A new cosmology theory: an integrated theory of everything

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Abstract. The prevailing cosmology theory "The Ultimate Free Lunch" satisfies only the third of three laws of physics. The three laws are: Conservation of Energy/Mass, Einstein's Theory of General Relativity, and the Second Law of Thermodynamics. Since a new cosmology theory "An Integrated Theory of Everything (TOE)" satisfies all three laws, it should replace "The Ultimate Free Lunch" theory.

1 Introduction

A new cosmology theory: an integrated theory of everything is based on an Integrated TOE. The foundations of an Integrated TOE are twenty independent existing theories. The premise of an Integrated TOE is without sacrificing their integrities; these twenty independent existing theories are replaced by twenty interrelated amplified theories. Amplifications of five of the twenty independent existing theories (string theory, Higgs forces, Super Universe, stellar black holes, and arrow of time) are required to define a new theory of cosmology.

2 String theory

An Integrated TOE via string theory unites all known physical phenomena from the infinitely small Planck cube scale (quantum mechanics) to the infinitely large Super Universe or multiverse scale (Einstein's general relativity). Each of 129 fundamental matter/force particles resides in a Planck cube as a string. Any object in the Super Universe can be defined by a volume of contiguous Planck cubes containing these fundamental matter or force particle strings. Super force string doughnut singularities existed at the center of Planck cubes at the start of the Super Universe, all precursor universes, and all universes including our universe [1].

Each of 129 fundamental matter/force particles resides in a Planck cube as a string. Table 1 shows 32 Standard Model (SM)/supersymmetric matter/force particles. There are 12 SM matter particles and 4 SM force particles. There are 4 supersymmetric matter particles and 12 supersymmetric force particles. Each of these 32 matter/force particles has one of 32 anti-particles and each of those 64 has an associated supersymmetric Higgs particle. Each of the 128 SM/supersymmetric particles and the super force particle are equivalently represented by a dynamic phantom point particle, its unique string, or its associated Calabi-Yau membrane. In traditional string theory descriptions, a one brane vibrating string generates a two brane Calabi-Yau membrane over time. String theory was amplified so that a zero brane dynamic phantom point particle generates particle positions over time for both a one brane vibrating string and a two brane Calabi-Yau membrane [1]. According to Greene, two basic Calabi-Yau membrane types are beach balls and doughnuts. Conifold transitions are the transformations of the two membrane types into each other. The Planck cube sized beach ball membrane contains periodic surface hills and valleys where particle energy/mass is proportional to amplitude displacement and frequency of these hills and valleys [2]. A string can be visualized as a thin sticky rubber band wrapped around a Calabi-Yau membrane. For example, a circle with periodic hills and valleys is the string associated with a beach ball membrane with periodic surface hills and valleys.

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Standard Model	Matter	Force	Supersymmetric	Matter	Force
graviton		x	gravitino	x	
gluon		x	gluino	x	
top quark	x		top squark		x
bottom quark	x		bottom squark		x
tau	x		stau		x
charm quark	x		charm squark		x
strange quark	x		strange squark		x
muon	x		smuon		x
tau-neutrino	x		tau-sneutrino		x
down quark	x		down squark		x
up quark	x		up squark		x
electron	x		selectron		x
muon-neutrino	x		muon-sneutrino		x
electron-neutrino	x		electron-sneutrino		x
W/Z bosons		x	wino/zinos	x	
photon		x	photino	x	

Table 1 Standard Model/supersymmetric matter and force particle.

Any object in the Super Universe can be defined by a volume of contiguous Planck cubes containing fundamental matter or force particle strings. Planck cubes can be visualized as infinitely small, cubic, Lego blocks. A proton can be represented by a 10^{-15} m radius spherical volume of contiguous Planck cubes containing up quark, down quark, graviton, photon, and gluon matter and force particles and spaces between matter particles. An atom can be represented by a volume of contiguous Planck cubes containing protons, neutrons, electrons and spaces between matter particles. By extension, any object in the Super Universe (e.g. molecule, encyclopedia, star, galaxy, or the entire Super Universe) can be represented by a volume of contiguous Planck cubes containing fundamental matter or force particle strings.

