Towards Reconciliation of Biblical and Cosmological Ages of the Universe[1]

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Abstract

Two opposite views of the age of the universe are considered. According to the traditional Jewish calendar based on the Talmud the age of the universe is less then six thousand years. The cosmological models of the universe supported by the abundant empirical data place the age of the universe in the thirteen billion years range. Critical examination of both views is presented in the first part of the paper. In the second part, we consider quantum-mechanical state of matter before and after the introduction of a conscious observer. Role of the observer's free will is examined. The definitions of physical and proto-physical states of matter are proposed. It is suggested that creation of the first conscious being with free leads to collapse of the global quantum wave-function thereby bringing the world from a proto-physical to physical state. We propose that the total cosmological age of the universe is comprised of two periods: proto-physical on the order of thirteen billion years and physical, which is no longer then the age of the conscious human observer. This thesis is used to reconcile the Biblical and scientific views on the age of the universe. This conclusion is analyzed within the framework of classical Jewish thought.

Introduction

1. Cosmological Age of the Universe

Contemporary science places the age of the universe in the thirteen to fourteen billion years range – 13.798±0.037 billion to be precise. This number is derived from both theoretical models as well as experimental data. Let us first briefly consider the theoretical foundations of modern cosmology.

1.1. Theoretical models

Modern cosmology is based on the theoretical foundation of Einstein's General Theory of Relativity (GR).[1] As Albert Einstein stated in 1942, "It is impossible to achieve any reliable theoretical results in cosmology outside of the principles of General Theory of Relativity."

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General Relativity

The main equation of GR is

$$\mathbf{G} = 8\pi\mathbf{T} \qquad (1a)$$

or

$$\Re_{ik} - \tfrac{1}{2}\Re^* g_{ik} = 8\pi\, T_{ik} \qquad (1b)$$

Let us consider a simple cosmological model based in GR. For this purpose the following assumptions are made:

(a) *Homogeneous density.* Let us assume that the stars are dispersed in the cosmos like dust with a constant average density of mass-energy ρ.

(b) *Homogeneous and isotropic geometry.* Let us also assume that the curvature of the space-time is constant throughout the universe.

(c) *Geometry is closed.* Let us further assume that the universe is closed, as the boundary conditions for the Einstein field equations.

Three-dimensional sphere satisfies all of the three conditions above. The space-time geometry of such a sphere is described by the following metric:

$$ds^2 = -dt^2 + a^2(t)\,[d\chi^2 + \sin^2\chi\,(d\theta^2 + \sin^2\theta d\phi^2)] \qquad (2)$$

The Einstein field equation (1) for this metric is rather simple:

$$6/a^2\,(da/dt)^2 + 6/a^2 = 16\,\pi\rho \qquad (3)$$

The first term in this equation is called the "second invariant of external curvature of the space section" of 4-geometry, which shows the rate of expansion of all linear dimensions with time. The second term is the "internal invariant of 3-dimensional curvature of the space section, taken in a given moment in time.

The total "mass" of the universe is

$$M = \rho\, 2\pi^2 a^3 \qquad (4)$$

And the maximum radius of the universe is

$$a_{\max} = 4M/3\pi \qquad (5)$$

The field equation (3) now takes a simple form:

$$(da/dt)^2 - a_{\max}/a = -1 \qquad (6)$$

The first term of this equation is analogous to the kinetic energy and the second – to the potential energy. It becomes now obvious that the expanding universe can not expand beyond the maximum radius a_{max} because it would render the kinetic energy of expansion negative, which, of course, is impossible. We see that that the universe begins to expand from a very small radius a with an ever slowing rate of expansion until it stops at the maximum radius a_{max} and begins to collapse back to it's original state. This is a very simple cosmological model of a closed universe, which begins its evolution with a Big Bang and ends in a Big Crunch.

The astonishing prediction of General Relativity that our universe was expanding was very disconcerting to Albert Einstein. In order to do away with this supposedly "erroneous" result, Einstein proposed an *ad hoc* cosmological constant as an additional term in the GR field equation. When Hubble proved experimentally in 1929 that the universe was indeed expanding,[2] Einstein admitted that the addition of the cosmological term was the biggest mistake of his life. It is interesting to note that several years ago new experimental data obtained from the Hubble telescope demonstrated that the universe is expanding at accelerated pace. This fact rekindled interest among cosmologists in the cosmological term which represents a mysterious repelling anti-gravity force permeating even the empty space. The nature of this force is now a subject of much speculation.

