

# The Dynamics of the Constancy of Light Speed

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## Abstract

Just as Einstein claimed, "Light is always propagated in empty space with a definite velocity  $c$  which is independent of the state of motion of the emitting body", which has been widely approved. However, physics textbooks do not tell us the dynamic reason why the speed of light remains constant in a vacuum. By re-examining the simultaneity (measured by light and sound without Doppler effect) within inertial frames, the electrostatic field dragged by moving charges, the gravitational field (Hill sphere) dragged by the sun, and the Casimir effect of a vacuum (not empty), this paper presents that all non-zero-mass objects possess their respective static vacuum fields, and reintroduces the vacuum medium model in which the constancy of light speed in a vacuum obeys continuum mechanics. This result shows that a simply modified classical theory can more intuitively explain everything special relativity can explain, and that a slightly revised Newtonian cosmic model can exactly predict the cosmological redshift, the cosmic microwave background, and the relevant cosmological constants, thereby equipping the theoretical possibility to quantize the vacuum and unify quantum-level and macroscopic systems.

**keywords:** light speed; special relativity; spin; cosmological redshift; cosmic microwave background (CMB)

## 1. Introduction

The vacuum with absolute permittivity is not empty, which has been proved by the Camille effect [1] and vacuum phonon heat transfer [2]. In particular, the vacuum, once called the ether, was used not only as a medium by Newton to explain the propagation of light and the non-contact interaction of gravitational and electromagnetic forces, but as a continuum model with great success in Huygens-Fresnel optics and Faraday-Maxwell electromagnetism. Furthermore, Einstein continued to ponder the dynamic properties of the ether (vacuum) until the last years of his life [3]. So, would reintroducing the medium model for the vacuum make the relevant physics principles more natural? Of course, this would give a more intuitive understanding of the Michelson-Morley experiment and the constancy of light speed, clarify some of the puzzling inferences of special relativity, and reveal a concise large-scale structure of the universe.

## 2. Discussion and Results

We will first re-examine "the relativity of simultaneity" of special relativity, the constancy of light speed in a vacuum, and the relevant experiments, and then explain the physical mechanism of the constancy of light speed by re-introducing the medium model of vacuum and reviewing the motion laws of photons.

### 2.1 *The simultaneity between equal-weighting inertial frames*

In *Relativity: The Special and the General Theory* (whose 15th edition was published in 1952), Einstein discussed "the relativity of simultaneity". For the stationary reference frame of a railway embankment, two lightning stroke events occur simultaneously at the same distance before and behind the midpoint of a traveling train (not left and right). However, from the view of an observer sitting in the middle of the train, Einstein thought he would see the lightning in the front preceding the lightning in the back, because the passenger is not stationary on the railway embankment (what happens if the lightning stroke location remains relatively resting with the passenger?) but is away from the rear roadbed event point and approaching the front roadbed event point (as if one riding a motorcycle would observe the

difference in the relative speed of sound between the front and behind?). Leaving aside whether Einstein's argument disregarded **the equidistant emission** of the two lightning stroke flashes in the inertial reference frame of the train and **the invariance** ("which is independent of the state of motion of the emitting body") of the light speed in the vacuum of an inertial frame, let's examine the following two questions:

- (1) According to the principle of relativity, the passengers can think that the two lightning hit at two fixed locations on the stationary train, and that light without the Doppler effect and light with the Doppler effect take the same amount of time to travel the same distance in the train's inertial frame. Suppose there are surveillance cameras outside the head and tail of the train and the monitoring display is located in the middle of the carriage, or there are powerful laser lamps controlled by lightning strokes on the insides of the head and tail of the train (with all the doors between its carriages open). Then, can the observer sitting in the middle of the train judge the simultaneity of the two lightning strokes?
- (2) The air sealed in the carriage moves in synchrony with the uniform-motion train, which can be considered a stationary rigid reference system relative to the passengers. Inside the train, the simultaneity measured by sound signals (without Doppler effect, not propagating in the ground air) and the simultaneity measured by light signals (without Doppler effect, cannot be directly observed from the ground) have equal weighting independent of observation coordinate systems. Also, the passengers will observe that the train being struck by lightning is an event that occurs at a fixed location within the train's inertial frame. So, can the observer sitting in the middle of the train hear that the two lightning bolts simultaneously hit the train's head and tail?