Super force string doughnut singularities existed at the center of Planck cubes at the start of the Super Universe, all precursor universes, and all universes including our universe. A Calabi-Yau membrane's potential energy/mass was represented by three springs aligned along the Planck cube's x, y, z axes and connected together at the Planck cube's center. A Calabi-Yau membrane's energy/mass was primarily a function inversely proportional to its radius and secondarily directly proportional to its surface hills and valley's amplitude displacement and frequency. A particle's energy/mass was amplified from two string parameters according to Greene [2] to three via addition of the radius parameter. Radius defined the particle's basic energy/mass whereas the amplitude displacement and frequency modulated it. A Calabi-Yau membrane just touching a Planck cube's sides with zero amplitude displacement and frequency defined zero tension or energy/mass. A range of amplitude displacements and frequencies about this zero energy/mass defined the 32 fundamental matter and force particles' energy/masses, from the lightest photon (zero) to the top quark (173 GeV) to supersymmetric particles (100 to 1500 GeV).

The big bang's near zero radius doughnut singularity consisted of superimposed super force strings containing our universe's near infinite energy of approximately 10^{54} kg (10^{24} $M_{\odot}$ or 10^{90} eV) as calculated from critical density and a measured Hubble constant [3]. A doughnut singularity's potential energy was also represented by three springs connected together at the Planck cube's center. Energy was a function inversely proportional to the singularity's radius so that the smaller the singularity's radius, the greater was its potential energy. The radius of the Super Universe's doughnut singularity was much smaller than our universe's doughnut singularity because the energy/mass of the Super Universe was much larger than the energy/mass of our universe. According to Colella, the Super Universe's energy/mass was 10^{120} times the energy/mass of our universe or (10^{120}) (10^{54} kg) = 10^{174} kg [1].

Our universe's super force doughnut singularity had energy (mass), charge, and spin. This doughnut singularity was created in our precursor universe by the evaporation, deflation, and collapse of a super supermassive quark star (matter) to a super supermassive black hole (energy) or Kerr-Newman black hole (see section 6 Arrow of time). Via conservation laws of energy/mass, charge, and angular momentum [4], the mass, charge, and spin of the doughnut singularity was distributed to the masses, charges, and spins of fundamental particles, atoms, molecules, stars, and galaxies in our universe. The mass, charge, and spin of any particle in our universe was directly related to the mass, charge, and spin of the doughnut shaped singularity. Entanglement was the indirect relationship between the mass, charge, and spin of any particle in our universe with the mass, charge, and spin of any other particle.

3 Higgs forces

Matter particles and their associated supersymmetric Higgs forces were one and inseparable and modeled as an underweight porcupine with overgrown spines. A matter particle could not exist without its associated Higgs force or vice versa. Spontaneous symmetry breaking was bidirectional. The super force could condense into a matter particle and its associated Higgs force or a matter particle and its associated Higgs force could evaporate to the super force. Our universe's and the Super Universe's eight permanent matter particles were the: up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino. The zino and photino were dark matter particles. Each of these eight permanent matter particles had an associated supersymmetric Higgs force. The sum of the eight Higgs force energies of these eight permanent matter particles was dark energy. The above was summarized from Colella's an intimate relationship between Higgs forces, dark matter, and dark energy [5].

4 Super Universe

The Super Universe or multiverse consisted of nested parallel precursor universes. Precursor universes consisted of nested parallel universes. Our universe was nested in our precursor universe which was nested in the Super Universe.

The Super Universe model is an infinitely large gumball machine. Our universe with a radius of 4.4×10^{23} km is one of the gumballs in the gumball machine. The other gumballs with different radii are parallel universes. A subset of the gumballs including our universe is our precursor universe. The entire gumball machine is the Super Universe of parallel universes. The Hubble Space Telescope is the most powerful telescope which can see approximately 95% of our universe. It cannot see the last 5% of our universe, nor our universe's boundary, nor beyond our universe's boundary to detect the parallel universes.

Universal laws of physics and structure were assumed across the Super Universe. For example, the Super Universe obeyed conservation of energy/mass, contained 129 matter/force particles, had eight permanent matter particles and their eight associated supersymmetric Higgs forces, and had a constant dark energy to total energy/mass percentage (68%) just like our universe.

