physical world.

As shown in Eq. (25), as $\eta\to\infty$, the line-element ds of the 4d spacetime $X^{4\mathrm{d}}(\eta)$ observed with the general observation agent OA(η) splits into mutually independent 1d time element dt and 3d space element dl.

This suggests that, in the objective and real physical world, space and time are indeed independent of each other, and the so-called spacetime is exactly the 3d space and 1d time described by Descartes for us, which can be called the Cartesian spacetime: the observed time dt is exactly the objective and real time $\mathrm{d}\tau$; the observed space strictly follows the Pythagorean theorem.

It is thus clear that the Cartesian spacetime or the Cartesian coordinate framework for space and time is a product of the idealized agent OA_∞, representing the objective and real spacetime.

So, the theorem of Cartesian spacetime, an important theorem in theory of OR, is derived.

4.2 The Theorem of Cartesian spacetime

Since the Cartesian spacetime $X^{4\mathrm{d}}{}_\infty=X^{4\mathrm{d}}(\infty)$ is flat, its spacetime metric $g_{\mu\nu}$ should be constant, which can be expressed as a theorem, that is, the theorem of Cartesian spacetime.

The theorem of Cartesian spacetime requires proof: 1. the objective and real spacetime X^{4d}_∞ is the flat Cartesian spacetime; 2. the metric $g_{\mu\nu}$ of Cartesian spacetime is exactly the Minkowski metric $\eta_{\mu\nu}$=diag(+1,–1,–1,–1).

4.2.1 Lemmas

The theorem of Cartesian spacetime consists of the following several lemmas.

Lemma A: Let OA(η) be the general observation agent, and η be the information-wave speed of OA(η); if $\eta\to\infty$, then the observed time (coordinate time) dt at any coordinate point of the 4d spacetime $X^{4d}(\eta)$ observed with OA(η) is the standard time dτ, that is, dt=dτ.

Lemma A is consistent with Eq. (25).

According to Lemma A, if $\eta\to\infty$, that is, in the Cartesian spacetime X^{4d}_∞ observed with the idealized agent OA$_\infty$, the time dt observed by an observer O must be the standard time (proper time) dτ. This suggests that, in the Cartesian spacetime X^{4d}_∞, time does not depend on space, or in other words, in the objective and real spacetime, space and time are independent of each other.

Then, a corollary can be derived from Lemma A.

Corollary A: If $\eta\to\infty$, then the 0i and i0 elements of the metric $g_{\mu\nu}$ in the Cartesian spacetime X^{4d}_∞ are zero, that is, $g_{0i}=g_{i0}=0$ (i=1,2,3).

Corollary A is of great significance:

(1) In the objective and real physical world, space and time are originally orthogonal: time is merely time; space is merely space.

(2) $\gamma_i=g_{0i}/\sqrt{(g_{00})}=0$ (i=1,2,3), and so, in the objective and real physical world, there is no the so-called gravitational vector potential.

However, it is worth noting that, in Corollary A of Lemma A, $\gamma_i=0$ (i=1,2,3) requires $\eta\to\infty$. This implies that, if the observation agent OA(η) has the observational locality ($\eta<\infty$), the gravitational vector potential γ_i (i=1,2,3), as a purely observational effect, may manifest in the observation of OA(η).

Lemma B: If $\eta\to\infty$, then the 00 element in the metric $g_{\mu\nu}$ of the spacetime $X^{4d}(\eta)$ observed with OA(η) is equal to 1, that is, $g_{00}=\eta_{00}=1$.

Lemma C: If $\eta\to\infty$, then the ii elements in the metric $g_{\mu\nu}$ of the spacetime $X^{4d}(\eta)$ observed with OA(η) are equal to –1, that is, $g_{ii}=\eta_{ii}=-1$ (i=1,2,3).

Lemma D: If $\eta\to\infty$, then the ik elements in the metric $g_{\mu\nu}$ of the spacetime $X^{4d}(\eta)$ observed with OA(η) are equal to zero, that is, $g_{ik}=\eta_{ik}=0$ (i,k=1,2,3; $i\neq k$).

The theoretical derivation is omitted here. For the proofs of the lemmas, please refer to Sec. 13.2.2 of Chapter 13 in the 2nd volume GOR of the Monograph of Observational Relativity [1,4].

4.2.2 The Theorem

The theorem of Cartesian spacetime can be proven based on lemmas A-D in Sec. 4.2.1.

The theorem of Cartesian spacetime: Let OA(η) be the general observation agent, $g_{\mu\nu}=g_{\mu\nu}(\eta,x^\alpha)$ the metric of the spacetime $X^{4d}(\eta)$ observed with OA(η), and η the information-wave speed of OA(η), then if $\eta\to\infty$, the $g_{\mu\nu}\to\eta_{\mu\nu}$=diag(+1,–1,–1,–1), that is, the Cartesian coordinate form of Minkowski metric.

Proof:

According to Lemma A and its corollary A, as well as Lemmas B-D, in the Cartesian spacetime X^{4d}_∞ observed with the idealized observer OA$_\infty$ ($\eta\to\infty$), one can conclude that

(1) The observed time dt is exactly the standard time (proper time) dτ: dt=dτ.

(2) The space and time of X^{4d}_∞ are orthogonal to each other: $g_{0i}=g_{i0}=0$ (i=1,2,3).

(3) The 00 element of the $g_{\mu\nu}$ of X^{4d}_∞ is exactly the 00 element of the Minkowski metric: $g_{00}=\eta_{00}=+1$.

(4) The ii elements of the $g_{\mu\nu}$ of X^{4d}_∞ are exactly the ii elements of the Minkowski metric: $g_{ii}=\eta_{ii}=-1$ (i=1,2,3).

(5) The ik elements of the $g_{\mu\nu}$ of X^{4d}_∞ are exactly the ik elements of the Minkowski metric: $g_{ik}=\eta_{ik}=0$ (i,k=1,2,3; $i\neq k$).

To summarize, the theorem of Cartesian spacetime holds: If $\eta\to\infty$, then $g_{\mu\nu}\to\eta_{\mu\nu}$=diag(+1,–1,–1,–1).

(End of proof)

So, according to the theorem of Cartesian spacetime, the objective and real spacetime, i.e., the Cartesian spacetime X^{4d}_∞ observed with OA$_\infty$, is flat and not curved.

4.3 Can the Doctrine of Big Bang Hold up without the Doctrine of Spacetime Curvature?

The theorem of Cartesian spacetime has revealed the essence of Einstein's spacetime curvature.

The theorem of Cartesian spacetime makes the picture of Cartesian spacetime depicted in Sec. 4.1 clearer. In fact, the theorem of Cartesian spacetime is consistent with the situation in Eq. (25).

As $\eta\to\infty$, the general observation agent OA(η) (Eq. (12)) becomes the idealized agent OA$_\infty$ (Eq. (25), and the observed spacetime $X^{4d}(\eta)$ becomes the Cartesian spacetime X^{4d}_∞. According to the theorem of Cartesian spacetime, the Cartesian spacetime X^{4d}_∞ is flat, and its metric is the Minkowski metric $\eta_{\mu\nu}$=diag(+1,–1,–1,–1).

The metric $g_{\mu\nu}(\eta)$ of the spacetime $X^{4d}(\eta)$ observed with the general observation agent OA(η) depends on the information-wave speed η of OA(η): $g_{\mu\nu}=g_{\mu\nu}(\eta)$, which can be decomposed into the flat metric (Minkowski metric) $\eta_{\mu\nu}$ and a curved metric $h_{\mu\nu}(\eta)$:

$$g_{\mu\nu}(\eta)=\eta_{\mu\nu}+h_{\mu\nu}(\eta)\quad\left(\lim_{\eta\to\infty}h_{\mu\nu}(\eta)=0\right)\qquad(26)$$

where the Minkowski metric $\eta_{\mu\nu}$ (flat metric) is constant that does not depend on observation or observation agents, while the curved metric $\eta_{\mu\nu}$ depends on the speed η of the information wave of OA(η): $h_{\mu\nu}=h_{\mu\nu}(\eta)$.

This suggests that the so-called spacetime curvature is an observational effect and apparent phenomenon caused by the observational locality $\eta<\infty$) of the observation agent OA(η), rather than the objective physical reality and real physical existence.

Thus, without the doctrine of spacetime curvature, the Big Bang model based on the doctrine of spacetime curvature no longer holds up.

Of course, without Einstein's theory of relativity, without the principle of the invariance of light speed and the doctrine of spacetime curvature, the universe still might have a big bang. Because we still have Newton's theory of universal gravitation, which is closer to the objective truth and more in line with the objective physical reality.

Theoretically, based on Newton's theory of universal gravitation, matter also might gradually accumulate and gather together, so that the density and temperature of matter in certain parts of the universe might be higher and higher, and ultimately lead to nuclear explosions.

However, a Big Bang in the universe does not necessarily require the participation of all matter in the universe. Perhaps, all matter in the Milky Way also might gather together to lead to a Big Bang. But that does not mean the birth of a new universe. Even if all matter in the universe participates in a Big Bang, it can only be an event that occurred in the evolutionary history of the universe, and does not mean that a new universe has been born, nor does it mean that there is a new beginning for the space and time of the universe.

It is worth noting that, according to the theorem of Cartesian spacetime (or Corollary A of Lemma A), the $0i$ and $i0$ elements of the metric $g_{\mu\nu}$ of Cartesian spacetime $X^{4d}{}_{\infty}$ are zero: $g_{0i}=g_{i0}=0$ (i=1,2,3). This suggests that space and time in the Cartesian spacetime are orthogonal to each other. In other words, space and time in the objective and real physical world are independent of each other. In fact, the universe only has independent time and independent space, and has no such a thing as spacetime.

Without spacetime, how can we talk about spacetime curvature? This question deserves serious consideration by cosmologists and designers of the Big Bang model.

Another question that deserves serious consideration by cosmologists and designers of the Big Bang model is: Since space and time are independent of each other, since the objective and real spacetime is flat and not curved, how can the universe expand?