The ration of the speed of expansion over distance is called Hubble constant:

$$H_0 = (\text{speed of expansion})/(\text{distance to the galaxy}) = (da/dt)/a \quad (7)$$

The Hubble constant is measured in kilometers per second (*km/sec*) per million light-years. The observable galaxies provide us with the distance and their rate of expansion allowing thereby to calculate the Hubble constant. The Hubble constant is approximately 68 *km/sec* per Mps. The reverse Hubble constant, H_0^{-1}, is called Hubble time and it is found to be approximately 14.4 billion years

$$T_H = H_0^{-1} \sim 14.4 \cdot 10^9 \text{ years} \quad (8)$$

The Hubble time is the time required to reach present observed distances between galaxies assuming that the speed of expansion was constant from time of the Big Bang. The age of the universe is approximately 0.95 of Hubble time, which comes to

$$T_U \sim 13.68 \cdot 10^9 \text{ years} \quad (9)$$

The Cosmological Models

Contemporary Curvature of the Space	Cosmological Term Λ	Cosmology
Hyperbolic; $K_0 < 0$	< 0	The universe evolves from the Big Bang expanding until maximum density and then beginning ever accelerating contraction into the Big Crunch
Hyperbolic; $K_0 < 0$	$= 0$	The universe evolves from the Big Bang expanding into a flat Minkowski space when the rate of expansion becomes constant
Closed; $K_0 > 0$	$<= 0$	Friedmann Cosmology: Expansion from the Big Bang, followed by collapse into the Big Crunch
Closed; $K_0 > 0$	$0 < \Lambda > \Lambda_{crit.}$	The Universe evolving from the Big Bang slows down its expansion rate until almost stopping still, then beginning to accelerate the expansion exponentially
Closed; $K_0 > 0$	$0 < \Lambda = \Lambda_{crit.}$	Einstein Cosmology. The Universe evolving from the Big Bang asymptotically approaches the maximum radius where it becomes static. This Cosmology is unstable and contradicts the experimental data
Closed; $K_0 > 0$	$0 < \Lambda < \Lambda_{crit.}$	Infinitely large Universe contracting exponentially until reaching a minimal radius, then beginning exponential expansion into infinity

Simply speaking, the universe can be either closed like a hyper-sphere, open like a saddle, or flat. The most recent experimental data seems to support the flat universe. However, instead of the slowing rate of expansion it appears to be accelerating. This fact led to recent resurrection of interest to cosmological constant.

Big Bang

Extrapolating backwards the expanding Universe one arrives at the initial point where the entire infinitely dense Universe was contained in one point, a singularity. The evolution of the Universe, according to this theory, called the Big Bang, begins from one singularity point, infinitely dense and infinitely hot; a point at which the concepts of space and time do not yet exist. Inexplicable, ineffable explosion, the courses of which are beyond the limits of scientific inquiry, created the space, time and matter in the first moment after the Big Bang.

The cosmology describes the primordial chronology as follows. The Big Bang created a dot of space of the size of approximately 10^{-33} cm. The first moment we can speak of is about 10^{-43} c. Before this *Plank time interval* we can no longer speak of *time* as we know it. At this point in time all four fundamental forces of nature: gravitation, electro-magnetism, strong and weak nuclear forces were combined in one "super force"[3]. The quarks begin to bond into photons, positrons and neutrinos along with their antiparticles. The density of the universe at this point is estimated to have been 10^{94}g/cm^3 much of it being radiation. This fireball continued to expand at astonishing speed, many times the speed of light, into a size of a pinhead, an apple, a ball. One millisecond after the explosion, the Universe was a fireball 30 million times hotter than the surface of the sun, 50 million times denser than lead. Known as the inflationary epoch, the universe doubled in size one hundred times in less than one millisecond, from an atomic nucleus to 10^{35} meters in diameter. An isotropic expansion of the Universe, when it was perfectly smooth, ends at 10^{-35}c. A small fluctuation of the density at this point is thought to have led to the creation of galaxies.[4]

When the universe aged to one hundredth of a second, the temperature dropped to 10^{13}K, the Electromagnetic, Strong and Week Nuclear interactions split off the "super force". Because of the continuous annihilation of the particles and antiparticle, the matter was not yet stable, unable to survive for more than a few nanoseconds. The light was not visible yet being trapped in the dense energy ball. It is called the "Epoch of Last Scattering".