5 Stellar black holes

Currently a stellar black hole is defined as a space-time region where gravity is so strong not even light can escape and having no support level below neutron degeneracy pressure. The black hole space-time region is a three dimensional sphere which appears as a two dimensional hole just as our three dimensional sun appears as a two dimensional disk. An inconsistency in black hole definitions exists as follows. A stellar black hole contains a singularity having minimum area and volume, whereas the same stellar black hole has maximum entropy implying maximum event horizon area as defined by Bekenstein [6] or maximum volume as defined by Colella [1].

Stellar black hole theory was amplified to include a quark star (matter) and black hole (energy), both of which were "black." Their differences were a quark star (matter) had mass, volume, near zero temperature, permanence, and maximum entropy. In contrast, a black hole (energy) had super force energy, a Planck cube singularity with minimal volume, near infinite temperature, transientness, and minimal entropy.

Stellar gravitational collapse occurs when internal energy is insufficient to resist the star's own gravity and is stopped by Pauli's exclusion principle degeneracy pressure. If the star's mass is less than 8 solar masses, it stops contracting and becomes a white dwarf supported by electron degeneracy pressure. The discrepancy between the initial 8 solar masses and the final 1.38 solar masses or Chandrasekhar limit is due to solar winds. If the star is between 8 and 20 solar masses, it gravitationally collapses to a neutron star supported by neutron degeneracy pressure with a supernova explosion. If the star is between 20 and 100 solar masses, it gravitationally collapses to a quark star (matter) supported by quark degeneracy pressure with a quark-nova explosion. According to Leahy and Ouyed, the quark star (matter) forms with a quark-nova's nuclear binding energy release. The delayed secondary explosion follows a neutron star's primary supernova explosion [7].

Six types of Super Universe stellar black holes were: supermassive quark star (matter), quark star (matter), super supermassive quark star (matter), its associated super supermassive black hole (energy), super super supermassive quark star (matter), and its associated super super supermassive black hole (energy). The first two types, supermassive quark stars (matter) and quark stars (matter) existed in universes. The second two types, super supermassive quark stars (matter) and their associated super supermassive black holes (energy) existed in precursor universes and created universes. The third two types, super super supermassive quark stars (matter) and their associated super super supermassive black holes (energy) existed in the Super Universe and created precursor universes.

The first type or a supermassive quark star (matter) contains 10^6 to 10^{10} solar masses. They may be "fossil quasars" [8] with masses proportional to their host galaxies' masses. According to Carilli, galaxy to central black hole mass ratio was 30:1 in our early universe and 700:1 now [9]. Population III stars containing hydrogen, helium, and lithium first formed approximately 200 million years after the start of our universe. These first generation stars contained up to 100 times more gas than the sun, had short lives, created over 100 billion neutron and quark stars (matter) and their supernova and quark-nova remnants [10]. Over the next 13.6 billion years, by accretion of stars/matter and merger with galaxies, approximately 100 billion galaxies with their supermassive quark star (matter) centers formed in our universe. That is, over the last 13.6 billion years, approximately 10^6 to 10^{10} solar masses were swallowed by the original neutron and quark stars (matter).

The second type or quark star (matter) contains between several and 10^6 solar masses. Quark stars (matter) having several solar masses were initially created by first generation star collapses. Their sizes were augmented by accretion of stars/matter and merger with neutron star or quark star (matter) galaxies during the next 13.6 billion years.

The third type or a super supermassive quark star (matter) contains 10^{10} to 10^{24} solar masses. In our precursor universe, the super supermassive quark star (matter) which consisted of a cold quark-gluon plasma [11], increased in size via accretion of stars/matter and merger with galaxies. At the 10^{24} solar mass threshold or our universe's energy/mass, quark degeneracy pressure was insufficient to stop further gravitational collapse. The super supermassive quark star (matter) instantaneously evaporated, deflated, and collapsed to the fourth type or its associated super supermassive black hole (energy) which created our universe's "big bang" (white hole) (see section 6 Arrow of time).

In the Super Universe, the fifth type or a super super supermassive quark star (matter) instantaneously evaporated, deflated, and collapsed to the sixth type or its associated super super supermassive black hole (energy) and created a precursor universe.

5.1 Einstein's general relativity

Einstein's General Relativity equations are so difficult not even Einstein could solve them. The Friedmann, Lemaitre, Robertson, and Walker (FLRW) metric is the accepted solution. Excluding our early universe's radiation pressure force which ended at 380,000 years, the solution describes two opposing forces which shape universes. The first is gravity/matter ($F = Gm_1m_2/r^2$) and the second is anti-gravity/dark energy ($\Lambda = (8\pi G/3c^2)\rho_\Lambda$) where G is the gravitational constant, m_1 and m_2 are two masses, r is the range between masses, Λ is the cosmological constant, c is the velocity of light, and ρ_Λ is dark energy density. Friedmann's three scenario solutions are as follows.