5 The Universe is not Really Expanding

Common sense and rationality tell us that the space and time of the universe are independent of matter, or in other words, independent of the distribution of the mass or energy of matter.

Regardless of whether matter is in motion or not, and regardless of whether there are interactions between matter and matter, the time of the universe keeps flowing quietly and uniformly; the space of the universe keeps existing quietly and eternally.

However, Hubble told us the universe was expanding.

Actually, both Hubble's cosmic expansion and Einstein's spacetime curvature are vague concepts, leaving ample room for different interpretations. Is Hubble's universe equivalent to Einstein's spacetime? Is Hubble's cosmic expansion the expansion of the distribution range of matter or the expansion of cosmic space?

Regardless of the original ideas of Einstein and Hubble, in the view of the modern cosmologists and designers of the Big Bang model, Hubble's law suggests that the spacetime of the universe is expanding with the expansion of the distribution range of matter.

Since the universe is expanding, it must be finite. Based on abductive reasoning in time, cosmologists believed that the universe must have originated from a spacetime point, that is, the singularity of the universe or Big Bang. In this way, both the space and time of the universe have their respective starting points.

Sections 2.4 and 2.5 have clarified that Hubble's Law, or Hubble's doctrine of cosmic expansion, is the most crucial empirical basis for the Big Bang theory. Without Hubble's doctrine of cosmic expansion, all the empirical evidences, including the radiation of CMB and the abundance of light elements, must lose their substantial significance as the evidences for the Big Bang theory. If Hubble's doctrine of cosmic expansion is invalid, or in other words, if the universe is not really expanding, then can the Big Bang theory still hold true?

This section, focusing on Hubble's doctrine of cosmic expansion, examines the empirical basis of the Big Bang model and the validity of the Big Bang theory.

5.1 Hubble's Law: On Hubble's Doctrine of Cosmic Expansion

Cosmological redshift plays the most crucial role among the empirical evidences listed for the Big Bang theory. Like all the so-called empirical evidences supporting the Big Bang theory, cosmological redshift may originally have infinitely many possible interpretations or answers, and is not the evidence materials specifically prepared for the Big Bang model.

However, after being interpreted by Hubble's law or doctrine of cosmic expansion, cosmological redshift becomes the most crucial empirical basis and pillar of the Big Bang theory.

Astronomical observations indicate that the spectra of all galaxies observed by the observers on the earth exhibits a redshift phenomenon, and that the farther a galaxy is from the earth, the more notable the redshift of its spectrum becomes. Alternatively, the relative redshift Z of the spectrum of a galaxy is proportional to the co-moving distance D of the galaxy:

$$\begin{cases} Z=\dfrac{\Delta f}{f}=\dfrac{f_o-f_e}{f_o}=1-\dfrac{f_e}{f_o} \\ |Z|=R_{ED}D \end{cases} \tag{27}$$

where f_e and f_o are the emitted and observed frequencies of starlight respectively, and R_{ED} is the coefficient of redshift or frequency attenuation.

Hubble supposed that the cosmological redshift is akin to the Doppler effect, resulting from the recession of galaxies relative to the earth. Let v_r be the recession speed of a galaxy, then, according to the Fizeau-Doppler formula, it holds true that

$$Z = 1 - \frac{f_e}{f_o} = 1 - \sqrt{\frac{1 + v_r/c}{1 - v_r/c}} \approx -\frac{v_r}{c} \qquad (28)$$

where the minus sign "–" represents the redshift of spectra, otherwise, the blueshift of spectra.

It should be pointed out that the observation agent for Eqs. (27-28) of the spectral redshift of galaxies is the optical agent OA(c), and the starlight is both the observed object and the information wave of OA(c).

Thus, Hubble's Law was born [13]:

$$v_r = H_0 D \quad (v_r = -cZ;\ H_0 = cR_{ED}) \qquad (29)$$

where H_0 is the Hubble constant. It is generally believed that the Hubble H_0, the recession speed v_r, and the co-moving distance D vary with the expansion of the universe; $H_0=70.4^{+1.3}_{-1.4}$ km/s/Mpc is the current Hubble constant.

Hubble's Law: Based on Eq. (29), Hubble concluded that all celestial bodies or galaxies in the universe are rapidly receding relative to the earth, and the farther a celestial body or galaxy is from the earth, the faster it is receding.

Hubble's Doctrine of Cosmic Expansion: Based on his law of recession, Hubble inferred that the universe is expanding, just as the scene after a Big Bang.

Hubble Distance: According to Hubble's Law, there must exist a distance D_H, known as the Hubble distance, beyond which the recession speed v_r of galaxies reaches the speed of light c, so that, the observers on the earth cannot observe those galaxies beyond the Hubble distance D_H.

The Hubble distance D_H can be calculated with Hubble's Law (Eq. (29)):

$$D_H = \frac{c}{H_0} \approx 4.26^{+0.09}_{-0.08} \times 10^3 \text{Mpc} \quad (v_r = c) \qquad (30)$$

As stated previously, Hubble's Law, that is, Hubble's doctrine of cosmic expansion, serves as the most crucial empirical basis for the Big Bang theory and is the indispensable pillar of the Big Bang model. Without Hubble's doctrine of cosmic expansion, all the other empirical evidences for the Big Bang theory will lose their substantial significance.

In fact, the phenomenon of cosmological redshift does not suggest that the universe is expanding.

5.2 Spacetime is Independent of Matter and does not Expand

Common sense and reason tell us that the universe or the objectively real spacetime does not expand.

In the theory of OR, the theorem of Cartesian spacetime has clarified that [1-4], in the objective physical world, space and time are independent of each other: space is merely space, unrelated to time; time is merely time, unrelated to space. The objective world has no the so-called spacetime, let alone curved spacetime.

In fact, the curvature of spacetime is quite puzzling. Perhaps you can envision the curvature of space, but you cannot envision the curvature of time.

Now. the theorem of Cartesian spacetime needs a supplementary lemma.

Lemma E: Let OA(η) be the general observation agent, and η be the information-wave speed of OA(η); if $\eta\to\infty$, then the GOR relativistic factor $\varGamma(\eta,v,\chi)$ of OA(η) converges to the Galilean factor $\varGamma_\infty\equiv1$:

$$\begin{aligned}\varGamma_\infty &= \lim_{\eta\to\infty} \varGamma(\eta, v, \chi) \\ &= \lim_{\eta\to\infty} \frac{1}{\sqrt{1 - v^2/\eta^2 + 2\chi/\eta^2}} = 1\end{aligned} \qquad (31)$$

The proof Lemma E is already included in Eq. (31).

For details on the GOR relativistic factor, please refer to Sec. 12.4.2 of Chapter 12 in the 2nd volume GOR of the Monograph of Observational Relativity [1,4]. According to the theorem of Cartesian spacetime, there is no gravitational vector potential in the objective and real gravitational spacetime: $\gamma_i=0$ (i=1,2,3).

For simplicity, the GOR relativistic factor $\varGamma(\eta,v,\chi)$ in Eq. (31) does not involved the vector potential $\gamma_i=0$.

Lemma E suggests that, in the objective and real physical world, the so-called Cartesian spacetime, not only is space and time independent of each other, but also both space and time are independent of matter, independent of the mass and energy of matter, independent of the motion and interaction of matter.

In this way, the theory of OR further clarifies that, in the objective and real physical world, both space and time cannot be curved, contracted or expanded.

In Einstein's theory of general relativity, time (dt) and space (dl) are influenced by the relativistic factor $\gamma(c,v,\chi)$, resulting in relativistic effects:

$$\begin{cases} \mathrm{d}t = \gamma(c, v, \chi)\mathrm{d}\tau \\ \mathrm{d}l = v\mathrm{d}t = v\gamma(c, v, \chi)\mathrm{d}\tau \end{cases} \quad \left(\gamma = 1\Big/\sqrt{1 - v^2/c^2 + 2\chi/c^2}\right) \qquad (32)$$

where the speed of light c is a constant.

Limited to the perspective of the optical agent OA(c), Einstein believed, and the mainstream physics community now also believes, that gravitational relativistic effects originated from the motion of matter (v) and gravitational interaction (χ), and are the intrinsic characteristics of the physical world; spacetime relies on matter, the motion and interaction of matter, and the distribution of the mass and energy of matter.

If χ=0, then the gravitational relativistic factor $\gamma(c,v,\chi)$ reduces to the special relativistic factor $\gamma(c,v)$, that is, the Lorentz factor $\gamma=1/\sqrt{(1-v^2/c^2)}$.

Einstein seemed somewhat contradictory: in his theory of special relativity, he adopted time dt, and advocated time dilation and length contraction; in his theory of general relativity, he adopted time dτ, referred to it as the standard time, and dt as the coordinate time that need transforming into the standard time.

In the theory of GOR, the time dt and the space dl observed with the general observation agent OA(η) are also influenced by the GOR relativistic factor $\varGamma(\eta,v,\chi)$, exhibiting gravitational relativistic effects:

$$\begin{cases} \mathrm{d}t = \Gamma(\eta, v, \chi)\mathrm{d}\tau \\ \mathrm{d}l = v\mathrm{d}t = v\Gamma(\eta, v, \chi)\mathrm{d}\tau \end{cases} \quad \left(\Gamma = 1 \Big/ \sqrt{1 - v^2/\eta^2 + 2\chi/\eta^2}\right) \tag{33}$$

However, from the broad perspective of the general observer agent OA(η) ($0<\eta<\infty; \eta\to\infty$), the theory of OR has discovered that [1-4] the relativistic effects of the observed time (dt) and space (dl) caused by the GOR relativistic factor $\Gamma(\eta,v,\chi)$, in essence, depend on the speed of the information wave of OA(η), rather than on the motion (v) and gravitational interaction (χ) of matter.

This suggests that all the relativistic effects presented by OA(η) including OA(c) ($\eta=c$) are observational effects and apparent phenomena caused by the observational locality ($\eta<\infty$) of the observation agent OA(η).

