

A Cosmic Time Dilation Model for the Week of Creation

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Abstract—A scientific interpretation of creation reconciling the beliefs of six literal days of creation and a 13.7-billion-year-old universe currently perceived by most modern cosmologists is proposed in this paper. We hypothesize that the reference timeframe of God's creation is associated with some cosmic time different from the earth's time. We show that the scale factor of *earth time to cosmic time* can be determined by the solution of the Friedmann equations. Based on this scale factor and some basic assumptions, we derive a Cosmic Time Dilation model that harmonizes the literal meaning of creation days and scientific discoveries with remarkable accuracy.

Keywords—Cosmological expansion, time dilation, creation, Genesis, relativity, Big Bang, biblical hermeneutics.

I. INTRODUCTION

THE quest for understanding the origin of the universe has been one of humanity's most profound pursuits since the dawn of civilization. The Holy Bible said that God created the universe in six days and has rested on the seventh day [1]. Over the years, theologians and biblical scholars have been perplexed by the six-day creation in the Book of Genesis. The meaning of "days" within the context of biblical creation can be interpreted in various ways. These days could be literally twenty-four-hour periods or represent longer periods. The nature of the creation account can also be seen as either a poetic or historical narrative. In addition, the universe's age is a subject of debate, with different perspectives ranging from a young earth view to an ancient universe view based on scientific evidence. There have been a lot of debates [2], [3] among creationists of young earth and old earth regarding these questions. The young earthers insist on the literal meaning of "day" equal to 20 hours in the Bible and believes that the universe was created in six days and was about 6,000 to 10,000 years old [4]. On the other hand, the old earthers believe that the universe was created in six long periods and about fourteen billion years ago supported by modern cosmology and astrophysics [5].

Many Christians and seekers are confused by the contradicting conclusions about the age of the universe from both creationist camps. This is particularly true to young adults in America. A significant factor contributing to the sense of disconnection among young adults from church or faith is the perceived tension between Christianity and science. A prevalent perception is that "Christians are too confident they know all the answers" (35%). Additionally, three out of 10 young adults with a Christian background believe that

"churches are out of step with the scientific world we live in" (29%). Another quarter of individuals hold the view that "Christianity is anti-science" (25%) [6].

Although the Bible is not a book of science, many creationists have attempted to offer systematic scientific explanation for the creation recorded in Genesis 1 [7]. For the past century, young earth creationists have tried hard to defend their positions of the universe created in six-literal-days and just thousands of years old. However, one of the most challenging problems for young earthers was to explain distant starlight in a young universe. The challenge revolves around explaining how light could traverse the immense distances from the farthest corners of the universe within a timeframe consistent with the biblical account of creation. Young-earth creationists and various cosmologies have endeavored to address this issue through different approaches. Some propose concepts like starlight being created in transit, a progressively diminishing speed of light, and alternative synchrony conventions [8]. Moreover, multiple relativistic solutions [9], [10] replying on Einstein's theory of general relativity have been proposed in the past three decades. Certain creationists have invoked the notion of time dilation as a potential explanation. According to this theory, specific cosmological models might permit a relatively swift progression of time, amounting to several billion years, in the remote regions of the universe. Meanwhile, only six days of time would have elapsed on Earth during the creation week. Advocates of this idea assert that it could provide an explanation for how starlight from galaxies billions of light years away reached Earth between the creation of cosmic bodies on day four and the creation of man on day six. Such time dilation cosmology, however, met with criticism of its scientific assertions even within the young-earth community [11].

On the contrary, old-earth creationists such as day-age creationists and progressive creationists prefer that the days of Genesis be long epochs to accommodate the modern Big Bang cosmology supported by the scientific evidence of expanding universe and the foundation of general relativity. Another approach to interpreting creation account in Genesis is to use a cosmic timeframe of reference different from that of the earth to describe those six days [12]. That way one can still retain a traditional view of six 24-hour days of creation while incorporating the discoveries of modern science for an aged universe. The key contribution of this paper is to apply this approach more vigorously and use the solution of Friedmann

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This work was straightly author's personal views that do not represent the churches or Christian organizations with which the author affiliates, unless otherwise clearly specified.

equations to derive the mapping between Genesis cosmic time and earth-based time based on the concept of time dilation due to cosmological expansion.