In the first scenario, matter and dark energy are in close balance. From a singularity, a universe expands at a decelerating rate until it reaches an inflection point and then expands at an accelerating rate. This is our universe's scenario where the inflection point is approximately eight billion years after our universe's start. This scenario applies to most Super Universe parallel universes because it is balanced and stable.

In the second scenario, matter overwhelms dark energy. From a singularity, a universe expands at a decelerating rate until it reaches a maximum radius and then contracts to another singularity (big crunch). This is our precursor universe's scenario where the super supermassive quark star (matter) evaporated, deflated, and collapsed to a super supermassive black hole (energy), creating our universe's "big bang" (white hole). This scenario applies to a small percentage of parallel universes because of the second law of thermodynamics (see section 6 Arrow of time).

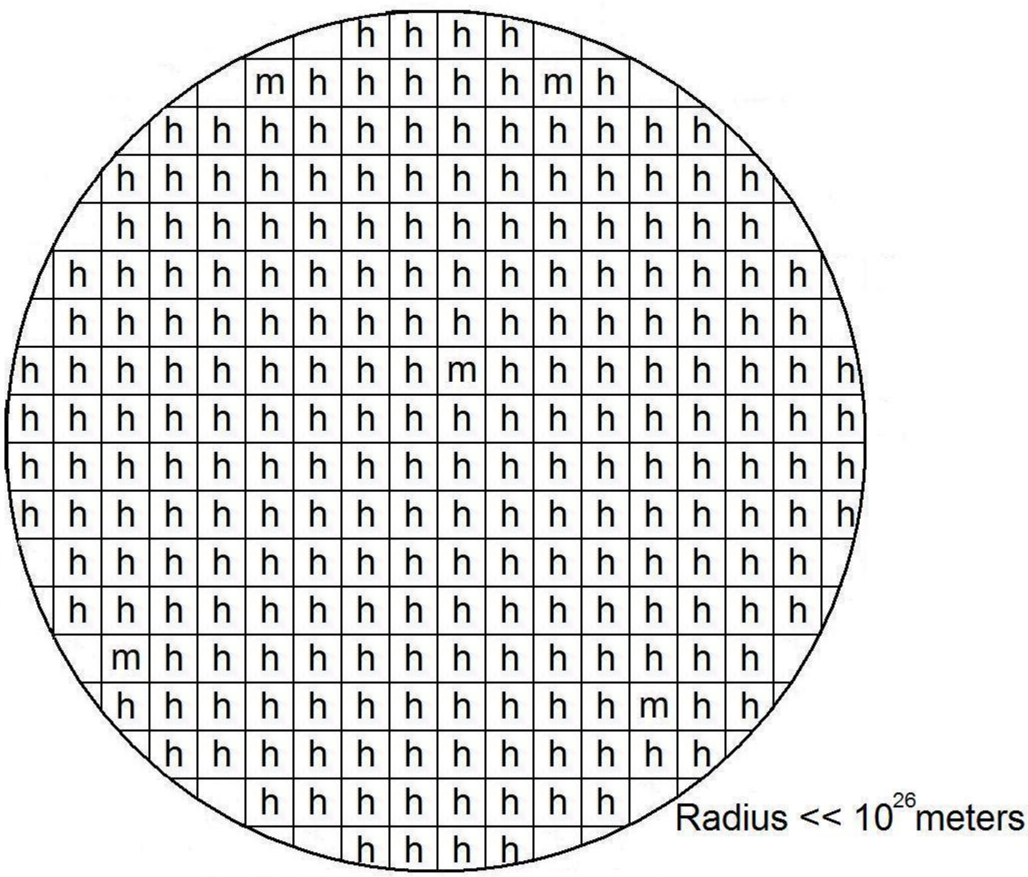
In the third scenario, dark energy overwhelms matter. From a nonzero radius, a universe expands at an ever increasing acceleration rate in its spherical vacuum bubble. As described by Colella, a universe's acceleration stops when a universe's boundary merges with its precursor universe's inner boundary [1]. This is the least understood scenario and applies to a small percentage of parallel universes because it is an unstable scenario [12].