One second after the Big Bang, the universe has expanded to the size of 20 light-years. The temperature cooled off to ten billion degrees. After three minutes, when the temperature cooled to one billion degrees, nucleosynthesis first began to take place.

The next important stage in the expansion occurred around thirty minutes later when creation of photons increased through annihilation of electron-positron pairs.

For the next 300,000 years the universe was expanding while cooling to 10,000K. It was then that the first helium atoms are thought to be born. At this point, as the density decreased, the light began to be visible. From this point on, the universe has been expanding at, apparently, an accelerated pace up until the present time.

In 1980, Dr. Alan Guth of MIT proposed an inflation theory to explain the initial explosion of the singularity – the Big Bang. This inflation theory seems to be well

supported by the most recent experiments measuring the size of the ripples in the background microwave radiation.

1.2. Experimental Data

Light from Distant Stars

It takes eight minutes for light to travel from the sun to earth. Knowing the velocity of light and the distance to the stars, it easy to calculate that it takes many millions of years for the light of the distant stars to reach earth. By measuring the position of a star at different times of year, astronomers can see the apparent motion of this star compared to more distant stars, and this information can be used to calculate the distance to the nearby star. Measuring the distances to nearby stars is the first step towards measuring distances to very remote objects, and ultimately in determining the distances to the most remote objects in the universe.

Astronomers rely on a stacked set of yardsticks of different lengths to measure distances to stars and galaxies. Each yardstick in the set is measured against, or calibrated to, the previous one. The most accurate yardsticks in this system are parallax measurements. The measurements across great cosmic distances run into an inherent problem: one must distinguish between a far, bright object and a nearby faint one. For this purpose the astronomers use an extremely bright object as "standard candles", such as supernovae.

Let us consider several examples for illustration purposes. The star closest to us, Proxima Centauri from the Alpha Centauri system, is 4.22 light-years away from us, which means that it takes 4.22 years for the light of Proxima to reach us on earth.

Eta Carinae in our galaxy is more than 8,000 light-years away. Estimated to be 100 times more massive than our Sun, Eta Carinae may be one of the most massive stars in our Galaxy. Eta Carinae was observed by Hubble in September 1995.

Trifid Nebula, in the constellation Sagittarius, is located about 9,000 light-years from Earth.

The galaxy M100 (100th object in the Messier Catalog of non-stellar objects) is one of the brightest members of the Virgo Cluster of galaxies. The galaxy is estimated to be tens of millions of light-years away. One of the prime goals of the Hubble Space Telescope has been the detection of Cepheid variable stars in distant galaxies. Before HST Cepheids had only been detected in very nearby galaxies, out to about 12 million light years. A team led by Dr. Wendy Freedman of the Carnegie Observatories has detected the furthest Cepheids yet in the Virgo Cluster spiral M100 at a distance of about 50 million light-years.

Sextans A in the Milky Way is about 10 million light years distant.

The pair of clusters are 166,000 light-years apart in the Large Magellanic Cloud (LMC) in the southern constellation Doradus. About 60 percent of the stars belong to the dense cluster called NGC 1850, which is estimated to be 50 million years old. A loose distribution of extremely hot massive stars in the same region are only about 4 million years old and represent about 20 percent of the stars in the image.

This is a Hubble Space Telescope image of an 800-light-year-wide spiral-shaped disk of dust fueling a massive black hole in the center of galaxy, NGC 4261, located 100 million light-years away in the direction of the constellation Virgo.

A rare and spectacular head-on collision between two galaxies appears in this Hubble Space Telescope true-color image of the Cartwheel Galaxy, located 500 million light-years away in the constellation Sculptor.