If we endeavor to devise negative answers to the above two questions in order to defend "the relativity of simultaneity", that would deviate from the constancy of the measurable light speed (independent of the relative motion of the railroad) in the passenger's inertial frame. Actually, because of the absolute status of the Minkowski metric (whose space world line is a geodesic), there is no time dilation between equal-weighting inertial frames (whose world lines are not geodesics and they have the same speed effect relative to the Minkowski metric space) with relative motion (see Ref. [4] and Eq. 5), and naturally, there is no relative length contraction between them.

It is conceivable that the spatial location of the event of an inertial frame remains relatively static with this inertial frame. For example, a bolt of lightning hitting a train that travels at a constant speed is, whether observed in the carriage or on the railway embankment, an event that happens at a fixed spatial location in their respective inertial frames. Thus, Einstein's thought experiment on lightning hitting a train should, in fact, be used to prove that the simultaneity between equal-weighting inertial frames is absolute (which is mainly embodied in the fact that their precise atomic clocks have the same timing frequency when observed in a particular "absolute" reference frame), not to argue "the relativity of simultaneity". As for the so-called time dilation, although it has been experimentally verified, it essentially reflects the change in a certain motion state (or period) of an object after the variation in forces (see Ref. [4] and Eqs. 4, 5, 6).

The following discussion is based on experimental facts and the underlying theory, unconstrained by the relativistic light-speed invariance postulate and the relativistic space-time view. We will clarify the physical mechanism of light speed more intuitively and give a clearer physics picture of several relativistic concepts.

## 2.2 Vacuum (field) waves and the speed of photons

As is known to all, a uniformly moving point charge always drags its independent electrostatic field in the reference frame with which it stays stationary, and the sun always drags its static gravitational field and all things belonging to

the solar system. Similarly, all objects with non-zero mass should drag (intrinsically possess) their respective vacuum media that present a compounded static field ( $|\mathbf{E}_r| = \left| \frac{1}{4\pi\epsilon_0} \sum_{i=1}^N \frac{q_i}{|\mathbf{r}-\mathbf{r}_i|^3} (\mathbf{r}-\mathbf{r}_i) \right| \geq 0$ ,  $|\mathbf{g}_r| = \frac{Gm}{r^2} > 0$ ), which possesses absolute permittivity  $\epsilon_0$ , **remains “absolute rest” relative to the object it belongs to**, and can transport quantized energy (photons) at light speed. Therefore, the **Michelson-Morley experiment** did not and should not detect the relative motion between the earth and the ether; namely, there is no relative motion between an inertial system and the static vacuum medium it is dragging.

Just as the different magnetic fields induced by the same point charge in different-motion-state reference frames do not influence each other, and just as numerous laser beams in a vacuum intersect at will without scattering, the vacuum media dragged by different objects should also be able to overlap infinitely. Moreover, photons only have observable meaning relative to an observer when interacting with the static vacuum field dragged by the observer, like the sound from the inside of a train that can only be heard directly from the ground when it vibrates the air outside. It should be noted that **light propagation along a straight line is only an approximation inside a local inertial system** (local absolute vacuum)—for example, a straight-line trajectory in the earth’s inertial system is typically curved when observed in the sun’s static Hill sphere.

In essence, the vacuum should be an isotropic, non-dispersive, and homogeneous linear medium whose plane waves (propagating strength  $f(x, t)_{dx/dt=\pm c}$ ) follow

$$\frac{\partial^2 f(x, t)}{\partial t^2} = \frac{dx}{dt} \frac{\partial}{\partial x} \left[ \frac{dx}{dt} \frac{\partial f(x, t)}{\partial x} \right] = c^2 \frac{\partial^2 f(x, t)}{\partial x^2}. \quad (1)$$

Obviously, the wave equation of the vacuum (field) is completely consistent with the wave equation of mechanical waves in mathematical form, showing that the propagation mechanism of electromagnetic waves transporting energy is unified with that of mechanical waves that transport energy in isotropic homogeneous linear media (such as air in resting laboratories and air in moving trains).