6 **Arrow of time**

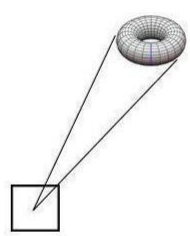
In an isolated system such as our universe, the Second Law of Thermodynamics states entropy increases irreversibly with time providing a thermodynamic arrow of time. In contrast, Einstein's Theory of General Relativity is time symmetric and apparently contradicts the Second Law of Thermodynamics. Schwarzschild's solution of Einstein's equations consists of a black hole, a white hole, and an Einstein-Rosen bridge (i.e. wormhole or singularity) connecting the two universes. Schwarzschild's solution is Friedmann's second scenario final stage collapse to a super supermassive black hole (energy).

During a specific time interval within a subset volume of our universe, entropy decreased without negating our universe's Second Law of Thermodynamics. A nebula's hydrogen/helium gas, dust, and plasma began ordering itself at our solar system's creation 4.6 billion years ago. Entropy decreased because life was created. Life is synonymous with low entropy or available energy and death with high entropy or unavailable energy. Since our solar system was one of approximately 100 billion Milky Way stars and our galaxy was one of approximately 100 billion galaxies in our universe, our solar system's entropy decrease did not negate our universe's entropy increase via the remaining 10^{22} stars. Similarly, entropy increased in our precursor universe whereas entropy decreased in a subset volume where a super supermassive quark star (matter) evaporated, deflated, and collapsed to a super supermassive black hole (energy).

At the 10^{24} solar mass threshold, the super supermassive quark star (matter) instantaneously evaporated, deflated, and collapsed to the super supermassive black hole's (energy) doughnut singularity shown in fig. 1. In fig. 1a, a



(a) Super supermassive quark star (matter) at t=-1 second



(b) Super supermassive black hole (energy) at t=0

Fig. 1. Super supermassive quark star (matter) collapse to a super supermassive black hole (energy).

matter particle is shown as an m and a Higgs force as an h in their Planck cubes. The m represents the eight types of permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino) and h represents their eight associated supersymmetric Higgs forces. Fig. 1a is shown in two, not three dimensions and not to scale since Planck cubes are much smaller than the super supermassive quark star (matter). At the super supermassive quark star's (matter) center, a single electron-neutrino and its associated Higgs force were subjected to extremely high pressure and temperature. The electron-neutrino and its associated Higgs force evaporated to the super force, incrementally increasing the super supermassive quark star (matter) center's temperature. A chain reaction began which instantaneously evaporated, deflated, and collapsed the super supermassive quark star (matter) to a super supermassive black hole (energy) as shown in fig. 1b. The super supermassive black hole (energy) or super force doughnut singularity was a Kerr-Newman black hole.

In fig. 1a, the supermassive quark star (matter) existed until approximately one second before our universe's start. The Hawking temperature of a quark star (matter) with mass M was approximately $T=10^{-7}$ (M_{Θ} /M) K = 10^{-30} K, where M_{Θ} was solar mass, and K was degrees Kelvin [13]. Since its equation of state and cold quark-gluon plasma density were unknown, its radius was "roughly" approximated as follows. Its upper radius was its Schwarzschild radius or $r_s = (2G/c^2)$ (m) = (1.48 x 10^{-27} m/kg) (.32 x 10^{54} kg) ~ 5 x 10^{26} m, where r_s is the Schwarzschild radius, G is the gravitational constant, c is the velocity of light, and m is our universe's mass [14]. The lower radius was approximated by assuming all matter particles were in contiguous Planck cubes. Since there were 10^{81} matter particles, the minimum quark star volume was V = (1.6 x 10^{-35} m)^3/ (matter particle) (10^{81} matter particles) = 4 x 10^{-24} m^3, and its radius was approximately 10^{-8} m. The "rough" approximate radius was between the upper (5 x 10^{26} m) and lower (10^{-8} m) radius and shown in fig. 1a as << 10^{26} meters.