The rest of this paper is organized as follows. Section II explores the meaning of the word “Day” in the Book of Genesis. In Section III, modern cosmology based on general relativity is briefly reviewed and the concept of the time dilation is discussed. Focus is given to explaining the age of the universe. Section IV derives the proposed Cosmic Time Dilation (CTD) model and establishes a simple mathematical relation between Genesis cosmic time and earth-based time. In Section V, the CTD model is validated by both biblical timing of creation events recorded in the Book of Genesis and the corresponding scientific dating through secular discoveries. Conclusions are finally drawn in Section VI.

II. MEANING OF “DAY” IN THE BOOK OF GENESIS

The Bible said that God created the universe in six days. However, it is unclear if these days are literally 24-hour days or they each represent a long period of time. To gain better understanding of how God created the universe, it is crucial to find out the proper biblical meaning of “day”. The Hebrew word *yom* translated into the English “day” can mean one of the followings:

- the period of 24 hours that it takes for the earth to rotate on its axis (Gen 7:11)
- the period of daylight between dawn and dusk (Gen 1:16), or
- an unspecified period (Gen 2:4)

The word *yom* has been used 2,301 times in the Old Testament. Outside of Genesis 1, *yom* plus an ordinal or cardinal number (i.e., Day one, second day, third day etc.) was used 410 times and almost always indicates an ordinary 24-hr day. The words *evening* and *morning* together used 38 times and most often indicate an ordinary day except in Daniel 8:26 which clearly implies a long period of time. After all, the context in Genesis 1, where the word *yom* is employed to describe each day as “the evening and the morning,” strongly indicates an interpretation of 24-hour periods. Furthermore, Exodus 20:9-11 supports this perspective by asserting that God established the six creation days of Genesis as a blueprint for humanity’s workweek—working for six days and observing a day of rest on the seventh. God wanted to provide an example for us to follow. It might be confusing if those six days of creation each is not 24-hr day. Hence, 24-hr day was the general interpretation of the days of Genesis 1 for most of Christian churches. Having that said, some early church fathers, such as Augustine, suggested a non-literal interpretation for the word “day”. Ancient Jewish scholar Nahmanides intuited that the six days of creation contain “all the secrets and ages of the universe” and those six days are special [13].

It is interesting to note that the starting date of the Jewish calendar was not set at beginning of the universe (Genesis 1:1) but rather set at the creation of the souls of Adam and Eve (Genesis 1:27) according to Jewish standard practice [14]. The year number on the Jewish calendar represents the number of years calculated by adding up the ages of people (since Adam)

in the Bible back to the time of creation. In other words, those six days of creation were never included in the Jewish calendar. Moreover, the description of time and events before Adam were very much different than that after him. During the first six days, blocks of events are described and then we are told that day one passed. In that case, time is driving the event description. The same pattern of event description was repeated for the second day and so on in a total of six times. It is as God Himself reporting the creation events from a higher dimension of heavens. After Adam had appeared, the accounting of time and events dramatically changed. The earthly events became the cause of the flow of time. For instance, Adam’s descendants are described by looking backward in time reporting how long each lived from a human’s perspective. Table I summarizes the differences of time/event description in the Book of Genesis before vs. after Adam appeared.

TABLE I
 COMPARING TIME/EVENT DESCRIPTION BEFORE & AFTER ADAM

Time/Event Description	Before Adam	After Adam
Communication type	Time-driven	Event-driven
Time arrow	Forward	Backward
Location	Heavens	Earth
Perspective	God	Human

From the above interesting observations, it is not surprising to hypothesize that different timeframes of reference (clocks) were employed to account for events happened before and after Adam appeared. Besides, the Bible seems to indicate that time in different timeframes of reference could also run at different speeds. Psalms 90:4 said, “*One thousand years in your sight are but a single day that passes by, just like a night watch*”. God and human in different timeframes of reference could have very different perspectives in terms of time which is interestingly similar to the modern concept of relative time in Einstein’s theory of relativity.

In summary, many biblical scholars believe that six literal days is the most likely interpretation of the Genesis account based on the principles of hermeneutics [15]. Yet those six-literal-days of creation could mysteriously comprise the ages of the universe. Modern cosmology and time dilation could offer a resolution to such a mystery.