If $\eta\to\infty$, then OA(η) becomes the idealized agent OA_∞, the observed time $\mathrm{d}t=\mathrm{d}t_\infty$ is the objective and real proper time (proper time) $\mathrm{d}\tau$, and the observed space $\mathrm{d}l=\mathrm{d}l_\infty$ is the objective and real proper space $v\mathrm{d}\tau$:

$$\begin{cases} \mathrm{d}t_\infty = \lim\limits_{\eta\to\infty} \mathrm{d}t = \lim\limits_{\eta\to\infty} \Gamma(\eta, v, \chi)\mathrm{d}\tau = \mathrm{d}\tau \\ \mathrm{d}l_\infty = \lim\limits_{\eta\to\infty} v\mathrm{d}t = \lim\limits_{\eta\to\infty} v\Gamma(\eta, v, \chi)\mathrm{d}\tau = v\mathrm{d}\tau \end{cases} \tag{34}$$

The idealized agent OA_∞ has no observational locality, representing the objective and real physical world. Lemma E of the theorem of Cartesian spacetime indicates that the objective and real physical world, that is, the Cartesian spacetime, has no relativistic effects, where time is the proper time and space is the proper space, independent of matter, independent of the motion of matter, and independent of the distribution of the mass and energy of matter.

So, the proper time and space can neither contract due to the concentration of matter nor expand due to the diffusion of matter.

According to the theorem of Cartesian spacetime, even if cosmological redshift is the Doppler effect of the spectra of distant galaxies, even if galaxies are indeed receding from the earth, and even if such a sort of recession originated from a Big Bang, it does not mean that the universe or its space is expanding, but merely mean that the distribution range of matter in the universe is expending, similar to the scene of a nuclear explosion on the earth.

Thus far, it could still be hypothesized that the cosmological redshift originates from a Big Bang, but it does not mean the expansion of the universe or cosmic space. Based on abductive reasoning in time, it could still be hypothesized that a huge amount of matter was once compressed together, but it does not mean the contraction of cosmic space, let alone that cosmic space and time were ever reset to zero. It could still be hypothesized that the huge amount of compressed matter ever triggered a Big Band, but it does not mean the birth of a new universe.

5.3 The Revelation from GOR Gravitational Redshift

More and more doubts seem to be pointing towards Cosmological redshift.

Since, according to the theorem of Cartesian spacetime in the theory of OR, cosmological redshift does not mean cosmic expansion, what does cosmic redshift mean? Is the spectral redshift of starlight really caused by the Doppler effect due to the recession of cosmic galaxies?

According to Hubble's doctrine of cosmic expansion, cosmological redshift is a manifestation of the recession of cosmic galaxies relative to the earth; the farther a galaxy is from the earth, the faster it recedes, even at the speed of light. Einstein believed that photons have no rest mass, and therefore, light could be travelling in space eternally.

This is contrary to human common sense and reason.

As stated earlier, cosmological redshift should be indubitable. However, according to the theorem of Cartesian spacetime, cosmological redshift does not represent the expansion of the universe, let alone the birth of a new universe at some moment in the past.

As the optical agent OA(c), starlight transmits the information on distant galaxies to earthlings. These galaxies are extremely far from the earth, and their starlight needs to travel for a long time and a long distance before reaching the earth. Human common sense and rationality tell us that the redshift of the starlight from distant galaxies in the universe is natural and inevitable.

5.3.1 The Redshift of Solar Spectrum

Albert Einstein, based on his theory of general relativity, made a theoretical prediction for the gravitational redshift of solar spectrum:

$$\begin{aligned} Z &= \frac{\Delta f}{f} = 1 - \frac{f_e}{f_o} = 1 - \frac{\sqrt{g_{00}(r_o)}}{\sqrt{g_{00}(r_e)}} \\ &\approx \frac{GM_{\mathrm{SUN}}}{c^2}\left(\frac{1}{D} - \frac{1}{R_{\mathrm{SUN}}}\right) \approx -2.12 \times 10^{-6} \end{aligned} \tag{35}$$

where G is the gravitational constant, M_{SUN} the mass of the sun, $r_e=R_{\mathrm{SUN}}$ the radius of the sun, $r_o=D$ is the distance between the sun and earth; g_{00} the 00 element of the spacetime metric $g_{\mu\nu}$.

It should be pointed out that the observation agent for the redshift formula (Eq. (35)) of solar spectral is the optical agent OA(c), where sunlight serves as both the object observed by earthlings and the information wave of OA(c).

The solar spectrum observed on the earth does exhibit a redshift. However, in the elliptical orbit around the sun, the earth sometimes moves towards the sun and sometimes away from the sun, and so, one cannot attribute the redshift of the solar spectrum to the sun's recession relative to the earth, let alone to the expansion of the universe.

The observed redshift of solar spectrum conforms to Einstein's theoretical prediction (Eq. (35)) within 5%. So, physicists believe in Einstein and attribute it to the gravitational effect on solar photons of the sun, that is, the so-called gravitational redshift. Physicists, including Einstein, are sometimes contradictory: there is no gravity in Einstein's general relativity, only curved spacetime; why do they call the redshift of solar spectrum gravitational redshift instead of curved redshift?

Actually, the solar spectrum observed on the earth not only contains redshifts but also blueshifts, which originate from three effects (not just gravity):

(1) Gravitational Effect: The gravitational fields of both the sun and the earth exert influence on solar light or photons. The gravitational field of the sun causes the redshift in the solar spectrum, while the gravitational field of the earth causes the blueshift in the solar spectrum.

(2) Doppler Effect: The earth moves in an elliptical orbit around the sun, and so, there is relative motion between the earth and the sun, which inevitably leads to the Doppler effect in the solar spectrum, with blueshifts while moving towards or redshifts while moving away.

(3) Interstellar-Medium Effect: The universe is not a vacuum, but the ocean of matter particles, and so, the motion of light or photons in universe must consumes energy, resulting in frequency attenuation and redshift.

Of course, the relative motion speed between the sun and the earth is slow and the distance is short, so that the gravitational redshift accounts for the main component in the solar spectrum observed on the earth.

5.3.2 The Gravitational-Redshift Theory of GOR

Actually, in the solar spectrum, no matter redshift or blueshift, no matter the gravitational, Doppler, or interstellar-medium effects, is all the manifestation of the attenuation of the kinetic energy of light or photons.

In other words, the essence of spectral redshift is the attenuation of the kinetic energy of light or photons.

According to the theory of OR, the frequency of light observed by different observation agents is different. In particular, in the case of the idealized agent OA$_\infty$, the frequency of light tends to infinity, making it impossible to define or calculate the spectral redshift based on frequencies f_e and f_o as in Eqs. (27-28) and (35).

Therefore, the theory of Gravitational OR (GOR) equivalently defines the spectral redshift observed with the general observation agent OA(η) ($c\leq\eta<\infty$; $\eta\to\infty$) as

$$Z(\eta)=\frac{\Delta K(\eta)}{K(\eta)}\quad(\eta\geq c)\tag{36}$$

where $Z(\eta)$ is the spectral redshift observed with OA(η), $K(\eta)$ and $\Delta K(\eta)$ are the kinetic energy and its increment of light or photons observed with OA(η), respectively.

In fact, the spectral redshift $Z=\Delta f/f$ (Eq. (27)) defined based on the frequency of light is a special case of the spectral redshift $Z=\Delta K/K$ (Eq. (36)) based on the kinetic energy of photons. In the case of the optical agent OA(c), the definition of spectral redshift $Z(\eta)$ in Eq. (36) is the same as that of spectral redshift $Z=Z(c)$ in Eq. (27):

$$Z=\frac{\Delta f}{f}=\frac{f_o-f_e}{f_o}=\frac{hf_o-hf_e}{hf_o}=\frac{\Delta K(c)}{K(c)}=Z(c)\tag{37}$$

where h is Planck constant.

It is based on the definition of spectral redshift with the kinetic energy of light or photons observed with the idealized agent OA$_\infty$, $Z_\infty=\Delta K_\infty/K_\infty$, the theory of GOR has derived the gravitational-redshift formula of light purely based on Newtonian mechanics [1-4]:

$$Z_\infty=\frac{\Delta K_\infty}{K_\infty}=\frac{2GMr_o}{r_oc^2+2GM}\left(\frac{1}{r_o}-\frac{1}{r_e}\right)\tag{38}$$

where r is the distance between the photon and the gravitational center, r_e and r_o are the emitted and observed positions of the photon, respectively.

According to Eq. (38), if mankind had the idealized agent OA$_\infty$, then the redshift of solar spectrum observed by him with OA$_\infty$ would be twice the redshift value observed with the optical agent OA(c):

$$\begin{aligned}Z_\infty&=\frac{2GM_{\text{SUN}}D}{Dc^2+2GM_{\text{SUN}}}\left(\frac{1}{D}-\frac{1}{R_{\text{SUN}}}\right)\\&\approx\frac{2GM_{\text{SUN}}}{c^2}\left(\frac{1}{D}-\frac{1}{R_{\text{SUN}}}\right)\approx-4.24\times10^{-6}\end{aligned}\tag{39}$$

where $c\gg\sqrt{GM_{\text{SUN}}/D}$.

Based on the definition $Z(\eta)=\Delta K(\eta)/K(\eta)$ (Eq. (36)) of spectral redshift, the theory of GOR has derived the gravitational-redshift formula of light observed with the general observation agent OA(η) ($c\leq\eta<\infty$; $\eta\to\infty$):

$$\begin{aligned}Z(\eta)&=\frac{\Delta K(\eta)}{K(\eta)}\\&=\frac{\left(g_{00}(r_o)\right)^{-1/2}-\left(g_{00}(r_e)\right)^{-1/2}}{K_{F\eta}/m_o\eta^2-\left(1-\left(g_{00}(r_o)\right)^{-1/2}\right)}\end{aligned}\tag{40}$$

where m_o is the rest mass of the photon [1-4,6], and $K_{F\eta}$ the kinetic energy of the photon in the free spacetime S_F observed with OA(η).