Fig. 2 shows our precursor universe's super supermassive quark star (matter)/black hole (energy) to our universe's big bang (white hole) transition. The x axis represents big bang time in seconds plus or minus from t = 0. Fig. 2 shows time symmetry between -10^{-33} and 10^{-33} s in accordance with Einstein's theory of General Relativity. At t = 0, all our universe's energy consisted of super force particles stacked one atop another in a doughnut singularity at the center of a Planck cube. The number of super force particles was a maximum between t = 0 and the start of inflation at t = 5 x 10^{-36} s. The start of inflation was time synchronous with the one to seven Planck cubes energy to matter expansion which consisted of six contiguous Planck cubes attached to the six faces of our universe's original Planck cube. The original Planck cube contained superimposed super force particles which condensed into six matter particles in the six contiguous Planck cubes. The first matter shell was then pushed out, and a second matter particle Planck cube shell condensed between the center Planck cube and the first matter shell. This process continued until enough shells with enough Planck cubes existed to accommodate all our universe's matter particles. By the end of inflation, the size of our universe had expanded from a Planck cube to a sphere with a radius of 8 m and our universe consisted of a hot quark-gluon plasma with a temperature of approximately 10^{25} degrees K. During matter creation between 5 x 10^{-36} and 100 s and at extremely high temperatures between 10^{27} and 10^{10} degrees K, heavy matter particles and their Higgs forces evaporated to the super force which then condensed to permanent matter particles and their Higgs forces. By t = 100 s, only eight permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino) and their eight associated supersymmetric Higgs forces existed [5].

On the left side of fig. 2, matter evaporation occurred between < -2 x 10^{-33} and -5 x 10^{-36} s and was the counterpart of matter creation or condensation between 5 x 10^{-36} and 100 s. Deflation differed from inflation because its duration was longer and had two phases. During the first deflation phase between < -2 x 10^{-33} and -10^{-33} s, the super supermassive quark star (matter) or cold quark-gluon plasma at 10^{-30} K, collapsed to a hot quark-gluon plasma with a radius of 8 m and a temperature of approximately 10^{25} K. During the second deflation phase between -10^{-33} and -5 x 10^{-36} s, the hot quark-gluon plasma collapsed to a doughnut singularity. The second deflation phase was the time reverse of inflation. That is, at -10^{-33} s, the super supermassive quark star (matter) consisted of a hot quark-gluon plasma with a radius of 8 meters and a temperature of approximately 10^{25} K identical to our universe's hot quark-

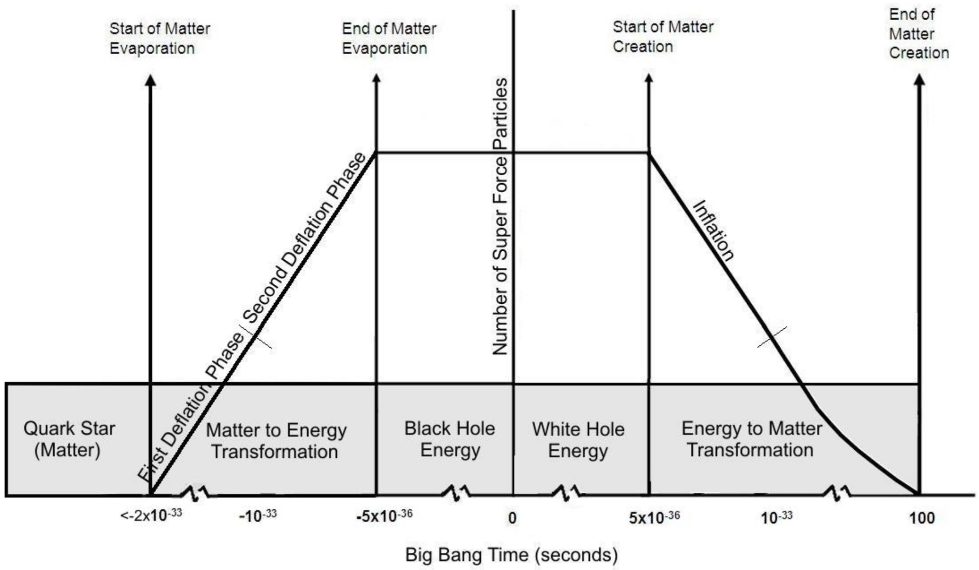


Fig. 2. Quark star/black hole to big bang (white hole) transition.

gluon plasma at 10^{-33} s. At -5 x 10^{-36} s, the super supermassive black hole (energy) or doughnut singularity was identical to our universe's white hole (energy) at 5 x 10^{-36} s.