Hubble astronomers conducting research on a class of galaxies called ultra-luminous infrared galaxies (ULIRG), within 3 billion light-years of Earth, have discovered that over two dozen of these are found within "nests" of galaxies, apparently engaged in multiple collisions that lead to fiery pile-ups of three, four or even five galaxies smashing together.

In other words the stars we see in the night sky are not the stars as they exist now but the stars as they existed billions of years ago. Many of them are long gone, exploded into supernovas, collapsed into black holes or simply burned out. The light from supernova number 1987-A in the Large Magellan Cloud, for example, that exploded 169,000 light years ago has just recently reached earth. Before the explosion, this supernova was first a red giant and then a blue giant star. The incontestable fact that we see the stars billions years old is the simplest and most direct argument for the age of the universe being at least as old as the oldest star.

Expanding Universe

In 1929 American astronomer Edwin P. Hubble discovered that the galaxies were moving apart in all directions. He earlier discovered the red shift in the spectrum of light emitted by remote stars. The shift in the wave frequency is usually associated with the Doppler effect. Observing two dozen galaxies 10^6 light-years away and gauging their distance by their brilliancy Hubble discovered that more distant galaxies were racing away from the Earth faster than the brighter ones, more closed to us. He further discovered that the rate at which galaxies were racing away from Earth was proportional to their distance from Earth. This let to the conception of the expanding Universe. According to the Friedmann cosmological model, the universe is expanding as 3-dimensional air-balloon blown in an imaginary 4-dimensional space.

The study of several dozen supernovae four to seven billion light-years away demonstrated that the explosions were about 25% dimmer than expected. This suggested that the universe was expanding slower in the past than it is now and, therefore, it took

longer for the universe to reach it present stage. Thus, an accelerated expansion suggests an older age of the universe.

Cosmic Background Radiation

Initially the matter and radiation were in thermal equilibrium. The energy released as the radiation cooled must have obeyed the laws of black-body statistics. If the temperature of this relict radiation, called cosmic microwave background radiation (CBR), can be measured now, one can calculate the original temperature and vice versa. Based on the theory of the Big Bang, this temperature was predicted to be around 2.7^{o}K. In 1965 Arno Penzias and Robert Wilson discovered uniform and isotropic relict radiation having this temperature, for which they received a Nobel Price. As it was later confirmed by NASA Cosmic Background Explorer (COBE), this discovery was the first sound experimental validation of the Big Bang theory.

The CBR has ripples, minor fluctuations, which allow astronomers to use them as the yardsticks to measure the cosmos. The size of the ripples, as measured recently by three teams and the Caltech, Princeton and Berkley, turned out to be approximately one degree on the sky, or twice the size of the Moon as seen from Earth. The size of the ripples is an indication of the geometry of space, which in turn is determined by the density of mass in the universe. The ripples of one degree are indicative of a flat universe, predicted by the inflation theory of Dr. Guth. This discovery once again brought back in focus the mysterious cosmological constant, introduced and then abandoned by Einstein.

As recent as five years ago, the experimental data was insufficient to predict the age of the universe more accurately than within the range of 10 to 20 billion years. In 1994 a team led by Wendy Freedman from Carnegie Observatories in Pasadena, Cal., suggested that the universe was much younger, between 8 to 12 billion years old. This finding suggested that universe may be younger than some of its oldest stars. The rival group led by Allan Sandage, interpreting the same data, defended the older universe. Both groups now converge on the number 12 billion years, which seems to be a consensus for the age of the universe among the scientists today.

Geological Age of the Earth

Even though the dating of the fossils and geological strata lies outside the scope of this paper, we will mention here in passing that geological age of our own planet further exacerbates the problem.

Carbon dating techniques using Carbon-14 (C^{14}) isotopes further corroborated by other methods, such as uranium-thorium radioactive decay place the age of the earth well beyond the biblical age.

To summarize, there are compelling theoretical considerations fully corroborated by available experimental data to establish that the ages of our planet, other stars and the

entire universe well beyond the apparent biblical age of less than six thousand years. Amounting to billions of years this discrepancy is so enormous that no amount of criticism related to the scientific methods and assumptions used to arrive at these numbers is going to help to reconcile this discrepancy. Even if the scientists were overestimating the age of the universe by 50%, which is highly unlikely, Torah and science would still be six billion years apart! Thus, we find such criticism unproductive and we shall look for solution of this problem elsewhere.