The gravitational-redshift theory GOR is that of the gravitational redshift of spectra observed with the general observation agent OA(η) ($0<\eta<\infty$; $\eta\to\infty$), which has generalized and unified Newton's redshift theory of light observed with the idealized agent OA$_\infty$ and Einstein's redshift theory of light observed with the optical agent OA(c): if $\eta\to c$, then the gravitational redshift Eq. (40) of GOR strictly converges to Einstein's gravitational redshift Eq. (35); if $\eta\to\infty$, then the gravitational redshift Eq. (40) of GOR strictly converges to Newton's gravitational redshift Eq. (38). This, from one aspect, confirms the logical consistency and theoretical validity of the gravitational redshift theory of GOR.

For the detailed statement on the gravitational redshift theory of GOR, please refer to Sec. 18.4 and Sec. 18.5 of Chapter 18 of the 2nd volume GOR in the Monograph of Observational Relativity [1-4,6].

5.3.3 The Revelation for Cosmological Redshift

The gravitational redshift theory of GOR defines the spectral redshift (Eq. (36)) based on the attenuation of the kinetic energy of light or photons. It is worth noting that such a definition is essential for deducing and calculating spectral redshift with Newton's classical mechanics.

However, this idea based on the principle of energy conservation is not only applicable to the idealized agent OA$_\infty$, but also to the general observation agent OA(η), including the optical agent OA(c); not only applicable to Newton's classical mechanics, but also the theory of relativity, including the theory of OR and Einstein's theory of relativity; not only applicable to the frequency redshift of light waves, but also the frequency attenuation of general matter waves; not only applicable to gravitational redshift, but also to the issue of the spectral redshift of distant galaxies, helping us to correctly understand the essence of cosmological redshift.

In Hubble's law, the spectral redshift (Eqs. (27-28)) is the manifestation of the frequency attenuation of light caused by the Doppler effect due to the recession of galaxies relative to the earth: the spectral wavelength $\lambda=c/f$ is stretched; whereas the spectral redshift (Eq. (36)) defined by the theory of GOR is the manifestation of the kinetic-energy attenuation of photons. In the gravitational-redshift theory of GOR, the attenuation $\Delta K(\eta)$ of the kinetic energy of a photon is equal to the increment $\Delta V(\eta)$ of the potential energy of the photon: $\Delta K(\eta)=-\Delta V(\eta)$, adhering to the principle of energy conservation.

In terms of the solar spectrum, a photon flying from the solar surface to the earth escapes the gravitational binding of the sun, resulting in an increase in its potential energy $\Delta V(c)=-\Delta K(c)=hf_e-hf_o>0$ ($f_o<f_e$), and a decrease in its kinetic energy $\Delta K(c)=hf_o-hf_e<0$. So, according to the spectral redshift (Eq. (36)) defined by the kinetic energy of photons, the solar spectrum observed on the earth must certainly exhibit a redshift phenomenon.

However, the attenuation or decay of the kinetic energy of solar photons is not solely due to gravity.

The gravitational-redshift theory of GOR sheds light on cosmological redshifts: like the spectra of the sun, the spectra of cosmic galaxies must also contain three effects of redshift or blueshift as stated in Sec. 5.3.1. Cosmologists need to understand and reinterpret the phenomenon of cosmological redshift based on the principle of energy conservation and the idea of the kinetic-energy attenuation of stellar photons.

Gravitational Effect: Similar to the light or photons emitted by the sun, the light or photons emitted by stars first need to break free from the gravitational field of the star; part of their kinetic energy must be transformed into potential energy, resulting in a redshift in the starlight spectrum, which is known as gravitational redshift.

Doppler Effect: The galaxies in the universe are not receding rapidly from the earth as Hubble imagined, let alone receding at the speed of light, however, any celestial body or galaxy cannot be stationary relative to the sun or the earth; so, the spectrum of its starlight must exhibit a frequency-shift phenomenon relative to the earth, either a redshift or a blueshift.

Interstellar-Medium Effect: The universe is not a vacuum, but filled with various matter particles, such as gravitons, neutrinos, electromagnetic particles, and etc.; so, starlight traveling in space, much like bullets fired from guns traveling in the earth's atmosphere, inevitably encounter the resistances of interstellar media that require consuming starlight energy, resulting in the spectral redshift of galaxies.

However, unlike the solar spectrum relative to the earth, the main component of the spectra of distant galaxies relative to the earth is not gravitational redshift; moreover, unlike the cosmic redshift interpreted by Hubble's law or doctrine of cosmic expansion, the main component of the spectra of distant galaxies relative to the earth is also not Doppler redshift.

Most of the galaxies in the universe are extremely far away from the earth, billions or even tens of billions of light-years away from the earth. Such vast distances inevitably require to consume the considerable energy of starlight or photons, which becomes the primary cause of the spectral redshift of galaxies. So, both the gravitational effect and Doppler effect are not the primary cause of the phenomenon of cosmological redshift. In cosmological redshift, that caused by the consumption of the kinetic energy of starlight or photons during the long journey in the vast universe becomes the main component of the spectral redshift of galaxies.

This seems to be consistent with the tired-light hypothesis proposed by Zwicky about 100 years [43].

5.4 The Law of Light Propagation: A New Interpretation for Cosmological Redshift

Inspired by the theory of OR and the gravitational redshift theory of GOR, to supersede Hubble's law and Hubble's doctrine of cosmic expansion, the author proposed the law and doctrine of light propagation for interpreting BP-15, one of the fifteen big puzzles of physics listed in the theory of OR [1-4], reinterpreting the phenomenon of cosmological redshift.

5.4.1 The Doctrine of Light Propagation

The doctrine of light propagation interprets the phenomenon of cosmological redshift base on the attenuation of the kinetic energy of photons.

Human common sense and reason tell us that any matter wave or material particles, including light wave or photons, could never be travelling in space eternally.

As stated previously, the universe is not a vacuum. The starlight emitted by celestial bodies or galaxies traveling in the universe, like bullets fired from guns traveling in the earth's atmosphere, requires to consume energy. Naturally, the farther a galaxy is from the earth, the more energy the starlight or stellar photons requires to consume to reach the earth. As soon as the kinetic energy of the starlight is exhausted, all the stellar photons must stop moving.

It seems that matter waves possess a certain mechanism that maintains their inherent speed.

Matter waves, such as sound wave, light wave, and gravitational wave, always seem to maintain their specific speeds in specific media: a matter wave has its specific speed in a specific medium. The speed of sound in air is about 340 m/s, and in water, is about 1480 m/s; the speed of light in water is about 2.25×10^8 m/s, and in vacuum, is about 3×10^8 m/s.

Actually, matter waves, including light wave, sound wave, and gravitational wave, are a type of collective or group behavior of countless material particles moving together. The mechanism by which a matter wave maintains its specific speed is exactly the collective or group effect exhibited by the countless material particles as a whole of the wave. The material particles in a matter wave move with the motion of the wave as a group. Following the principle of energy conservation, if the kinetic energy of the material particles decays, the frequency of the wave decays accordingly and the wave spectrum redshifts, but the inherent speed of the wave remains unchanged; if the kinetic energy of the material particles increases, the frequency of the wave increases accordingly, the wave spectrum blueshifts, but the inherent speed of the wave remains unchanged.

This is why a matter wave can maintain its specific speed and travel a long distance.

However, common sense and reason tell us that such a mechanism by which a matter wave maintains its specific speed is relative, not absolute.

It can be imagined that a single photon travelling in the universe must quickly exhaust its kinetic energy and cease to move. Only when it moves as a member of light, along with numerous photons, can it travel over a long distance.

Even so, it does not suggest that light or photons could be travelling eternally.

The attenuation or redshift of the frequency of starlight signifies the attenuation or redshift of the overall energy of starlight as a whole of countless photons. When the overall energy of starlight decreases to a certain extent, it can no longer sustain or meet the energy needs of all its members: some photons begin to fall behind; starlight as a collective of photons gradually shrinks. Ultimately, starlight must be engulfed by the ocean of cosmic matter particles and cease to exist.

This is the doctrine of light propagation for the phenomenon of cosmological redshift.

So, light, as a form of matter motion, can definitely not be flying in space forever as Einstein envisioned.

By the way, the so-called long-range forces is also relative; in fact, there exists no long-range force with infinite active scope in the physical world. As the theory of OR has clarified, the rest masses of both photons and gravitons are not zero [2]; the active scopes of both electromagnetic and gravitational force are not infinite.

The doctrine of light propagation is conducive to the correct understanding of cosmological redshift.

5.4.2 To Clear Zwicky's Name

The author was always puzzled: why could not physicists interpret the spectral redshift of cosmic galaxies based on the principle of simplicity and common sense, but instead complicated and mythologized the phenomenon of cosmological redshift, fabricating the doctrines of cosmic expansion and even the Big Bang.

Zwicky's Tired-Light Hypothesis

Actually, as early as 1929, almost at the same time as the birth of Hubble's law, the Swiss astronomer Fritz Zwicky proposed the tired-light hypothesis (TLH) [43].

Zwicky hypothesized that, as starlight travels in the universe, traverses through gravitational fields and interacts with interstellar media, it must lose energy, resulting in the redshift of its spectrum.

Zwicky's doctrine of TLH exactly aligns with the doctrine of light propagation and the energy-decay view of the theory of OR, conforming to human common sense and reason and easy to understand.

Sometimes, however, compared to common sense, mankind seems more willing to believe in myths; compared to reason, mankind seems more willing to believe in superstitions.

It is said that [44-47] Zwicky's doctrine of TLH has been falsified by cosmologists, because the doctrine of TLH cannot explain the so-called perfect blackbody spectrum of CMB radiation and the so-called time dilation of high-redshift supernovae; and why distant galaxy images captured by the Hubble telescope are still clear and sharp.

Zwicky's TLH has been neglected by the mainstream physics community for nearly a century.

It is puzzling that cosmologists do not question the Big Bang theory based on Zwicky's TLH, including the so-called empirical evidences for the Big Bang model, such as cosmic expansion, CMB radiation, and the time dilation of high-redshift supernovae, but instead demand that Zwicky's TLH conform to and explain the so-called empirical evidences for the Big Bang. Should we believe in Zwicky's TLH or in the so-called evidences for the Big Bang observed with the optical agent OA(c)?