Technically speaking, the wave of electromagnetic field oscillations necessarily transports energy (photons), but the photon is an energy particle with an intrinsic spin rather than the electromagnetic wave. Since the elliptical polarization of light is similar to the projection of helical motion, its linear polarization is similar to the projection of cycloidal motion, and its diffraction ability is negatively correlated with the frequency, we can conclude that the spin of photons is a circular motion obeying  $|\mathbf{r} \times \mathbf{p}_\gamma| = |\mathbf{r} \times \frac{h\nu}{c^2} \mathbf{c}| = \hbar$ . In this way, the energy of a photon is contributed jointly by the spin kinetic energy  $\frac{1}{2}p_\gamma c$  and translational kinetic energy  $\frac{1}{2}p_\gamma c$ , and the wavelength and frequency of a photon are  $\lambda = 2\pi r$  and  $\nu = c/\lambda$ , respectively. The translation of photons in a vacuum must be accompanied by the oscillation of vacuum media (where the observable phenomenon is the quantized photon whose energy and momentum meet the observable threshold), so it is easy to understand that Paul Dirac mentioned “each photon go partly into each of the two components” when explaining the double-slit interference of photons (see Dirac’s *The Principles of Quantum Mechanics*, Chap. 1.3).

Considering the medium nature of the vacuum and the particle properties of light, it can be believed that **the constancy of light speed in a vacuum only means that the propagation speed of the same photon in a specific static vacuum (rather than in any reference frame) is constant**. Based on this understanding, it is reasonable to infer that the relative motion of light sources will cause the deflection of light (which has been confirmed by stellar aberration), thereby intuitively clarifying a few inferences of relativity.

### 2.3 The light deflection induced by relative motion

The measurable speed of light in a vacuum remains constant (ignoring the propagation of light before interacting with the vacuum of observation reference frames), but the direction of light can be deflected by gravity, manifesting that the effective acceleration acting on photons is embodied in their radial directions. From the deflection of starlight in stellar aberration phenomena (where the star that is approximately stationary in the sun's gravitational field can be viewed as a moving light source relative to the earth), it can be deduced that the light emitted by a moving light source will be deflected towards the motion direction of the light source when interacting with the static vacuum of stationary inertial frames (ignoring for now the impact of the **Hill sphere** on observations).

Suppose a laser transmitter (whose stationary horizontal coordinate system is  $X'-O'-Y'$ ) moves with velocity  $v$  along the  $X$ -axis of an observer's coordinate system  $X-O-Y$ , and the angle between its laser beam (parallel to the  $X-O-Y$  plane) and the  $X'$ -axis is  $\alpha$ . For the  $X-O-Y$  coordinate system, the laser photon will deflect towards the moving direction of the laser transmitter with an angle of  $\beta$  ( $\sin\beta \approx v\sin\alpha/c$  when  $v \ll c$ ) due to the initial radial impulse  $\mathbf{p} \cdot \sin\alpha$ . When the laser beam is emitted perpendicular to the  $X'$ -axis ( $\alpha = \pi/2$ ), its deflected angle  $\beta$  satisfies

$$\sin\beta = \frac{v}{c} \quad (0 \leq v < c), \quad (2)$$

which has been confirmed by the observation of stellar aberration, showing that the velocity (including direction) of light in a vacuum is **not strictly “independent of the state of motion of the emitting body”**.

For a star directly above an observer on the earth (where  $\alpha = \pi/2$ ), the speed of the starlight parallel to the tilted lens barrel of the observation telescope is  $c$ , and its component (or projection) perpendicular to the ground is  $c \cdot \cos\beta = c \cdot \sqrt{1 - v^2/c^2} = \sqrt{c^2 - v^2}$  (where  $v$  is the earth's revolution speed). In this case, the composition of the velocity of a photon (particle) still seems to obey the parallelogram law of classical mechanics, except that its speed is a constant in the vacuum with which it interacts. Accordingly, when the photon emitted from a moving emitter interacts with the vacuum dragged by a resting inertial frame, its speed relative to the emitter will change and will no longer be the constant  $c$ .

### 2.4 Light deflection and the projection view of special relativity

Since the coordinate transformation keeps space-time distances invariant (similar to the vector-module invariance of Euclidean-space rotation), the Lorentz transformation can be considered an orthogonal mapping (a microscopic rotation related to vortices and energy) of the quantum-level motion system of particles with non-zero mass in three-dimensional space. To explain the “transformation of time” (see *Feynman Lectures on Physics Volume I*, Chap. 15-4), Feynman also took the photon emitted perpendicular to the moving direction of an atomic clock as an example: “the distance the light travels in the same time is proportional to  $c$ , and the vertical distance is therefore proportional to  $\sqrt{c^2 - v^2}$ . ... (that is the source of the square root expressions in our equations).”