2. Torah View

2.1. The Jewish Calendar

According to the traditional Jewish calendar we live now in the year 5775. The implication of this number is that it seems as the world, from the traditional Jewish point of view is no older than six thousand years. First of all let us note that the popular misconception that the Torah begins counting the calendar from the beginning of creation of the world has no basis. In fact, the calendar begins with the creation of Adam – the first man. Thus, when we say that, according to Jewish tradition, today, for example is five thousand seven hundred sixty years three months and five days, it is from the date first man was created and not from date the world was created.

3. Previous Attempts to Reconcile the Conflict

In his book "Immortality, Resurrection, and the Age of the Universe: a Kabbalistic View"[5], the late Rabbi Aryeh Kaplan present an excellent overview of the various attitudes towards this problem and attempts to resolve it. In summary, these attitudes may be categorized as follows:

Six Days as Six Epochs	Each day represents an entire epoch billions of years long	This interpretation of the biblical text is far from the literal meaning is not based on any classical commentaries
Dismissal	If G-d created the first man fully grown he could have created a "mature" universe which was already billions of years old at the point of creation	Irrefutable and, therefore, unscientific approach
Sabbatical Cycles	Base on the concept of the cosmic sabbatical cycles, the world was 15 billion years old the first man was created	A significant but now widely accepted view expressed by some important kabbalists almost two thousand years ago

To this we may add another recent approach expressed by Gerald Schroeder that attempts to explain the difference in ages by means of gravitational time dilation.[6]

3.1. Sabbatical Cycles

The most interest for our discussion present the kabbalistic approach of sabbatical cycles expounded by R. Kaplan. This section closely follows R. Kaplan's exposition of this approach. The idea of sabbatical cycles is based on esoteric interpretation of several scriptural and talmudic sayings. According to the Talmud, the world will exist for seven thousand years and in the [end of] seventh millenium it will be destroyed.[7]

According to the Talmudic sage and a great kabbalist of the first century rabbi Nehunya ben HaKanah expressed in his important work *Sefer HaTemunah*, this seven thousand years period is only one cycle out of total even. This idea is based on a biblical concept of a Jubilee, which consists of seven sabbatical (seven-year) cycles. This leads to forty nine thousand years as the total age of the universe. According to many later kabbalists the present cycle is the last of the seven and, therefore, when Adam, the first man, was created, the world was forty two thousand years old.

This approach is alluded to in some midrashic sources. Thus *Midrash Rabbah* on the verse "It was evening and it was morning, one day" (Genesis 1:5) states, "This teaches that there were orders of time before this." Another Midrash teaches that "G-d created universes and destroyed them"[8] seams to support the concept of sabbatical cycles, as it is explain in another kabbalistic treatise *Ma'arekheth Elokuth*. Interestingly, the Talmud states that there were 974 generations before Adam.[9] The idea of sabbatical cycles was expressed and elaborated in the works of such sages of Jewish philosophy and kabbalah as Bahya, Ziyoni, Recanati and *Sefer HaChinukh*'s commentaries on Leviticus 25:8. This idea is also alluded to in the commentaries of Nachmanides on Genesis 2:3, Yehuda HaLevy[10] and Ibn Ezra's commentary on Genesis 8:22.

Rabbi Kaplan's discovery of a little known commentary by Rabbi Isaac of Akko sheds entirely new light on the concept of sabbatical cycles. Commenting on the verse, "A Thousand years in Your sight are as a day" (Psalms 90:4) midrashic sources have stated that one divine day is equal to a thousand terrestrial years. In his kabbalistic treatise, *Otzar HaHayim*, Rabbi Isaac of Akko states that the first six sabbatical cycles are counted in the divine not human years. If a divine day is thousand years and, then a divine year, equal to 3651/4 divine days, is 365,250 terrestrial years. If we multiply this number by forty two thousand years comprising the first six cycles before Adam we get fifteen billion three hundred forty and a half million (15,340,500,000) years. Thus, according to one of the greatest Talmudic sages of the first century, R. Nehunya ben HaKanah, as explained by a prominent kabbalist of the 13th century, R. Isaac of Akko, at the time Adam was created, the universe was already more than fifteen billion years old – a number very closely correlated with the current estimates of the cosmological age of the universe!