III. MODERN COSMOLOGY AND TIME DILATION

Modern cosmology is the science about the origin and development of the universe. The Big Bang theory is a prevailing cosmological model framework based on general relativity as put forward by Albert Einstein [16] and Alexander A. Friedmann [17] in the 1920s. The model accounts for the fact that the universe expanded from a very high density and high temperature state. Following the initial expansion, the universe underwent a cooling process that enabled the creation of subatomic particles and, subsequently, basic atoms. Massive clouds composed of these primordial elements eventually came together under the influence of gravity, giving rise to the formation of stars and galaxies. From Einstein’s field equation of gravitation, Friedmann first derived a set of equations that

governs the spacetime expansion in homogeneous and isotropic models of the universe. Ever since Georges Lemaître initially observed in 1927 that a universe undergoing expansion could be retraced to a singular starting point or singularity, scientists have developed and expanded upon his concept of the universe originating from a "big-bang" event.

Accumulated scientific evidence provides strong support for such an expanding cosmological model of Big Bang. The two primary observational phenomena are the universe's expansion and the cosmic microwave background. Initially, regarding the expansion of the universe, galaxies are observed to recede at a rate proportional to their distance from us, discovered by Edwin P. Hubble [18] in the 1930s. Second, the cosmic microwave background (CMB), the afterglow of the Big Bang, as a very isotropic blackbody radiation at a temperature of about 2.7 degrees Kelvin, was discovered in 1965 by Arno A. Penzias and Robert W. Wilson [19]. Presently, these observations have been verified with an accuracy within a few percent, contributing to the establishment of the latest standard parameterization of the hot Big Bang, incorporating dark matter and dark energy. This model is commonly known as the Lambda-CDM model [20].

In our relativistic universe, the condition of the observer relative to the events being observed strongly affects the perception of those events. One such perception is the passage of time. Due to the principles of relativity, individuals can encounter the phenomenon of time dilation. This refers to a disparity in the elapsed time measured by two clocks, arising from either their relative velocity or variations in gravitational potential between their respective locations. It is important to note that unlike Doppler redshift due to relative velocity, cosmological redshift is due to expansion velocity or the expansion of space itself. The latter is the cause of the so-called CTD. Photons originating in a specific region of the universe traverse through space, undergoing time dilation. This dilation is expressed as a reduction in their frequency due to the expansion of the universe. In other words, the ticks of a clock within the emitter's frame of reference appear stretched when observed from a different co-moving reference frame situated some distance away. The duration and wavelength of light emitted from a distant object, characterized by the redshift z , will be elongated by a factor of $1+z$ when perceived by the observer. A proof of the CTD related to cosmological redshift is given in Appendix A.

IV. COSMIC TIME DILATION MODEL FOR CREATION

The Bible said that Adam and Eve were created on the sixth day. According to Hebrew time reckoning, we are currently in the sixth millennium. The Hebrew calendar commences its year count from 3761 BC, marking the year when, according to tradition, Adam left the Garden of Eden entering civilization. This practice was formalized in the 12th century by the Jewish philosopher Maimonides, who set the timeframe based on the biblical date of creation. In fact, most archeologists also believe this fundamental development in human evolution took place in the Tigris/Euphrates Valley almost 6,000 years ago.

Modern cosmology estimated the age of the universe by measuring the rate of expansion or the Hubble constant of the

universe and extrapolating back to the Big Bang. The accuracy of this extrapolation relies on the historical expansion rate, which, in turn, is contingent upon the current density and composition of the universe. These parameters can be accurately determined by analyzing the cosmic microwave background using the Planck satellite. As of this writing, astronomers have estimated the age of the universe to be 13.77 ± 0.04 billion years [28].

The age of human history and the age of the universe turn out to be keys for our proposed CTD model to reconcile the belief of literal six-days of creation and the belief of an old universe. Light is the very first thing that God spoke of creating. According to Einstein's special theory of relativity, anything like a photon or light particle traveling at the speed of light experiences no time at all. Anything with mass, m , however, can never travel at the speed of light, c , so it always experiences time. At about the first 10^{-6} seconds of the Big Bang, quarks became confined within hadrons entering the so-called hadron epoch. This was when energy, E , was transitioning to form stable matter according to Einstein's famous equation of $E = mc^2$. We hypothesize that God chose this moment of stable mass forming or quark confinement to start His cosmic-clock timer for creation. Six days of cosmic time were dilated in earth time due to cosmological expansion. In Appendix B, this hypothesis is validated by estimating the six days of creation in earth time. After the first six days of creation, the biblical account switched the timeframe of reference from the cosmic clock to the earth-based clock when Adam got his spirit or consciousness from God's breath (Gen 2:7). From a humankind perspective, the age of the universe is the sum of the dilated six days of creation in perceived earth time and all the days on the Jewish calendar up till present time.