When the initial emitted direction of a photon (or other light-speed particles, e.g., neutrinos) is orthogonal to the velocity  $v$  of the emitted particle, its radial deflection angle  $\beta$  follows

$$\cos\beta \approx \sqrt{1 - \frac{v^2}{c^2}} = \frac{m_0 c}{\sqrt{m_0^2 c^2 + p^2}} = \frac{m_0}{\sqrt{m_0^2 + m_p^2}} > 0 \quad (m_0 > 0), \quad (3)$$

where  $v = \frac{p}{\sqrt{m_0^2 + (p/c)^2}} < c$  now can be considered an empirical formula (although it is also an inference of relativity);  $m_p = p/c$  can be understood as the energy factor of bound-state photons that contribute momentum  $\mathbf{p}$  (via a fully

inelastic collision) to the particle with mass  $m_0$ , as Newton's *Optics* (Ques. 30) conjectured, “**Bodies receive much of their Activity from the Particles of Light which enter their Composition**”—the relativistic energy-momentum relation reflects this conjecture. Similar to the fact that the magnetic field induced by a moving charge is not observable in the stationary reference frame of the charge, the bound-state photons that drive a particle moving are also invisible in the stationary reference frame of the particle (ignoring the observable change in its energy-related spin frequency).

In the Hafele-Keating experiment [4], whether an atomic clock is moving east or west, its “time dilation” depends on its speed relative to the resting earth's center, not relative to the resting ground. Also, the relativistic composition speed between two atomic clocks has no observable substantive meaning for the “time dilation” between them. Therefore, **the so-called relativistic composition speed should not apply to Eq. (3).**

Equation (3) shows that a particle with non-zero mass cannot be directly accelerated to light speed in a stationary reference frame. Even though the synthesis speed of two particles exceeds light speed (according to Galileo transformation), the “relativistic kinetic energy” of one particle relative to the other still equals the algebra sum (obeying Galileo transformation) of the “relativistic kinetic energy” of the two particles (moving below light speed) relative to a certain stationary reference frame. Thus, we can grasp certain inferences of special relativity from the perspective of projection:

$$\left. \begin{array}{l} \text{rotation-system distance projection } ct \cdot \cos\beta = ct_0, \\ \text{moving-system energy projection } E_v \cdot \cos\beta = m_0 c^2, \end{array} \right\} \quad (4)$$

where  $E_v = m_0 c^2 / \cos\beta = \sqrt{m_0^2 + p^2 / c^2} c^2$  is the relativistic energy-energy relation;  $t = t_0 / \cos\beta = ct_0 / \sqrt{c^2 - v^2}$  merely means that when keeping a given projected distance  $ct_0$  in a particular stationary reference frame, a specific light-speed particle travels a longer distance  $ct = ct_0 / \cos\beta$  or its speed relative to the moving system it belongs to slows to  $c \cdot \cos\beta = \sqrt{c^2 - v^2}$ , not that the moving system experiences a slower speed of time elapsing. If the motion period  $T = T_0 / \cos\beta$  of such a deflected light-speed particle (whose specific relative speed  $c \cdot \cos\beta$  is insisted on being transformed into the constant  $c$ ) is regarded to remain invariant, using it for timekeeping ( $t_v = \frac{\Delta t_0}{T/T_0} = t_0 \cos\beta$ ) would appear to reflect the so-called time dilation rather than the changes in the timing period of clocks.

## 2.5 Light deflection and time dilation

Of particular note is the Hafele-Keating experiment [4], which is thought to demonstrate the so-called time dilation. In fact, the experiment proved that the earth's center is approximately an **absolute reference system** within the earth's Hill sphere (like the special status of the Minkowski metric whose world line is a geodesic). There is no time dilation between equal-weighting reference frames relative to the earth's center (regardless of how they move relative to each other), and relative motion between observers does not necessarily generate time dilation effect.