Zwicky's TLH provides a reasonable interpretation for the spectral redshift of galaxies in the universe. Now, we clear Zwicky's name, and clear the name of Zwicky's LTH.

Zwicky's TLH vs Galactic Optical Images

According to the theory of OR, modern cosmology, including the optical and the radio, employs the optical agent OA(c) to observe distant galaxies. However, OA(c) does not represent the objective and real physical world. As clarified in Sec 2.5, restricted by the observational locality ($c<\infty$) of OA(c), the so-called evidences supporting the Big Bang theory are only the optical images of the universe presented by the optical agent OA(c), rather than the objective physical reality or real physical existence.

The theory of OR repeatedly emphasizes that the so-called empirical evidences for the doctrine of Big Bang originally have an infinite number of possible interpretations, not the evidence materials specifically prepared for the doctrine of Big Bang.

Cosmologists take the distant galaxy images captured by the Hubble Telescope as evidences to refute Zwicky's TLH, and claim that Zwicky's TLH cannot explain why those images remain clear and sharp. They argue that according to Zwicky's TLH, the interaction between stellar photons and interstellar media must produce light scattering similar to the Compton effect, altering the direction of light and blurring those images.

However, no matter how clear and sharp they are, those images cannot represent the real appearance of celestial bodies or galaxies billions of years ago.

The existence of interstellar media in the universe is beyond doubt. Similar to light passing through the atmosphere of the earth, it is natural and inevitable that starlight exhibits slight scattering and deflection as it travels in the universe and interacts with interstellar media. However, this does not necessarily mean that the information or images it transmits are fuzzy or blurred. Compared to the density of matter in the universe, the atmosphere of the earth is so dense that the divergence of a searchlight beam can be visible to the naked eye. Nevertheless, the scenes we see through light on the earth are still “clear and sharp”.

Zwicky's TLH vs Time Dilation

Cosmologists also take the time dilation of high-redshift supernovae as an evidence to refute Zwicky's TLH. The concept of time dilation originates from Einstein's theory of special relativity.

We have now known that Einstein's theory is that of optical observation, however, cosmologists have not yet realized that the so-called time dilation is only an observational effect and apparent phenomenon. The time dilation of high-redshift supernovae is only an apparent phenomenon cause by the observational locality of the Hubble telescope, that is, the optical agent OA(*c*).

The theory of OR has clarified that the objective and real time does not dilate.

Zwicky's TLH vs CMB Radiation

The cosmic microwave background (CMB) radiation has always been regarded by cosmologists as a crucial empirical evidence for the Big Bang theory. Now, cosmologists also take CMB radiation as an evidence to refute Zwicky's TLH.

Actually, when the doctrine of light propagation emphasized that the universe is not a vacuum and Zwicky's TLH pointed out that the universe is full of interstellar media, CMB radiation had no longer been the empirical evidence for the Big Bang theory, but an empirical evidence of the Zwicky's TLH and doctrine of light propagation.

As we all know, the existence and movement of material particles cause the physical environment to exhibit corresponding temperature: the lower the matter density, the lower the environmental temperature; conversely, the higher the matter density, the higher the environmental temperature. Exactly based on this, cosmologists have built the model of Big Band that traces the universe from the state of high temperature to a Big Bang and to cosmic expansion.

It is natural and inevitable for the universe to be full of interstellar media.

The universe is a vast ocean of matter. In a sense, the universe is a gravitational world, which must be filled with gravitons. Furthermore, there are also neutrinos and electromagnetic particles traveling through the universe. In particular, the universe also has countless comets, satellites, planets, stars, and even colossal celestial bodies, such as black holes.

So, it is natural and inevitable for the universe to exhibit a slight temperature (2-3K) above absolute zero, which does not need to be interpreted as the so-called residual temperature of the Big Bang, or the so-called CMB radiation.

Originally, Alpher and Herman predicted in 1948 that the residual temperature left by the Big Bang in the present-day universe would be 5K [20]. However, the radiation of CMB detected by Penzias and Wilson in 1965 was 3.5K, and was later revised to 3K [21]. The accurate measurement with modern technology has determined the temperature of CMB radiation to be 2.725 ± 0.001K. After unceasingly mending and patching, the theoretical value of the temperature of CMB radiation in the Big Bang model has now been fixed at 2.725K.

Zwicky's LTH was originally regarded as a heresy that could shake the foundations of the Big Bang theory, and so, it was opposed by cosmologists and neglected by the mainstream physics community. However, it is particularly interesting that, nowadays, in order to repair the Big Bang model, cosmologists to have begun paying attention to Zwicky's LTH [48-50]. They are attempting to employ Zwicky's LTH to address the JWST problem encountered by the Big Bang theory [51,52].

5.4.3 The JWST Problem and the Repair of the Big Bang Model

Actually, the Big Bang theory is a phenomenological model: in order to align with the phenomena from astronomical observations, cosmologists have to constantly revise the Big Bang theory or repair the Big Bang model.

On the one hand, cosmologists believe that the empirical evidences supporting the Big Bang theory are flawless and perfect; on the other hand, in response to the adverse evidences from astronomical observations, cosmologists have to unceasingly mend and patch the Big Bang model.

However, solving one problem has led to more problems. The tinkered Big Bang model seems to face increasing problems and challenges.

Since its commissioning in 2022, the James Webb Space Telescope (JWST) has discovered some new celestial phenomena that contradict the Big Bang theory, posing new challenges to the doctrine of the Big Bang [48-50].

Those are the JWST problems, including

(1) The rotation of galaxies is not randomly oriented, which seems to contradict the assumption of isotropy in the universe.

(2) It seems that there were many mature galaxies in the early universe.

(3) Supermassive black holes seem to have existed in the early universe.

(4) The Hubble constant H_0 determined by the JWST is 74 km/s/Mpc while the theoretical value of H_0 calculated based on the radiation of CMB is 67 km/s/Mpc, which suggests that the properties of dark energy, gravitational theory, and cosmic components (such as neutrinos and dark matter) need to be revisited.

One comment stated [53]: “The James Webb Space Telescope is reminding us with cold, hard data that human understanding of the universe is still far from complete.” Thus, cosmologists have embarked on a new round of mending and patching the Big Bang model.

In 2023, Professor Rajendra Gupta of the University of Ottawa, in order to address the JWST problem, established a CCC+TL model of cosmic expansion by combining Zwicky's LTH and covariant coupling constant (CCC) that does not rely on dark matter. Based on the CCC+TL model, Gupta has revised the age of the universe from 13.8 billion years to 26.7 billion years [51,52].

Actually, according to the theory of OR, the data observed by the JWST, as the information on distant galaxies billions of years ago transmitted by the optical agent OA(*c*), does not represent the past physical reality or past physical existence. As clarified in Sec. 5.3, the phenomenon of cosmological redshift does not suggest cosmic expansion, nor does it signify the birth of a new universe. Therefore, the so-called age of the universe, whether it is calculated to be 13.8 billion years based on Hubble's law or 26.7 billion years based on Gupta's CCC + TL model, has no substantial significance for the Big Bang.

In a sense, the astronomical data observed with the James Webb Space Telescope is both a negation of the Big Bang theory and a support for the doctrine of Light Propagation and Zwicky's Light-Tired Hypothesis.

5.4.4 Zwicky's Law and Zwicky Distance

The theorem of Cartesian spacetime in the theory of OR has theoretically proven that the objective and real universe, no matter time or space, is independent of matter, and so, never expand with the diffusion of matter. This is a denial of Hubble's law and doctrine of cosmic expansion.

So, cosmology needs to revisit the issue of cosmological redshift and reinterpret the spectral-redshift phenomenon of cosmic galaxy.

In 2022, based on the theory of IOR [2], the author has established the theory of GOR [3], and discovered that Einstein's theory of relativity, including the special and the general is that of optical observation, does not represent the objective and real physical world. Consequently, based on the theory of OR [1-4], the author questioned the physical models based on Einstein relativity theory, and listed fifteen big puzzles in physics, including BP-15: The Big Bang. In BP-15, the author proposed the law and doctrine of light propagation for reinterpreting the phenomenon of cosmological redshifts.

As early as a century ago, Zwicky proposed the light-tired hypothesis (TLH) [42] (see Sec. 5.4.2). The fundamental idea of Zwicky's TLH is completely consistent with the doctrine of light propagation in the theory of OR (see Sec. 5.4.1). Therefore, we may as well refer to the law of light propagation as Zwicky's law.

Zwicky's Law: The starlight emitted by distant galaxies traveling in the universe needs to overcome the resistance from interstellar media. Consequently, the kinetic energy K of the starlight or its photons must decay gradually, leading to the spectral redshift of starlight. The relative redshift Z is defined as $Z=\Delta K/K$, that is,

$$Z = \frac{\Delta K}{K} \quad \text{and} \quad |Z| = R_{ED} D \quad \left(R_{ED} = \frac{c}{H_0}\right) \tag{41}$$

proportional to the distance D of the celestial body relative to the earth, that is, $|Z|=R_{ED}D$. The greater the distance D between the celestial body and the earth, the greater the kinetic-energy decay $|\Delta K|$, and the greater the relative redshift $|Z|$ of the starlight spectrum.

Zwicky Distance: According to Zwicky's Law, there must be a theoretical upper limit D_Z of the distance in the universe, may be called the Zwicky Distance, the starlight emitted by celestial bodies or galaxies beyond which cannot reach the earth due to energy limitation, so that such celestial bodies or galaxies cannot be observed by the observers on the earth.