To derive the mapping of cosmic time to earth time, we consider the solution of the Friedmann equations for the spatially flat universe [20]. The solution for the scale factor is:

$$a(t) \propto \begin{cases} t^{1/2}, & \text{radiation dominated} \\ t^{2/3}, & \text{matter dominated} \\ e^{H_0 t}, & \text{dark energy dominated} \end{cases} \quad (1)$$

where H_0 is the Hubble constant and t denotes time counting from the beginning of the universe. Modern cosmology believes that our universe was dominated by radiation in the first 47 thousand years since the Big Bang. Between 47 thousand years to 9.8 billion years of age, the universe was matter dominated. The rest of the history of the universe into the future is dominated by the so-called dark energy. From the derivation of CTD in Appendix A, we noticed from (12) that time interval, δt , is proportional to cosmic scale factor, $a(t)$

$$\delta t \propto a(t) \quad (2)$$

By using a more common term to reference creation events in time, we introduce a "time-ago" or "age" variable t_a as depicted in Fig. 1. Hence, we obtain following proportional relationship:

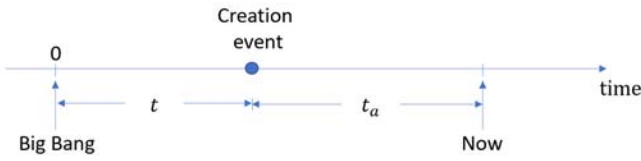


Fig. 1 Time ago vs. Time from the Big Bang

$$\delta t_a \propto -\delta t \propto -a(t) \quad (3)$$

Inspired by the facts that i) $-a(t)$ is a monotonically decreasing function with some fractional-polynomial “decay” characteristics in most of the past history of our universe, and ii) the integral of an exponential function is an exponential function itself, we propose using (4) to approximate the mapping of cosmic time τ (in days) onto the corresponding time-ago t_a (in years) observed on earth:

$$t_a(\tau) = k_1 + k_2 e^{-k_3 \tau} \quad (4)$$

where k_1 , k_2 and k_3 are constant parameters. For the proposed CTD model, we have the following three assumptions:

- (i) From Adam, human history has started about 6,000 years ago on earth,
- (ii) The universe is about 13.7 billion years old, and
- (iii) One creation day (24-hours) for the cosmic clock is the “half-life” of the dilated time history for the earth-based clock.

The justification of assumptions (i) and (ii) were discussed in the beginning of this section. Half-life, the duration required for a quantity undergoing exponential decay to reduce to half of its initial amount, is the only crucial parameter associated with an exponential decay function independent of system boundary conditions. In the Book of Genesis, “day” is the only length of time used to describe the creation week. Thus, we make assumption (iii) by equating the half-life ($T_{1/2}$) of the dilated time history with the 24-hr creation day – i.e., $T_{1/2} = 1$. With the above three assumptions, one can easily determine k_1 , k_2 and k_3 of (4) from the following boundary conditions and the “half-life” definition:

$$t_a(6) = k_1 + k_2 e^{-k_3(6)} = 6000 \quad (5)$$

$$t_a(0) = k_1 + k_2 = 13.7 \times 10^9 \quad (6)$$

$$e^{-k_3(1)} = 1/2 \quad (7)$$

Solving the system of (5)-(7), we obtain $k_1 = -0.218 \times 10^9$, $k_2 = 13.9 \times 10^9$ and $k_3 = 0.693$. Hence using (4), we can compute the age of the universe at the ending time of each dilated creation day as shown in Table II.

The proposed CTD model is plotted in Fig. 2. It is interesting to note that, unlike the first six days, there was no mentioning of the evening and the morning for the seventh day of God’s creation in the Bible. This may indicate that the seventh day has not ended or may not have an end at all. On the seventh day, God has rested from His creative work and has been in His “sustaining mode” since then.