We must note however, that this approach was strongly contested by Isaac Luria, the holly lion, *Ari*, who is considered by many the greatest kabbalist of all times. Ari maintained that the previous sabbatical cycles did not exist on the terrestrial plane and were purely spiritual worlds. Most of the later kabbalists with rare exceptions accepted the opinion of Ari. Apparently there was a difference of opinion between these two (pre and post lurianic) schools of kabbalah whether the first phase of creation which stretched for fifteen billion years took place in the physical or spiritual universe.

4. Quantum reality

4.1. Particle-Wave Dualism

In 1923, Louis de Broglie suggested that every particle has a wavelength associated with it:

$$\lambda = \hbar/p \qquad (10)$$

were p is the momentum of the particle and $\hbar$ *is the Plank constant.*[11]

Sin 19926, Erwin Schrödinger formulated his famous equation[12]

$$-\hbar/2m \cdot \nabla^2\psi + V\psi = E\psi \qquad (11)$$

where V is the potential energy of a particle, E is the kinetic energy and ψ is the wavefunction that describes the quantum-mechanical state of the particle.

4.2. Wave Function

What is the wavefunction? The attempts by Schrödinger and others to interpret it as a scalar potential of some physical field were not successful. In 1926, Max Born noticed that the square of the amplitude of the particle wavefunction in a given region gives the probability of finding the particle in this region of configuration space. He suggested that the wavefunction represented not a physical reality by rather our knowledge of the quantum state of an object.

The wavefunction represent our knowledge of all possible quantum mechanical states of an object. In other words the quantum mechanical state of a physical system is a linear superposition of all possible states of this system. Thus, for example, the state vector for a left circularly polarized photon $|\psi_L>$ is a linear superposition of the vertical and horizontal eigenstates

$$|\psi_L> = 1/\sqrt{2}\,(|\psi_v> + i|\psi_h>) \qquad (12)$$

When a left circularly polarized photon goes through a calcite crystal it is detected to be in either vertical or horizontal polarization states. At the moment of the measurement the state vector $|\psi_L>$ being a superposition of two possibilities $|\psi_v>$ and $|\psi_h>$ is suddenly reduced to one actuality: either $|\psi_v>$ or $|\psi_h>$. This is called the collapse of the wavefunction. What actually happens during the collapse of the wavefunction is that the previously amorphous reality existing in undetermined state of various possibilities is suddenly comes into a physical reality in one particular state (eigenstate).

The irreversible (time-asymmetric) collapse of the wavefunction does not follow from the Schrödinger equation.

5. Introduction of an Observer [13]

The collapse of the wave functions is a serious problem in the quantum theory. The trouble is that it doesn't follow from the Schrödinger equation. Let us consider an experiment in which we collide one elementary particle with another to measure it's momentum. Such an experiment is an interaction of two subatomic particles and should obey the Schrödinger equation. However, as we said before, this Schrödinger equation does lead to a collapse of the wave function, which is a necessary result of any experiment. So, what than causes the collapse of the wavefunction?

To resolve this paradox, it was proposed by the Copenhagen interpretation of quantum mechanics to attribute the collapse of the wave function to the interaction of a microscopic particle with a macroscopic measurement apparatus. Since the macroscopic object behave according to the classical Newtonian physics and is not described by a wavefunction, it was thought to cause the collapse of the wavefunction of a microscopic object under measurement. The apparent difficulty with such an explanation is that there is no reason why a macroscopic object should not obey the Schrödinger equation. In deed, any macroscopic object is composed of microscopic molecules and atoms, which do obey the laws of quantum physics.

This situation leads to absurd as clearly demonstrated by the Schrödinger Cat gedanken experiment. If one places a cat in a closed steal chamber, together with a Geiger tube containing some radioactive material, a hammer connected to the Geiger tube and a phial of prussic acid. From the amount of the radioactive material and it half-life we calculate that there is 50% chance that within one hour one atom will decay. If an atom decays, the Geiger counter is triggered and causes the hammer to break the phial of prussic acid, which kills the cat. Prior to the measurement the state vector of the atom is a linear superposition of two possibilities: decayed and not-decayed atom. Accordingly the state vector of the cat is also a linear superposition of two physical possibilities: cat is alive and cat is dead. In other words, before the measurement takes place the cat is dead and alive at the same time! To be more precise, the cat is neither alive nor dead but is in state, which is a blurred combination of both possible states.