The maximum relative redshift $Z_M=-1$ of light signifies the exhaustion of the kinetic energy of light: $\Delta K=-K$, which corresponds to the maximum propagation distance of light, that is, the Zwicky distance. According to the current data of the International System of Units, the theoretical value of the Zwicky distance D_Z in the universe is approximately 13.8 billion light-years:

$$\begin{aligned} D_Z &= \frac{|Z_M|}{R_{ED}} = \frac{1}{R_{ED}} = \frac{c}{H_0} \quad (Z_M = -1) \\ &\approx 4.26 \times 10^3 \text{ Mpc} \approx 1.38 \times 10^{10} \text{ ly} \end{aligned} \tag{42}$$

A comparison can be made: a bullet flying in the earth's atmosphere typically travels no more than a distance of 1,000 meters for no more than 2 seconds; whereas a photon flying in the universe can travel more than a distance of 13.8 billion light-years for more than 13.8 billion years. This is reasonable. Conversely, Einstein's belief that light and photons can be travelling eternally in the universe is contrary to common sense and reason.

Interestingly, the Zwicky distance D_Z is exactly equal to the Hubble distance D_H, and moreover, both the Zwicky distance D_Z and the Hubble distance D_H share a common implication: light or photons emitted by celestial bodies or galaxies beyond the distance are unobservable to the observers on the earth.

However, the Zwicky distance D_Z and the Hubble distance D_H are two completely different concepts: the Zwicky distance D_Z represents the upper limit of the distance light can travel; whereas the Hubble distance D_H suggests that the celestial bodies or galaxies at the Hubble distance D_H are receding from the earth at the light of speed *c*. It is certainly puzzling you that, according to Einstein's mass-speed relation, those massive celestial bodies or galaxies at the Hubble distance D_H must have no rest mass, and that the recession speeds of the celestial bodies or galaxies beyond the Hubble-Hubble distance D_H must exceed the speed of light *c*.

Actually, there is no the so-called Hubble distance in the universe: it is difficult to imagine a celestial body or a galaxy moving in the universe at the speed of light or even at a superluminal speed.

However, the Zwicky distance is essential: no material particle can travel in the universe eternally without consuming energy. Zwicky's LTH and Zwicky's law tell us that the phenomenon of cosmological redshift does not represent cosmic expansion, but rather the natural manifestation of the energy decay of starlight as traveling in the universe.

6 Discussion

Without Einstein's theory of relativity as its theoretical basis (see Sec 3 and Sec 4), without Hubble's law or doctrine of cosmic expansion as its empirical basis (see Sec. 5), can the doctrine of Big Bang still hold up?

The Swedish physicist Hannes Alfvén, a Nobel Prize winner, once in his article Cosmology: Myth or Science [54] bluntly criticized the scientific superstition that had spread after Einstein's theory of relativity. In Alfvén's view, science has become increasingly myth-like and contrary to common sense.

To a large extent, this is attributed to Einstein's theory of relativity, the invariance of the speed of light, and the doctrine of spacetime curvature, as well as the mainstream physics community's lack of correct understanding of Einstein's theory of relativity.

The theory of OR has discovered that all relativistic phenomena in Einstein's theory of relativity, including the invariance of light speed and the doctrine of curvature spacetime, are observational effects and apparent phenomena, rather than the objective physical reality or real physical existence. The mainstream physics community has not yet realized so far that Einstein's theory of relativity, including the special and the general, is that of optical observation adopting the optical agents OA(c). Restricted by the observational locality of $c<\infty$, the optical agent OA(c) only presents to us optical images of the physical world.

Sections 3-5 question the theoretical and empirical bases of the Big Bang model from a scientific perspective, and refute the Big Bang theory in both speculative and empirical senses. Actually, the problem of Big Bang is not a scientific problem, not belonging to scientific category.

This section, based on the conclusions drawn in Sections 3 to 5, examines the doctrine of Big Bang from a more philosophical perspective. We will discuss the origin of the universe and the doctrine of Big Bang from the perspectives of simplicity principle, common sense and rationality, empiricism and speculation, as well as, science and philosophy.

6.1 The Principle of Simplicity

Common sense is mankind's inherent view of nature, that is mankind's belief in the essential simplicity of the universe or nature.

Great philosophers and scientists, including Socrates, Aristotle, Kant, Galileo, Newton, as well as Einstein and Russell, all had held and expressed such a belief: The universe or nature, is complex in phenomenon, but simple in essence. This is the principle of simplicity [55], also known as Ockham's razor [56].

Physicists' pursuit of unified physics is a manifestation of their belief in the inherent simplicity of the physical world. Therefore, unified physics must follow the path and direction guided by the principle of simplicity. In Einstein's way, the principle of simplicity can be stated as [57]: "Seeking, as far as possible, logical unity in the world picture, i.e. paucity in logical elements." Unified physics, no matter The Grand Unified Theory (GUT) or The Theory Of Everything (TOE), must possess this logical and formal simplicity, adhering to the principle of simplicity.

However, the doctrine of Big Bang is a product of scholasticism, or a product of overly complicated, scholastic philosophy, contrary to the principle of simplicity.

Violating the principle of simplicity often means violating the essence of science.

Logic is a contradictory unity of cause and effect: cause and effect are both mutually opposed and mutually unified, and can be transformed into each other under certain conditions. A cause must be an effect of other causes; an effect must be a cause of other effects. Thus, the cause-effect chain of logic must have no beginning and no ending. Moreover, restricted by the observational locality of mankind, what mankind can perceive or observe are only the phenomena of the natural world, rather than the essence of the natural world.

So, due to both the cause-effect chain of logic with no beginning or ending and the observational locality of mankind, mankind will never be able to reach the realm of absolute truth.

However, human reason can touch the objective truth.

Reason is also mankind's inherent view of nature: a scientific theory must possess rationality, and must be logically and empirically verifiable or falsifiable.

So, can the doctrine of Big Bang, which violates the principle of simplicity, withstand empiricism and speculation? Does the doctrine of Big Bang conform to human common sense and reason? Is the Big Bang theory a scientific theory or a scientific myth?

6.2 Empiricism and Speculation

Physics is a contradictory unity of empiricism and speculation, which is both empirical and speculative. Empiricism tells us what and how; speculation tells us why.

There are two ways to question a certain theory in physics, such as the OR theory or the Big Bang theory:

(1) The Empirical: Questioning its empirical basis;

(2) The Speculative: Questioning its logical consistency and theoretical validity.

So, can the Big Bang theory stand up to empirical testing and speculative examining?

Section 2 has clarified based on the theory of OR that Einstein's theory of relativity is the most crucial theoretical basis of the Big Bang theory, in which the principle of the invariance of light speed the doctrine of spacetime curvature play important roles.

Section 3 has clarified based on the theory of IOR that the speed of light is not really invariant.

Section 4 has clarified based on the theory of GOR that spacetime is not really curved.

Thus, without Einstein's theory of relativity, without the principle of the invariance of light speed, without the doctrine of spacetime curvature, the doctrine of Big Bang loses its original logical and theoretical basis. In the sense of speculation, the doctrine of Big Bang no longer holds true logically and theoretically.

As stated in Sec 2.4: Hubble's law or doctrine of cosmic expansion are the most crucial empirical basis of the Big Bang model; without Hubble's law, all the so-called empirical evidences for the Big Bang model will lose its substantial significance.

Section 5 has clarified based on the theory of OR that the universe is not really expanding.

So, cosmological redshift does not adhere to Hubble's law. According to the law of light propagation (also known as Zwicky's law), the spectral redshift of galaxies in the universe is not caused by the Doppler effect due to the recession of galaxies, but rather the result of the kinetic-energy decay as starlight traveling in the universe.

Thus, the doctrine of Big Bang loses its original empirical basis, and consequently, all other empirical evidences supporting the Big Bang theory loses its substantial significance. In the sense of empiricism, the doctrine of Big Bang also no longer holds true without Hubble's law or doctrine of cosmic expansion.

It is thus clear that empiricism and speculation do not support the doctrine of the Big Bang.

As stated in Sec. 5.4.3, the Big Bang model is not a true theoretical model but rather a phenomenological one. In order to address the continuous challenges from new data of astronomical observation, such as the JWST problem, cosmologists have to unceasingly revise and repair the Big Bang model.

According to the theory of OR, the so-called empirical evidences supporting the Big Bang theory, such as cosmological redshift, CMB radiation, and the abundance of light elements, are only the optical images of the universe presented to us by the optical agent OA(c), rather than the objective physical reality or real physical existence, let along the essence of the universe or natural world. The author repeatedly emphasizes that all empirical evidences listed by cosmologists for the Big Bang model, including cosmic redshift and CMB radiation, which are regarded by cosmologists as the most important evidences for the Big Bang, may have an infinite number of possible interpretations, and are not the evidence materials specifically prepared for the Big Bang theory.

Now, Einstein's theory of relativity serving as the theoretical basis of the Big Bang model is no longer valid; Hubble's law or doctrine of cosmic expansion serving as the empirical basis for the Big Bang model is also no longer valid. The only choice for cosmologists is not how to continue to repair the Big Bang model, but to completely abandon the myth of Big Bang!

6.3 Common Sense and Reason

Physics is a contradictory unity of common sense and reason: common sense implies simplicity and rationality in the empirical sense; reason implies simplicity and rationality in the speculative sense.

Common sense and reason are the fundamental elements of human wisdom. It is based on common sense and reason that mankind can distinguish the truth from falsehood in science. A doctrine in science, whether it violates human common sense or reason, must imply that it is moving towards fallacy, myth, or even superstition.

Common sense tells us that the speed of matter motion follows Galileo's law of speed addition. However, Einstein's speed of matter motion follows the relativistic law of speed addition; in particular, the speed of light plus a speed remains the speed of light, which is known as the invariance of the speed of light. Common sense tells us that a material object must have its own mass. However, Einstein's photons and even all objects moving at the speed of light have no mass. Common sense tells us that a moving object must stop moving as its kinetic energy is exhausted. However, Einstein's photons cannot stop. Common sense tells us that time is just time, and space is just space. However, Einstein's theory of relativity introduces the concept of spacetime: time is also space, and space is also time; time can dilate, and space can contract. In particular, spacetime can be curved.

As stated previously, the doctrine of spacetime curvature is quite puzzling. Perhaps one can imagine and comprehend the curvature of space, or even the contraction or expansion of space; however, based on common sense and reason as well as his or her inherent view of nature, it is difficult for one to imagine and comprehend how time is curved. Nevertheless, the doctrine of spacetime curvature has become a belief in the mainstream physics community.