TABLE II
 TIME AGO IN EARTH TIME FOR DILATED SIX DAYS OF CREATION

Creation Day of Genesis	Time Ago (Year)
0	13.7 billion
1	6.73 billion
2	3.26 billion
3	1.52 billion
4	652 million
5	217 million
6	6000

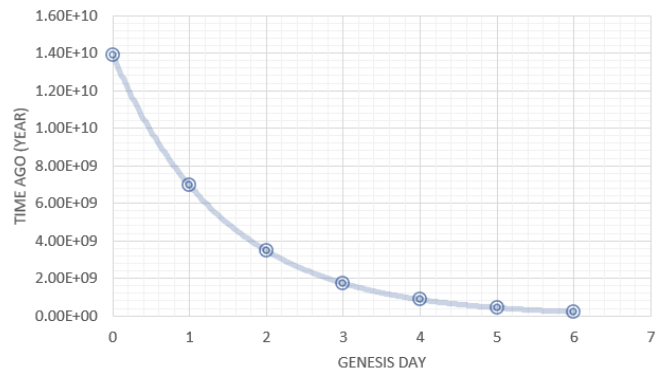


Fig. 2 The Mapping of Genesis Day to Time Ago (CTD Model)

V. CTD INTERPRETATION OF THE CREATION WEEK

Using the proposed CTD model in the previous section, the creation events described in the Book of Genesis can be interpreted and explained in a scientific way. The sequence of scientific observations of cosmology and paleontology is compared with the sequence of key events mentioned in the creation week.

Genesis day one began 13.7 billion years ago and ended 6.73 billion years ago. As the Big Bang model suggested, the universe has a beginning and expanded from a very high density and high temperature state. At this point, physical matters (earth) only existed as shapeless, abstract waves (waters) in underlying quantum field of vacuum (without form, and void) in the first 10^{-43} second. The universe is at the quantum state of some elementary particles at their lowest energy level or the so-called zero-point energy (the deep) determined by Heisenberg uncertainty principle. The divine consciousness (Spirit of God) began to collapse (moved upon) the superimposed wave functions of matters (face of the waters) into their perceived physical reality in terms of the Copenhagen interpretation of quantum mechanics [21]. That concisely sets the initial conditions of the universe as stated in the first two verses in Genesis 1. As the universe cooled, the symmetry of the unified fields began to break (separated the light from the darkness). At about 10^{-6} seconds, quarks and gluons combined to form more stable particles such as protons and neutrons. When the universe was about 380,000 years old, light broke free from electron scattering and first became visible as the cosmic background radiation observed today. The first star was formed when the universe was about 200 million years old and the age of the oldest stars in the thin disk of our Milky Way near our solar system is about 10 billion years. The Bible said that God

spoke light into existence and his creation progressed from a less to greater order (darkness to brightness) and that was day one.

Day two started 6.73 billion years ago and ended 3.26 billion years ago. Most of the stars of our Milky Way was formed during this period. The age of our solar system, derived from the study of meteorites, is near 5 billion years while the age of the Earth was estimated to be 4.5 billion years [22]. As the Bible tells us, on day two the heavenly firmament was made. Jewish scholarly tradition also holds the fact that the Sun was made on day two with the other stars in the firmament or outer space and provided light to the Earth's surface as soon as the Earth formed.

Day three began 3.26 billion years ago and ended 1.52 billion years ago. Until approximately 2.5 billion years ago, most of the Earth was submerged under oceans, leaving only 2% to 3% of the surface as dry land, in contrast to the current 28% of land coverage. Large landmass close to the size of landmass today emerged about 2.3 billion years ago. Around 2.7 to 2.8 billion years ago, tiny organisms known as cyanobacteria, or blue-green algae conducted photosynthesis using sunshine, water, and carbon dioxide to produce carbohydrates and oxygen – the start of plant life. Kabbalah (14th – 16th century Jewish tradition of mystical interpretation of the Bible) held the argument that there was only the start of plant life which was developed further during the subsequent days [23].

Day four began 1.52 billion years ago and ended 652 million years ago. Around 850 million years ago, oxygen started to accumulate in the atmosphere causing it to become transparent. The Great Oxygenation Event (GOE) was the introduction of free oxygen into our atmosphere between about three billion to one billion years ago. That was caused by blue-green algae

doing photosynthesis for a long period of two billion years. Around 2.45 billion years ago, atmospheric oxygen rose suddenly [24]. The Sun, Moon and stars become visible in the sky from the Earth. The Bible said the heavenly bodies became visible that they could be used for telling times and seasons.

Day five began 652 million years ago and ended 217 million years ago. The Bible said that the first animal life swarmed abundantly in waters followed by winged animals. The Cambrian explosion [25] happening approximately 541 million years ago was well within this period. At this stage, practically all major animal phyla started appearing in the fossil record and paleontology now becomes the dominant science to confirm the biblical truth. The multicellular life began to appear 540 million years ago. Fossils of Mud Dragon around 530 million years and fossils of sea monsters with 18 tentacles named *Daihua sanqiong* around 518 million years ago. Amphibians began to appear around 340 million years ago, and birds began to appear around 310 million years ago.