As shown in  $ct \cdot \cos\beta = (c \cdot \cos\beta) \cdot t = ct_0$ , time dilation is nothing but the change in the motion time required by deflected light-speed particles in a rotation system when the projected distance  $ct \cdot \cos\beta$  remains invariant or the projected speed  $c \cdot \cos\beta$  varies. Specifically, the so-called time dilation (the variation of a particular motion period) verified critically by electron transition or particle decay (rather than a single pendulum) can be expressed as

$$T \approx \frac{cT_0 \cdot \sqrt{1 - \frac{2R_0 g_0 + r_0 a_0}{c^2}}}{c \cdot \sqrt{1 - \frac{2Rg + ra}{c^2}}} = \frac{\sqrt{c^2 - (2R_0 g_0 + v_0^2)}}{\sqrt{c^2 - (2Rg + v^2)}} T_0, \quad (5)$$

where  $2R_0 g_0 + v_0^2 \ll c^2$  (a correction term from the earth's gravity and rotation) can be ignored when the “absolute” speed  $v$  (sustainable, relative to the earth's center, or relative to a centrally directed force field that can ignore the

earth's gravity) is close to light speed  $c$ . **Note:** When  $v$  is well above the third cosmic velocity, there must also exist an equivalent centrally directed force field (e.g., cyclotrons, or a point in the galaxy), where  $ra = v^2$ ; when the surface gravity of a dense celestial body (whose internal gravitation follows Newton's shell theorem) satisfies  $2Rg \geq c^2$ , its constituent particles will have no discrete energy levels (no significant radiation from transition or decay, but there is still a conversion of energy to matter and the spin motion of elementary particles, and thus, **time never stops**).

For example, the timing period of an atomic clock (which keeps time by electrons capturing and releasing photons) on a GPS satellite is

$$T_G \approx \sqrt{\frac{c^2 - 2R_\oplus g_0 - v_0^2}{c^2 - 3R_G g_G}} T_\oplus, \quad (6)$$

where  $\sqrt{R_\oplus g_0} \approx 7905 \text{ m} \cdot \text{s}^{-1}$ ,  $v_0 \approx 465 \text{ m} \cdot \text{s}^{-1}$ , and  $\sqrt{R_G g_G} \approx 3885 \text{ m} \cdot \text{s}^{-1}$ . So, is its timing speed faster by about  $38 \mu\text{s}$  every day? Essentially, the atomic clock at different gravitational fields ticks at different rates [5], which is unified with the timing period variation  $\frac{T_1}{T_2} \approx \frac{\sqrt{g_2}}{\sqrt{g_1}}$  of a pendulum clock at different gravitational potentials, reflecting the change in the motion state of objects under different forces rather than the change in the elapse speed of background time of isotropic cosmic space.

## 2.6 The motion laws of photons and the large-scale structure of Universe

Undoubtedly, it is necessary to reintroduce the medium model of vacuum and classicize the space-time view of special relativity. After all, a clearer physical cognition of the constancy and radial deflection of light speed is critical for us to further explore the fluid properties of the vacuum and the large-scale structure of the universe.

According to experiments, near-light-speed positrons and electrons are encircled by an ultra-strong circumferential magnetic field  $\mathbf{H} = \frac{1-v^2/c^2}{(1-v^2 \sin^2 \alpha / c^2)^{3/2}} \frac{(\mu_0 e \mathbf{v}) \times \mathbf{r}}{4\pi \mu_0 r^3}$  ( $\alpha \rightarrow \pi/2$ ;  $q_m = \mu_0 q v$  can be defined as a magnetic charge), and their collisions can generate various leptons and hadrons [6]. Moreover, the vacuum electromagnetic field depends on electric charges rather than mass. Hence, the charges "disappearing" after energy released from particle-antiparticle annihilation (e.g.,  $e^+ + e^- \rightarrow 2\gamma_{m_e c^2}$ ) should have zero mass and will fuse into the vacuum dielectric in positive-negative pairs (which can be considered invisible neutral virtual electron pairs  $e_v^+ + e_v^-$ ). Besides, photons are subjected to gravitation, which should also be related to the vibration of virtual electrons in the vacuum, since photons have little interaction between them but easily interact with charged particles (including charged particles that are electrically neutral as a whole).

Naturally, the vacuum dielectric composed of virtual electron pairs can present electromagnetic fields and provide electric charges to the resulting particles from positron-electron collisions. Such zero-mass virtual electron pairs (with non-zero energy close to cosmic background radiation) inevitably oscillate at light speed, where the single virtual-electron spin is a uniform circular motion obeying  $|\mathbf{r} \times \mathbf{p}_{e_v}| = \hbar$  and the total spin of a virtual electron pair is  $\mathbf{r} \times \mathbf{p}_{e_v^+} + \mathbf{r} \times \mathbf{p}_{e_v^-} = 0$ . (It is reasonable to settle the spin of elementary particles as a circular motion based on the correlation of photon spin to polarization and the correlation of electron spin to its magnetic moment.) Now, we can imagine the inherent resonance frequency of virtual electron pairs (who else could it be?) endows the vacuum with absolute permittivity  $\epsilon_0$ .