Contrary to human common sense often implies contrary to human reason.

Reason tells us that the physical world is objective, independent of whether the observer observes or whether the observer moves. However, Einstein's physical world bears a strong subjective hue: different observers have different time and space, as well as different simultaneity. From the perspective of different observers, the same material object may even have different masses.

After the establishment of Einstein's theory of relativity, due to the observational locality ($c<\infty$) of the optical agent OA(c), the mainstream physics community has formed many misunderstandings and misconceptions on relativistic effects, and many myths and even superstitions have been given rise to in human being's physics, such as the twin paradox, time travel, spacetime tunnels, the Einstein-Rosen bridge (so-called wormholes), and so on.

The doctrine of Big Bang is arguably the most representative myth in modern cosmology.

Now, the theory of OR tells us that common sense and reason remain valid!

The theory of OR has discovered that relativistic effects are merely apparent phenomena: Einstein's theory of relativity, including the special [9] and the general [10], is that of optical observation and does not represent the objective and real physical world. All relativistic effects in Einstein's theory of relativity are apparent phenomena caused by the observational locality ($c<\infty$) of the optical agent OA(c). In the objective and real universe, time does not dilate, space does not contract, spacetime is not really curved, and the speed of light is not really invariance or cannot be exceeded.

Thus, the doctrine of Big Bang, which is based on Einstein's theory of relativity, becomes a mirage purely based on illusory optical images.

Of note, it is legitimate and logical that Einstein's theory of relativity, as a theory of optical observation, is consistent with the optical phenomena observed by the optical agent OA(c), and presents us with relativistic optical images of the physical world. For this reason, Einstein's theory of relativity, including the special and the general, has been supported by almost all observations and experiments that adopt the optical agent OA(c).

However, the problem lies in that both Einstein himself had not and the mainstream physics community today has not yet realized that Einstein's theory of relativity, including the special and the general, is that of optical observation, and the optical images it presents do not represent the objective physical reality and real physical existence. Einstein mistakenly believed, and the mainstream physics community today still mistakenly believes, that relativistic phenomena are the essential properties of the physical world. Now, Einstein's theory of relativity has become a belier of the mainstream physics community, employed as the crucial theoretical foundation of modern physics. So Modern physics, including the so-called Big Bang theory, is increasingly contrary to human common sense and human reason, more and more like myths and even superstition as stated by Alfvén [54].

As described in Sec. 2.5, Hawking once referred to the issue of singularities in his book A Brief History of Time [39]. If Hawking was serious, then he should continue to argue that Einstein's theory of special relativity breaks down at the Lorentz singularity ($v=c$); Einstein's theory of general relativity breaks down at the Schwarzschild singularity ($\chi=-c^2/2$); and the Big Bang theory breaks down at the Big-Bang singularity ($R_0=0$). Perhaps, this is exactly what Hawking meant. In his A Brief History of Time, Hawking also said: "For years, my early work with Roger Penrose seemed to be a disaster for science. It showed that the universe must have begun with a singularity, if Einstein's general theory of relativity is correct. That appeared to indicate that science could not predict how the universe would begin."

The theory of OR has cleared Galileo and Newton's names [5]: The Galilean transformation and Galileo's law of speed addition, as well as Newton's classical mechanics, including the inertial and the gravitational, remain valid, which if fact represent the objective truth, in line with human common sense and reason!

As discovered and clarified by the theory of OR, Galileo's doctrine and Newtonian mechanics are that of idealized observation adopting the idealized agent OA_∞ ($\eta\to\infty$) with no the observational locality, presenting us with a true portrayal of the physical world. The idealized agent OA_∞ can be referred to as God's Eye that represents the objective and real physical world.

6.4 Science and Philosophy

Physics is a contradictory unity of science and philosophy: early physics was known as Natural Philosophy [58].

But science and philosophy have essential differences.

Scientific propositions should be what can be verified or falsified by mankind logically and empirically; whereas philosophical propositions are what cannot be verified or falsified by mankind.

The doctrine of Big Bang is rooted in the problem of the origin of the universe. However, the problem of the origin of the universe should belong to the category of philosophy, not to that of science.

The limitations of Science
and the Role of Philosophy in Science

The cause-effect chain of logic has no beginning and no ending, so logically, there is no the so-called first principle or first cause in science. According to the theory of OR, mankind's perception of the objective world has the observational locality. Therefore, both logically and empirically, the science of mankind must have its own limitations.

In a strict sense, due to the observational locality, mankind can neither verify nor falsify his scientific theories through observation and experiment: all what present in mankind's perception and observation are only phenomena of the natural world, not the essence. As Hawking stated in his A Brief History of Time [39]: "Any physical theory is always provisional, in the sense that it is only a hypothesis: you can never prove it. No matter how many times the results of experiments agree with some theory, you can never be sure that the next time the result will not contradict the theory."

Due to the cause-effect chain with on beginning and no ending, a scientific theory has to set a logical starting point for itself, that is, a so-called axiom as its logical premise of the theory. According to the great logician Gödel's incompleteness theorem [59,60], an axiom is a proposition that can neither be verified nor falsified by the theory itself.

A so-called axiom is really just a hypothesis.

All axioms and even principles must embody scientists' subjective and idealistic ideologies, encompassing idealized or hypothetical conditions, which are far from the objective truth. Hence, philosophy holds its existential value and significance in relation to science.

Actually, all logical premises or axioms of scientific theories, including so-called principles, are largely the products of human philosophical thinking.

The Dialectics of Nature in Philosophy

The author believes in the dialectics of nature, advocating that physicists, including cosmologists, should hold the dialectical materialist view of nature.

Whether it is Hegel's idealist dialectics [61], Marx's materialist dialectics [62], or Engels' dialectics of nature [63], all belong to the category of philosophy. Philosophy plays an important role in science; in particular, the dialectics of nature plays a significant role in physics.

Based on the dialectical materialist view of nature, the author believes that the universe has two attributes: one is spacetime, the other is matter; the universe is a contradictory unity of spacetime and matter. Spacetime has two attributes: one is space, the other is time; space and time is a contradictory unity of space and time. Matter has tow attributes: one is mass, the other is energy; matter is a contradictory unity of mass and energy. The two sides in a contradictory unity are both mutually opposed and mutually interdependent, and under certain conditions, can be transformed into each other.

In a certain sense, Einstein's theory of relativity, both the special and the general, excellently interprets the natural view of dialectical materialism; the relativistic effects of spacetime as well as matter motion and matter interactions presented in Einstein's theory of relativity excellently interprets the dialectics of nature.

However, philosophy can only play the role of philosophy but cannot play the role of science. The philosophical propositions of the dialectics of nature can be neither scientifically verified nor scientifically falsified. When philosophy, including the dialectics of nature, is treated as scientific truth in the category of science, it must inevitably be caught in the whirlpool of paradoxes. In this way, science must turn into its opposite, becoming pseudoscience, myth, or even superstition.

According to the dialectics of nature, everything in the natural world is relative. Yet, this proposition itself is absolute, negating the view that "Everything in the natural world is relative". According to the dialectics of nature, there is no absolute truth in the natural world. Yet, this proposition simultaneously implies a denial of itself.

Therefore, even if a theory conforms to a certain philosophical concept, even if Einstein's theory of relativity conforms to the dialectical materialist view of nature, it still cannot represent the objective physical reality, and it still may not conform to the laws of nature, especially when we only know what and how but not why.

Philosophy provides the logical basis for science, and simultaneously, introduces the paradoxes for science that science cannot solve.

Science is merely science and cannot replace philosophy; philosophy is merely philosophy and cannot replace science. A so-called scientific theory that attempt to treat a philosophical issue as a scientific one must inevitably lead to the opposite of science.

The Origin of the Universe:
Did the Universe Begin with the Big Bang?

Tracing back to its roots, the doctrine of Big Bang is rooted in the problem of the origin of the universe.

Since we, the human beings, had self-awareness, we have been asking:

"Where do we come from, and where are we going?"

"Were human beings created by God?"

"Was there a creator, who created the universe?"

"Is the universe eternal and infinite?"

"Is time finite or infinite?"

"Is space finite or infinite?"

"Does the universe have a beginning?"

"Is the matter in the universe inherent to the universe or created out of nothing?"

Actually, all these questions can be attributed to one: The Problem of the Origin of the Universe.

However, the origin of the universe is not a scientific problem, but a philosophical problem.

Philosophical propositions can neither be scientifically verified nor scientifically falsified. Mankind can never be able to answer the question of how the universe originated.

If you attempt to treat a philosophical problem as a scientific one, you must inevitably encounter paradoxes: if you can verify it, then you can also falsify it too. Ultimately, you may end up either with nothing like Newton's seeking for the first driving force of the universe, or with a fallacy, myth, or superstition.

To answer how the universe originated, cosmologists treat a philosophical problem as a scientific one. Taking Einstein's theory of relativity as the theoretical basis and Hubble's law as the empirical basis, they have constructed the Big Bang model, attempting to provide a temporal and spatial starting point for the universe. The Big Bang theory suggests that the universe originated from a massive explosion, known as the Big Bang; and that not only the universe is finite, but also it can contract and expand; and that matter was produced from NULL, that is, Nothingness = Positive Matter + Negative Matter.

In this way, cosmologists have invented the doctrine of cosmic origins that is in line with religious beliefs, and simultaneously, have brought cosmology into a whirlpool of paradoxes.

The First-Cause Paradox of Big Bang

If the doctrine of Big Bang could answer how the universe originated, then the quantum fluctuation should be the first driving force, that is, the first cause of the birth of the universe: it was the quantum fluctuation that triggered the Big Bang, and so the universe was born.

We already know that there is no the so-called first cause in the infinite cause-effect chain of logic. Mankind must inevitably ask what the driving force behind quantum fluctuations is, and embark on seeking for another first cause. Such a process of tracing back for the first cause must be endless.

This is the first-cause paradox that the doctrine of Big Bang must inevitably encounter.