Day six starts 217 million years ago and ended just under 6,000 years ago, at Adam's creation time. There was a mass extinction of life followed by repopulation about 250 million years ago according to paleontology records. Crocodiles and mammals first appeared around 200 million years ago [26]. For millions of years, many species of vegetarian and crocodiles roamed the earth. *Homo sapiens* first appeared between 200 and 300 thousand years ago. The Bible said that the appearance of land animals, mammals and, more importantly, first human being created out from God's image. Green vegetation was given to all land animals and birds for food. God saw all that he had made was very good. That ends the account of the six days of creation.

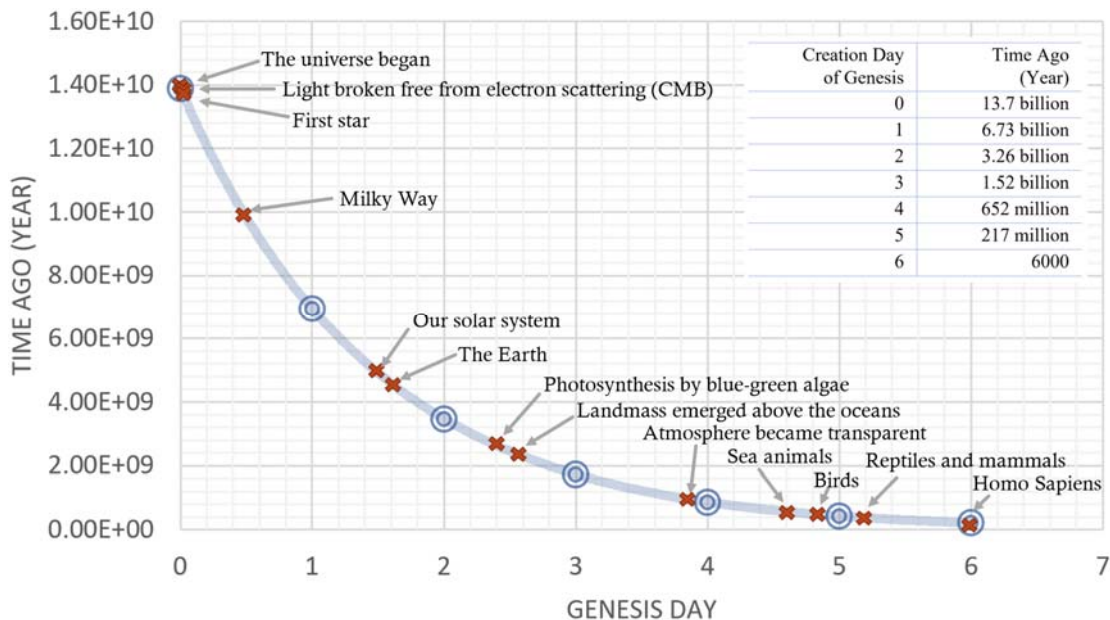


Fig. 3 Main Creation Events of Scientific Discoveries in CTD Model Timeline

Fig. 3 summaries the major cosmological events and paleontological discoveries related to the creation week. It

overlays those creation events and discoveries on the CTD model to illustrate the consistency of timing of events between

the biblical account of creation and scientific discoveries on a day-by-day basis. We can conclude that modern science has come to match the biblical truth.

VI. CONCLUSION

The laws of nature are the general revelation of God. Through scientific discoveries over time, humankind can deepen their understanding of God's creation. Although the main purpose of the Bible is not to tell humankind how the universe is created and governed, the truth of science should be ultimately fully compatible with the truth of God's Word if the Bible is properly interpreted. This paper proposes a scientific interpretation of creation reconciling the belief of literal six days of creation and the old-earth belief of the age of universe of 13.7 billion years. Based on the cosmological scale factor, our proposed CTD model maps the six "cosmic" days onto the corresponding "earth" timeline. Consequently, we found that the sequence of scientific observations from cosmology and paleontology closely match the creation events described in Genesis. This model provides a scientific explanation of the creation week and demonstrates not only that Christians are not necessarily anti-science, but also that science and the Bible are complementary for strengthening our faith in God.