In addition, photons have the following physical properties: The photon is an elementary particle, specifically an energy quantum (see photoelectric effect and Compton effect); its escape from a gravitational field consumes energy (see gravitational redshift); its escape requires overcoming the gravitation of countless galaxies (see Newton's shell



theorem and Newton's law of gravitation) and it will accumulate considerable redshifts on the escape path; it (as a free photon, the same below) does not get trapped in the Hill sphere of a star and is subject to the gravitation from numerous galaxies simultaneously at every moment; it can be deflected by gravitation, but its escape speed remains constant under gravitation (superposed gravitational acceleration can only act upon its radial direction); it has particle-like momentum  $\frac{h\nu}{c^2}c$  and translational kinetic energy  $\frac{1}{2}\frac{h\nu}{c^2}c^2$ , but it is invariably weightless as it travels along the geodesic (escape path)... Consequently, one reasonable inference is that the escape of starlight is a uniform circular motion along the geodesic (great circle) of a large-scale spherically symmetric space. Based on the principle of least action, we can infer that starlight travels along one great-circle path (ignoring local gravitational lenses) from one galaxy to another within the great circle.

Suppose the maximum radius of the spherically symmetric space orbited by starlight is  $r_u$  and the vacuum pressure (or energy density  $\rho_{vac}c^2$ ) relative to photons is  $P_{vac}$  ( $P_{vac} = \rho_{vac}c^2$ ), then the light speed  $c$  can be expressed as

$$c = \frac{1}{\sqrt{\epsilon_0\mu_0}} = \sqrt{\frac{P_{vac}}{\rho_{vac}}} = \sqrt{g_u r_u} = \frac{h/m_\gamma}{4\pi} \int_0^\pi \frac{\sin\theta d\theta}{r}, \quad (7)$$

where the last term is derived from the Biot-Savart law in fluid mechanics, and  $m_\gamma = h\nu/c^2$  is an energy factor of zero-mass vacuum particles whose spin follows  $|\mathbf{r} \times m_\gamma \mathbf{c}| = \hbar = h/2\pi$ . As for  $c = \sqrt{g_u r_u}$ , not only does it indicate that the orbiting speed of the spherically symmetric space with radius  $r_u = \frac{G\rho_u V}{c^2} = \sqrt{\frac{3c^2}{4\pi G\rho_u}}$  (applicable to photons whose escape speed is constant and far exceeds the fifth cosmic speed) is light speed, but its expression is consistent with the surface wave speed  $v = \sqrt{gd}$  of shallow water with an effective depth of  $d$  and an equivalent wavelength of  $\lambda = 2\pi d$ .

Evidently, Eqs. (1) and (7) hold out a natural and unified dynamical explanation for the constancy of light speed, and they also imply a large-scale structural model of an infinite universe (no Big Bang, no violation of the law of energy conservation, and no Earth-centricity to define cosmic size). Simply by measuring the average density  $\rho_u$  of the universe, we can directly calculate the observable cosmic radius (the so-called Hubble length)  $R_U = 2r_u = \sqrt{\frac{3c^2}{\pi G\rho_u}}$ , the observable cosmic mass  $M_U = \frac{4\pi}{3}R_U^3\rho_u = \frac{4c^3}{G}\sqrt{\frac{3}{\pi G\rho_u}}$ , and the Hubble time (the so-called cosmic age)  $t_{H_0} = \frac{R_U}{c} = \sqrt{\frac{3}{\pi G\rho_u}}$ .

Another key point is that from the translational kinetic energy  $\frac{1}{2}h d\nu = -\mathbf{F} \cdot d\mathbf{r} = -\frac{G(\rho_u V)(h\nu/c^2)}{r^2} \frac{\sqrt{R_U^2 - r^2}}{R_U} dr$  (where  $r = R_U \left| \sin \frac{ct}{R_U} \right|$ ) consumed by the escape of starlight, we can derive a classical cosmological redshift equation (ignoring the increase in the effective escaped displacement and redshift extrema caused by the refraction of starlight into non-its original spherically symmetric space)

$$Z_U \approx \exp \left\{ \frac{8}{3} \left( 1 - \left| \cos^3 \frac{ct}{R_U} \right| \right) \right\} - 1. \quad (8)$$

This formula clearly has a more adequate theoretical basis to replace the Big Bang model to account for the distance-dependent redshift of starlight, showing that a steady-state infinite universe can display a cosmological redshift that appears as if the universe once expanded (if one can only think of the Doppler effect, without ever imagining the escape of starlight) and the expansion is accelerating (since  $\frac{dZ_U}{dt} \neq C$  has an interval that decreases with time and approximately matches observations).