The Time Paradox of Big Bang

If the doctrine of Big Bang could answer how the universe originated, it must imply that the Big Bang theory proved that the universe had a beginning in time. So, mankind must inevitably ask where was the universe before time began to flow?

This is the time paradox that the doctrine of Big Bang must inevitably encounter.

Cosmologists respond to this by stating that time has no meaning before the birth of the universe. However, the Big Bang cannot evade the time paradox.

The limited mind of human beings cannot comprehend the eternal universe. However, the universe with finite or limited time must inevitably encounter another philosophical problem: in terms of time, could the universe have been created out of nothing?

The Space Paradox of Big Bang

The space paradox and the time paradox of the Big Bang should be equivalent: a universe that is eternal in time must also be infinite in space.

If the doctrine of Big Bang could answer how the universe originated, it must imply that the Big Bang theory proved that the universe had a beginning in space; and that, no matter how fast the universe expands, its space must be finite. A universe with finite space must have its boundary. So, what lies beyond the boundary of the universe?

This is the space paradox that the doctrine of Big Bang must inevitably encounter.

Cosmologists may also respond to this by stating that space has no meaning before the birth of the universe. But, the Big Bang cannot evade the space paradox.

The limited mind of human beings cannot comprehend the infinite universe. However, the universe with finite or limited space must inevitably encounter another philosophical problem: in terms of space, could the universe have been created out of nothing?

The Matter Paradox of Big Bang

The Big Bang gave birth to a new universe. So, how did the matter in the new universe come into being? Was it created by God or inherent to the universe?

If matter is not inherent to the universe, then it must be created out of nothing. This violates the principle of conservation of matter in physics, or the principles of conservation of mass and energy, and negates the scientific validity of the Big Bang theory. If matter originally existed and only gathered towards the Big-Bang singularity as the universe contracted, then the universe and its matter would have existed before the Big Bang. Thus, the Big Bang could not represent the birth of a new universe.

This is the matter paradox that the doctrine of Big Bang must inevitably encounter.

The limited mind of human beings cannot comprehend the inherent matter to the universe. So, cosmologists always aspire to find a deity for all things is the universe, including matter and human beings. Actually, this is exactly what the designers of the Big Bang model and cosmologists are striving for, as suggested by the subtitle of Big Bang Theory in China Baidu Encyclopedia: "A hypothesis of cosmic origin consistent with religion".

The Singularity Paradox of Big Bang

It relies heavily on Einstein's theory of general relativity for the doctrine of Big Bang to explain how the universe evolved from the Primeval Atom [17] to the current state, how time began to flow from the rest state, and how space began to expand from the null state. In the Big Bang theory, Lemaitre's primeval atom evolves into the Big-Bang singularity, or called the singularity of the universe.

The Big-Bang singularity has too many puzzles.

Could the universe really contract or curl up into a singularity with no the universe or spacetime? Could the vast amount of matter in the universe really pile up and be squeezed into a singularity with no space and no time?

Would the accumulation of massive matter in the universe really lead to a big explosion? If so, would the same be true for all the matter in the Milky Way galaxy? If it is, might the big explosion of Milky Way count as the birth of a new universe?

In the Big Bang model, was the matter gathered at the Big-Bang singularity in rest or in motion? If it was in rest, then the Big-Bang singularity could not explode; if it is in motion, then the time of the universe could not have stopped in a state of rest before the Big Bang, and the space of the universe could not have contracted to a point of null.

In his book The First Three Minutes: A Modern View of the Origin of the Universe, Weinberg once observed [64]: "One possibility is that there never really was a state of infinite density. The Big Bang may have begun when the density of the universe had reached some very high but finite value."

However, Weinberg's doctrine of non-singularity Big Bang cannot resolve or eliminate the paradox of the Big-Bang singularity. The question remains: before Weinberg's Big Bang of non-singularity, was the high-density matter gathered together in rest or in motion?

Actually, as stated previously, Newton's theory of universal gravitation can also allow the matter in the universe to gather together through gravitational interaction. However, even if all the matter in the universe gathered together, it does not suggest that the spacetime of the universe is curved or warped, nor does it mean that the time of the universe stops flowing and that the space of the universe contracts to null. Even if all the matter in the universe participated in a big explosion, it can only be an ordinary event in the universe, does not imply the birth of a new universe.

6.5 Kant's Conclusion

It is time to draw a conclusion on the Big Bang.

Here, the author specifically quotes Kant's classic philosophical work **Critique of Pure Reason** [65], which Hawking called a Milestone Work.

In fact, the denial of the Big Bang theory presented in this article based on the theory of OR was already proposed by Kant in the 18th century. In 1781, the great philosopher Immanuel Kant has a profound thought on the origin of the universe in his work Critique of Pure Reason and arrived at his own conclusions.

In his work Critique of Pure Reason, regarding the origin of the universe, Kant deeply investigated two philosophical questions: "Does the universe have a beginning in time?" and "Is the universe finite in space?". The author believes that they are two equivalent questions. Kant referred to the paradoxes or conflicts between affirmative and negative propositions involving the origin of the universe as Antinomies of Pure Reason. Kant believed that there are equally compelling arguments that can prove both the affirmative proposition that "The universe has a beginning" and the negative proposition that "The universe has existed for an infinite amount of time". The author believes that the arguments mentioned by Kant should be in the sense of philosophical rationality and speculation, rather than in the sense of empiricism.

In brief, Kant told us that the origin of the universe is a philosophical problem, an inaccessible forbidden area of human cognition. Any proposition related to the origin of the universe not only can be verified but also can be falsified. OR in other words, mankind can be neither verified nor falsified them.

Now, by summarizing Sections 3, 4, 5, and 6, we have had the following conclusion: The doctrine of Big Bang is contrary to both science and philosophy.

Conclusion

The theory of Observational Relativity (OR), as a new theory of human being's physics, has brought new discoveries and new insights.

The OR serial reports are aimed to interpret the theory of OR for readers. OR Serial Report 1 reported [5]: the speed of light is not really invariant; spacetime is not really curved. OR Serial Report 2 reported [6]: the rest mass of photons is not really zero. OR Serial Report 3 reported [7]: Einstein's prediction of gravitational waves is a historic mistake. OR Serial Report 4 reported [8]: Einstein's theoretical prediction of the precession of Mercury's perihelion is not the objectively physical existence.

Now, OR Serial Report 5 reports to readers that the origin of the universe is not a scientific problem and the doctrine of Big Bang is not a theory in scientific sense.

The human mind is limited, cannot comprehend the infinite universe in terms of time and space. Therefore, human beings always want to give the universe a starting point or beginning in time and space. Thus, cosmologists constructed the Big Bang model. According to this model, the universe we rely on for survival originated from a big explosion 13.8 billion years ago. From that moment on, time began to flow and space began to expand. However, a universe from nothing seems to be contrary to human rationality and speculation in the philosophical sense, as well as, to the laws and principles of human being's physics in the scientific sense.

Originally, the origin of the universe was a philosophical problem. However, the designers of the Big Bang model and cosmologists treated it as a scientific problem, and then, human being's physics has had the so-called Big Bang theory.

Science can only play the role of science; philosophy can only play the role of philosophy. As stated in Sec. 6.4, treating a philosophical problem as a scientific problem must inevitably lead to the opposite of science, that is, a pseudoscience.

Scientific theories must be built on certain logical premises or axiom systems. As stated in Sec. 2.3, the most crucial theoretical basis of the Big Bang theory is Einstein's theory of relativity, in which the principle of the invariance of light speed and the doctrine of spacetime curvature play crucial roles.

The theory of OR has discovered that Einstein's theory of relativity, including the special and the general, is that of optical observation adopting the optical agent OA(c). OA(c) has the observational locality ($c<\infty$), which presents us with only the optical image of the physical world and does not represent the objective and real physical world. All the relativistic effects in Einstein's theory of relativity are observational effects and apparent phenomena caused by the observational locality ($c<\infty$) of OA(c). Section 3 has clarified that the speed of light is not really invariant; Section 4 has clarified that spacetime is not really curved. Thus, without Einstein's theory of relativity as its theoretical basis, without the principle of the invariance of light speed and the doctrine of spacetime curvature, the Big Bang theory no longer holds up.

As stated in Sec. 2.4 and Sec. 2.5, Hubble's Law or Hubble's doctrine of cosmic expansion serves as the most crucial empirical basis of the Big Bang theory. Based on the theory of OR, Section 5 has clarified that cosmological redshift does not imply cosmic expansion, and thus, Hubble's Law or Hubble's doctrine of cosmic expansion cannot hold true. Without Hubble's doctrine of cosmic expansion, all the empirical evidences supporting the Big Bang theory, such as the radiation of CMB, the abundance of light elements, the large-scale structure of the universe, the evolution and distribution of galaxies, as well as, primordial gas clouds, lose their substantial significance. Thus, without Hubble's doctrine of cosmic expansion as its empirical basis, the Big Bang model no longer holds up.

Thus far, based on the theory of OR, by the empiricism and speculation in the sense of science, this article has negated the doctrine of Big Bang that attempts to solve the problem of the origin of the universe within the category of science.

After that, based on the conclusions already made in Sections 3, 4, and 5, Section 6 examines the doctrine of Big Bang from a more philosophical perspective, in which it has been clarified that the doctrine of Big Bang is rooted from the problem of the origin of the universe; whereas, the problem of the origin of the universe belongs to the category of philosophy, not belongs to the category of science. We have briefly discussed the origin of the universe and the doctrine of Big Bang from the perspectives of simplicity principle, empiricism and speculation, common sense and reason, as well as, science and philosophy.

For the origin of the universe, as early as the 18th century, Kant had already pondered it profoundly in his book Critique of Pure Reason, and arrived at a clear conclusion: The propositions about the origin of the universe, as philosophical issues, can neither be proven nor disproven.

Thus far, this article has elucidated for readers from the perspectives of both science and philosophy that the doctrine of Big Bang is not only contrary to science but also contrary to philosophy.

Now, the only choice for cosmologists is not how to continue to repair the Big Bang model, but to completely abandon the myth of Big Bang!

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