APPENDIX A: DERIVATION OF COSMIC TIME DILATION

In a homogeneous, isotropic expanding universe, the interval ds between two spacetime events is given by the Robertson-Walker (RW) metric [20].

$$ds^2 = c^2 dt^2 - a^2(t) \left[\frac{dr^2}{1-kr^2} + r^2(d\theta^2 + \sin^2\theta d\varphi^2) \right] \quad (8)$$

where c is the speed of light in vacuum, t is time, (r, θ, φ) are the comoving spatial coordinates, $a(t)$ is the dimensionless scale factor, and k is the curvature parameter.

Without loss of generality, we consider radial null rays only ($d\theta = d\varphi = 0$). We note that massless photons travel along null geodesics ($ds^2 = 0$). Hence, for a photon emitted at time t_e from an object located at $(r_e, \theta_e, \varphi_e)$ and observed at time t_o , (8) implies:

$$\int_{t_e}^{t_o} \frac{cdt}{a(t)} = \int_0^{r_e} \frac{dr}{\sqrt{1-kr^2}} \quad (9)$$

Assuming that the object from which the photon was emitted has constant coordinates $(r_e, \theta_e, \varphi_e)$, for a photon emitted at time $t_e + \delta t_e$ and observed at time $t_o + \delta t_o$, Equation (8) also implies:

$$\int_{t_e+\delta t_e}^{t_o+\delta t_o} \frac{cdt}{a(t)} = \int_0^{r_e} \frac{dr}{\sqrt{1-kr^2}} \quad (10)$$

Breaking the integral's interval in (10), and subtracting (9) from (10), we get:

$$\int_{t_o}^{t_o+\delta t_o} \frac{cdt}{a(t)} = \int_{t_e}^{t_e+\delta t_e} \frac{cdt}{a(t)} \quad (11)$$

For small δt_e and δt_o , scale factor $a(t)$ remains roughly constant and (11) becomes:

$$\frac{\delta t_o}{\delta t_e} = \frac{a(t_o)}{a(t_e)} \triangleq \gamma \quad (12)$$

Equation (12) gives the so-called CTD factor γ due to cosmological expansion. Due to cosmological redshift, a light wave emitted with frequency ν_e will reach the observer with frequency ν_o such that:

$$\frac{\nu_e}{\nu_o} = \frac{a(t_o)}{a(t_e)} \quad (13)$$

In other words, the duration of the emitted light from a distant object at the redshift $z \triangleq \nu_e/\nu_o - 1$ will be dilated by a factor of $\gamma = 1+z$ at the observer.

APPENDIX B: ESTIMATION OF SIX DAYS OF CREATION IN EARTH TIME

We note the Planck-Einstein relation for the quantum nature of light:

$$E = h\nu \quad (14)$$

where E is the photon energy, ν is the frequency of peak light intensity, and h is the Planck constant. The Boltzmann constant k is the proportionality factor that links this characteristic microscopic energy E with the macroscopic temperature scale T .

$$E = kT \quad (15)$$

Equating (14) to (15), we obtain the following proportional relationship:

$$\nu \propto T \quad (16)$$

According to the Big Bang model, the very early universe was filled with "quark-gluon plasma" but then had cooled to the point where quarks and gluons combined to form composite particles at about a millionth of a second old. That was when energy was first transitioning to form stable matter and the concept of time has started to be experienced. To estimate the dilated six days of creation in earth time for a homogeneous, isotropic expanding universe, we apply (12), (13) and (16) and cast the CTD factor in terms of temperatures.

$$\frac{\delta t_o}{\delta t_e} = \frac{T_e}{T_o} \quad (17)$$

where T_e represents the temperature of radiation emitted when quarks and gluons breaking free from their confinement inside protons and neutrons, and T_o represents the CMB temperature measured by the observer on earth. According to quantum chromodynamics, the temperature at quark confinement was about 2.04×10^{12} K [27]. Since the CMB measured today is about 2.73 K and the cosmic clock in t_e reference started to tick for a period of six days (or 0.0164 yr), the dilated six days of

creation in earth time t_o can be calculated as:

$$\delta t_o = \frac{T_e}{T_o} \delta t_e = \frac{2.04 \times 10^{12}}{2.73} (0.0164) \approx 12.3 \times 10^9 \text{ yr} \quad (18)$$

This simple estimation is remarkably close to the age of universe of 13.7 billion years old derived from the latest Lambda-CDM model.

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