Of course, for a steady-state universe, the isotropic cosmic microwave background (CMB) can also be more reasonably explained by the black-body radiation of ground-state hydrogen atoms in the vacuum inside the static Hill spheres dragged by different stars and galaxies (as well as galaxy groups and clusters). In the same (distant)

region, the velocities of the Hill spheres of different galaxies relative to our detector must not be exactly the same, which undoubtedly leads to tiny fluctuations in the isotropic cosmic microwave background. By examining the elastic deformation (total potential energy  $\mu_B B_{a_0}$ ) and precession (frequency  $\frac{1}{2\pi} \frac{e B_{a_0}}{2m_e}$ ) of the electron spin magnetic moment, the “surface temperature” of an isolated ground-state hydrogen atom can be obtained from

$$T_0^H \approx \frac{2}{3k} \left( \frac{1}{2} \mu_B B_{a_0} \right) = \frac{2}{3k} \left( \frac{1}{2} h \frac{e B_{a_0}}{4\pi m_e} \right) = \frac{2}{3k} \frac{1}{2} \left[ \frac{1}{2} \frac{(\mu_0 e \alpha c)^2}{4\pi \mu_0 a_0} \right] \approx 2.80 \text{ K}, \quad (9)$$

where  $B_{a_0} \approx \mu_0 \frac{\mu_0 e(\alpha c)}{4\pi \mu_0 a_0^2} = \frac{\alpha^4 m_e c^2}{2\mu_B}$  ( $|\mathbf{a}_0 \times m_e(\alpha c)|_{\alpha c \perp \mathbf{a}_0} = a_0 m_e(\alpha c) = \hbar$ ,  $\mu_B = \frac{e}{2m_e} \hbar = \frac{1}{2} a_0 e(\alpha c) = \frac{e}{2\pi a_0 / \alpha c} (\pi a_0^2) = \frac{1}{2} |n \mathbf{a}_0 \times e(\frac{\alpha}{n} c)|$ ).

### 3. Conclusions

By investigating the physical mechanism of the constancy of light speed, this paper presents the medium nature of the vacuum, the classical counterpart of elementary-particle spin, the projection view of certain relativistic inferences, and the large-scale structure of the Newtonian universe. Accordingly, such a plain universe can be fully explained by the modified classical mechanics without being described by the empirically counterintuitive Friedmann equations (which give an expanding cosmic model that both violates the law of energy conservation and is centered on the earth to define cosmic size) and special relativity (whose space-time view complicates physics concepts). Go to verify Eqs. (2) and (3) strictly in different inertial frames and simplify established theories from a unified perspective, which will bring us a little closer to the truth about nature.

**Note:** The main points of this paper have been discussed in a preprint analyzing the large-scale cosmic structure, in which the resulting average cosmic density is expressed as a constant  $\rho_u = \frac{m_p^3}{m_e M_p^2} \frac{3m_p}{4\pi(\hbar/m_e c)^3} \approx 7.52 \times 10^{-26} \text{ kg} \cdot \text{m}^{-3}$  ( $M_P = \sqrt{\frac{\hbar c}{G}}$ ), the relevant cosmological constants (e.g., substituting  $\rho_u$  into the calculated  $M_U = \frac{4c^3}{G} \sqrt{\frac{3}{\pi G \rho_u}} \approx 7.04 \times 10^{53} \text{ kg}$ ,  $R_U = \sqrt{\frac{3c^2}{\pi G \rho_u}} \approx 1.307 \times 10^{26} \text{ m}$ , and  $t_{H_0} = \frac{R_U}{c} \approx 4.36 \times 10^{17} \text{ s} \approx 13.82 \text{ Gyr}$ ) agree nicely with the astronomical observations [7], and the corresponding cosmic model will be further verified by the James Webb Space Telescope (which will observe more and earlier regular galaxies that conflict with the Big Bang).

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I am grateful that Newton’s thoughts on physics still resonate with me today.

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