5.1. Role of a Conscious Observer

In 1932 the mathematician Von Neumann published his famous work, Mathematical Foundations of Quantum Mechanics[14], in which he first clearly demonstrated the discrepancy between continuous time-symmetrical wave function in Schrödinger equation and a discontinuous time-asymmetrical (irreversible) event of measurement. In this book Von Neumann made a startling suggestion that it must be a conscious observer who causes the wavefunction to collapse. The reason for this is that the conscious is the only element present in the quantum-mechanical measurement process which is not time-symmetrical and is not required to observe the laws of quantum mechanics. In other words, Von Neumann replaced the dualism of macroscopic-microscopic worlds with the mind-matter dualism. While the former is easily critiqued the latter is immune to criticism because whatever we mean by the word *consciousness* it does not have to obey the Schrödinger equation.

Since the mind is to a large degree the product of biochemistry of the brain, once we distill that level of the mind, which is no longer vested in a physical brain and is not a product of biochemical reactions, such non-physical mind has been called by some a human soul, or, more specifically, the intellectual faculty of the soul. Hence, Von Neumann's approach to collapse of the wavefunction leads us to a classical Cartesian body-soul dualism.

In 1961, Eugene Wigner revisited the hypothesis of a conscious observer.[15] He posed a question: whose mind exactly collapses the wavefunction? In one considers a *gedanken* experiment in which an observer relegates the measurement to his assistant and leaves the room. After his return he inquires of the result of the measurement. Until he learns of the result, as far as he is concerned, the state of the quantum-mechanical system under observation is a linear superposition of all possible eigenstates. However, when he asks his assistant whether he knows definitively the results of the experiment, the assistant answers that of course he does. This led Wigner to conclude that it is the very first conscious observer who collapses the wavefunction.

One can ask a question at this point, what level of consciousness an observer must poses in order to collapse the wavefunction? Is the cat in the Schrödinger experiment considered a conscious enough creature to collapse the wavefunction and thereby escape the inconvenience of being dead and alive at the same time?

What about the omniscient G-d? If G-d knows the eigenstate of all wavefunctions doesn't He immediately collapse them all?! This question is closely related to the paradox of free will. If G-d knows everything, and His knowledge must be absolute and true, then how can anybody poses free will? Doesn't G-d forces us into acting in a certain way simply by virtue of Him knowing that we were going to act this way? One possible answer to this paradox, as it is given in Chasidic philosophy, is that G-d indeed knows everything but He keeps His knowledge to Himself without affecting the actions and decisions of His creations. One may try apply a similar rational here and suggest that, perhaps, G-d's knowledge in some peculiar way does not automatically collapse all the wavefunctions of the universe. Alternatively, one may say that the global collapse of the

world wavefunction caused by G-d's ultimate knowledge further underlines the paradox of free will.

6. Resolution of the Conflict

Putting aside any discussion of the merits of Von Neumann-Wigner hypothesis of conscious observer, accepting for the time this hypothesis will allow us to resolve the discrepancy between biblical and cosmological ages of the universe.

Let us consider the wavefunction ψ_0 in the initial moment of time t_0 describing all possible eigenstates of the singularity from which, according to the Big Bang theory, the universe is about to be born. One of the eigenstates of this wavefunction is $|\psi_+>$, which represents the possibility of the explosion that we call Big Bang. Another eigenstate $|\psi_->$ represents an alternative – no Big Bang. The state vector of the universe in this instance is a linear superposition of both eigenstates: to be or not to be. Even though the probability of the Big Bang and the subsequent birth of the universe is greater than zero, the state vector of the universe will remain such superposition of existence and non-existence for billions of years, until such time as a conscious observer enters the scene and collapses the world wavefunction thereby realizing the one and only one eigenstate of the universe corresponding to its existence. The universe is like a giant Schrödinger cat who is awaiting its observer to find out whether it is alive or dead. It is the man who brings the universe into existence from its undefined state of mathematical probabilities. The great paradox of the Creation is that if the universe was ever born, it needed a human for a midwife.