The start of matter evaporation coincided with the start of the first deflation phase at t < -2 x 10^{-33} s. Deflation of the 10^{-30} K super supermassive quark star (matter) began when its energy/mass reached the threshold of 10^{24} solar masses (10^{54} kg). A single electron-neutrino at the center of the super supermassive quark star (matter) was subjected to extremely high pressure and temperature (10^{10} K), even though the super supermassive quark star's (matter) average temperature was 10^{-30} K. This electron-neutrino and its associated Higgs force evaporated to the super force, incrementally raising the temperature of the super supermassive quark star's (matter) center. A chain reaction began which instantaneously evaporated, deflated, and collapsed the maximum entropy super supermassive quark star (matter) first to a hot quark-gluon plasma at -10^{-33} s and then to a minimum entropy super supermassive black hole (energy) doughnut singularity at -5 x 10^{-36} s. The super supermassive black hole (energy) "resurrected" life via creation of super force particles in a subset volume of our precursor universe. Thus, the super supermassive quark star (matter)/black hole (energy) had a dual nature; evaporation of eight permanent matter and their eight associated supersymmetric Higgs particles in the quark star (matter) state and resurrection of life via creation of super force particles in the black hole (energy) state.

For creation of a variety of universe and precursor universe sizes, quark star (matter) collapse size was assumed to be a function of two thresholds, energy/mass and energy/mass density. For our universe's creation, the energy/mass threshold was 10^{24} solar masses and the undefined energy/mass density was $\rho_{qs,}$ If only one collapse threshold existed (e.g. energy/mass), each super supermassive quark star (matter) would collapse at the 10^{24} solar masses threshold to its associated super supermassive black hole (energy) and all created universes would be identically sized. There were many combinations of energy/mass and energy/mass density thresholds of super supermassive quark star (matter) collapses to associated super supermassive black holes (energy) for a variety of created universe sizes. There were also many combinations of energy/mass and energy/mass density thresholds of super super supermassive quark star (matter) collapses to associated super super supermassive black holes (energy) for a variety of created precursor universe sizes.

6.1 A new cosmology theory justification

Table 2 compares the Ultimate Free Lunch theory versus an Integrated TOE. Three laws of physics are listed in column one, the Ultimate Free Lunch theory in column two, and an Integrated TOE in column three. The Ultimate Free Lunch theory stated the near infinite energy of our universe was created from nothing or more precisely from random energy fluctuations. Thus, the Ultimate Free Lunch theory violated Conservation of Energy/Mass before and after t = 0. An Integrated TOE satisfied Conservation of Energy/Mass because the energy/mass (10^{54} kg) in our precursor universe's super supermassive quark star (matter)/black hole (energy) was identical to our universe's energy.

Einstein's Theory of General Relativity is time symmetrical about t = 0 and consists of a black hole, a white hole, and an Einstein-Rosen bridge (i.e. a wormhole or singularity) connecting two universes. The Ultimate Free Lunch theory violated Einstein's Theory of General Relativity because nothing but random fluctuations preceded our universe. In contrast, an Integrated TOE included a black hole, a white hole, and a wormhole or a doughnut super force singularity in a Planck cube.

The Ultimate Free Lunch satisfied the Second Law of Thermodynamics because of its assumed primacy over the laws of Conservation of Energy/Mass and Einstein's Theory of General Relativity. The logic was if our universe's entropy was minimum at time t = 0, nothing could possibly have preceded our big bang because entropy increases irreversibly with time. An Integrated TOE also satisfied the Second Law of Thermodynamics. In our precursor universe, the maximum entropy super supermassive quark star (matter) evaporated, deflated, and collapsed to the minimum entropy super supermassive black hole (energy). This collapse reset entropy from maximum to minimum and "resurrected" life via creation of super force particles.

Law	The Ultimate Free Lunch theory	An Integrated TOE
Conservation of Energy/Mass	violates	satisfies
Einstein's Theory of General Relativity	violates	satisfies
Second Law of Thermodynamics	satisfies	satisfies

Table 2. The Ultimate Free Lunch theory versus an Integrated TOE.

7 Conclusions

Since a new cosmology theory "An Integrated TOE" satisfies three laws of physics, it should replace "The Ultimate Free Lunch" theory which satisfies only one.

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