Therefore, we may say that the universe has two important dates the date of its conception, t_0, and the date of its birth. When human observer probes the age of the universe the physics dictated that he will arrive at the age when the universe was conceived as a mathematical wavefunction having probability of existence. The real age of the universe may by definition be no greater than the age of the first human observer who collapsed the world wavefunction.

6.1. Adam as the First Observer

According to the biblical account of creation, Adam was the first fully conscious being – the first observer. Prior to first human the universe existed in a superposition of all possible states, including the states of existence and no-existence. When the first man looked for the first time at the universe he immediately collapsed the world wavefunction and brought the world into physical existence.

It is easy to see now why the Bible begins the chronology of creation with Adam and not before. Even though the universe could have been already billions of years old it was the first human (Adam) who actualized the creation and brought it from a fuzzy state of existence/non-existence into the definite physical existence.

Perhaps this is why the Bible states:

"And G-d blessed the seventh day, and sanctified it; because on it He had rested from all his work which G-d created to make" (Genesis 2:3)

The classical Jewish commentators on the Bible suggest that the meaning of the peculiar expression "G-d created to make" is that G-d created a man to complete His creation, to be a partner of G-d in creating the universe. Now it makes perfect sense. Initially G-d created the universe in amorphous spiritual form and He created a man to complete the creation and to bring the universe from its potential to an actual reality.

This approach allows us to rationally resolve the apparent contradiction between the scientific and the biblical ages of the universe.

6.2. Resolution of the Dispute regarding Sabbatical Cycles

As we noted before, the dispute related to the age of the universe existed not only between science and religion but also between two main schools of Jewish esoteric philosophy – kabbalah. According to the ancient school of Rabbi Nehunya ben HaKanah, as explained by Rabbi Isaac of Akko, the universe existed for over fifteen billion years before creation of Adam. While the lurianic school of kabbalah maintained that this took place in the spiritual rather than physical world.

It seems that our approach allows to resolve that contradiction as well. Indeed, both opinions may be correct at the same time and do not contradict each other. When Rabbi Nehunya ben HaKanah and Rabbi Isaac of Akko along with other early sages of kabbalah spoke of sabbatical cycles and billions of years in pre-human history they spoke of the universe as originally created by G-d in general terms. Ari, however, further clarified the picture by pointing out that the initial phase of pre-human world history was different from the phase the post-human phase and existed on a different plane, which he called spiritual world. In fact, the quantum mechanics confirms that prior to the first human, the world indeed existed on the different (almost spiritual) plain described by purely mathematical constructs such as the wavefunction. This completes the puzzle.

Conclusions

Following the approach advocated by some of the most respected scientists of this century, Von Neumann, Wigner, Wheeler and others, we are able to reconcile the apparent discrepancy in the age of the universe as it is predicted in the biblical account of creation and contemporary cosmology. The history of the universe is comprised of two main periods: pre and post human. In the first period, before first conscious observer peered into the universe, the universe was in an amorphous fuzzy state of linear superposition of all possible states. The universe at this stage existed only mathematically, as a distribution of probabilities. This period lasted approximately twelve billion years. When the first human opened his or her eyes he/she collapsed the world wavefunction and brought the universe into actual existence. From that point on the Bible and the humanity began counting the new age of the universe.

The approached outlined above, while appears to be promising, does not purport to solve all apparent contradictions between science and religion even in the area of biblical chronology which is the subject of this paper. We limited ourselves to the attempt of reconciling the general age of the universe without going into specific interpretations of the meaning of the six days of creation and other specific details of the biblical account of creation. Some of these problematic areas include the sequence of creation of planets and stars, the meaning appearance and evolution of the biological flora and fauna, such as apparent indications that Bible speaks of the creation of the first humans, Adam and Eve, in a fully grown and mature form and others. These remain to be addressed in the future. All that we attempted to do that not the dismissal of contradictions by there honest assessment and scientific analysis may not only lead to a resolution of an apparent contradiction by moreover, help to enrich our understanding the Bible and the science alike and further our quest for the unified and harmonious view of the universe.

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