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Fibonacci sequence, Golden Ratio and Fractal Geometry as the New Dimensionless Constants for Unraveling the Architectonic Principles of the Cosmos

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Abstract: ***The entire Universe can be thought of as a gigantic information-processing architectural wonder whose beauty can be deciphered using the codes of some dimensionless constants in nature. The dimensionless constants are not burdened with our arbitrary choice of imposing units of measurements and can act as milestones of our progress and lampposts for our further quest. Changing or modifying these collections of fundamental constants can have enormous repercussions on the model of our universe. Her we try to define three such concepts or mathematical constructs and analyze whether they can serve as fundamental constants for expressing the basic symmetry, recursiveness and self-similarity of patterns as manifest in the natural world on different scales. The essential architectonic pattern of nature both on macroscopic and microscopic levels holds lots of similarities to those normally found in the world of man and his art. The universe being an architectural wonder should definitely possess some fingerprints of its creator which can reveal before us some basic recurring patterns of symmetries in nature. These fingerprints can be the dimensionless constants with the right arrangement of which we can derive a universe exactly like ours; but our quest is far from being complete and there are many areas where we need to discover some new dimensionless constants to address some serious issues. Here we try to see if Fibonacci sequence, Golden Ratio and Fractal Geometry can serve as dimensionless constants for a new theory of Universe which tries to posit our physical realty as a great architectural wonder full of endlessly recurring and often self-similar patterns of mind-boggling symmetry. The Universe is essentially a work of art whose beauty lies in its power of reducing all microscopic and multidimensional complexities into packets of simple and symmetrical events and shapes.***

I. INTRODUCTION

We all know that Fundamental Constants are of immense significance for us in our task of observation and derivation of the more complex properties of the Universe on both macroscopic, as well as microscopic scales. They tell us of the nature of interactions and the exchange of forces that occur among the particles. Now whether the Fibonacci Sequence, Golden Ratio or Fractal Geometry will qualify for the status of Fundamental Constants of Universe only time will tell but this study intends to provide some glimpses into the workings of nature where those three principles play a major role in determining the pattern f interaction among macroscopic and microscopic properties of objects to help certain type of symmetries to emerge. Now when considering about the most basic of properties of space-time fabric of Universe itself we should into compel ourselves into thinking about the constants based on units of “distance”, “time” or “mass”; rather we should accept the Fundamental Constants just as they are without the superfluous burdens of “metre”, “second” or “kilogram”. Only true dimensionless constants in correct forms can give rise to the properties like strength of interactions among different particles, masses of particles and even the speed limit of light itself. Standard Model of particle physics is based on certain fundamental constants that the model itself cannot predict but only measure. The exact cause and origin of the precise values that these constants take can be explored by various approaches all of which can be labeled under the umbrella term of Grand Unified Theories. Although certain Grand Unified Theories predict the values of such constants can change over long periods of times. However the present study does not intend to deal with these issues; rather it attempts to examine the probability of those three above-mentioned quantities to be considered as Fundamental Constants of deep, underlying symmetry of our reality. Now choosing and defining the right constants is challenging task. Changing the fundamental constants can cause existing theories to crumble and new theories to emerge. So adding new forms of constants can either help us visualize the physical reality from an entirely different perspective or can cloud our ability to judge the true nature of reality. If the entire creation is considered to be a great architectural wonder then the fundamental constants can be thought of as the blueprints of its Creator and changing or adding

new types of blueprints to the existing trove of treasures can have drastic effects. For example the value of speed of light is vacuum is 299,792,458 meters/second and of it is altered even slightly then theories or integral parts of theories like Inflation in Big Bang and carefully measured quantities like the rate of expansion of the Universe etc. can get altered. Now we should be aware of our definition of the units themselves which we use to define quantities like the speed of light. Each unit is not only arbitrary but also depend on that which they try to define. As for example the metre itself is officially defined as the distance that light travels in 0.00000000333564095 second and the second itself is again defined in terms of a particular frequency of light emitted by the Cesium-133 atom. So if the speed of light changes then the rulers we use to measure and quantify that speed will also change and the speed of light is not just about the light only, but it entails concepts like causality and the speed of propagation of any signal inside the space-time itself. So changing the speed of light is like changing independently to its underlying dimensions. So instead of choosing constants based on our arbitrary definition of units we should only keep in mind the dimensionless constants which are independent of those units. Here we can list 26 dimensionless constants to describe the universe as simply and as completely as possible. In fact Fibonacci Sequence and Golden Ratio themselves can be thought of as pure dimensionless constants. Among the 26 dimensionless constants, there is the Fine-structure constant or the strength of Electromagnetic interaction; the Strong Coupling constant which defines the strength of the Strong Nuclear Force that holds Protons and Neutrons together; the fifteen constants to describe the masses of fifteen particles in the Standard Model: six quarks, six leptons, W, Z, and the Higgs Boson; the four quark mixing parameters which can describe Weak nuclear force, radioactive decay and CP-Violation etc.; four neutrino mixing parameters which can describe how almost massless neutrinos oscillate from one type into another and last but not least the Cosmological Constant which describes how the Dark Energy accelerates the Universe. Still we need other Constants to solve various types of mysteries which plague our Standard Model and Grand Unified Theories like the problem of matter-antimatter asymmetry and Baryongenesis; the problem of Cosmic Inflation; the problem of Dark Matter and the problem of strong CP-Violation that can be seen in weak nuclear interactions and in neutrinos. So we are far from finding a complete system of theory which can explain everything but here in this paper our aim is not to find solutions to those problems but to address the issue of symmetry and more specifically to see if any new set of constants can predict the emergence of symmetries across different scales. So the main topic of interest in this paper is that of occurrence and emergence of symmetries and then examining the possibility whether any particular theory can predict their origin and nature.

II. BEAUTY OF SYMMETRIES

The architectural beauty of the Universe is most manifest in its symmetries and man's quest to unravel the pattern of nature's architectonic beauty has led him to construct a number of vantage points or theories about how symmetries on various scales relate to and even reinforce each other. Many have failed to pass the rigorous test of fidnign equality between theoretical predciitons and observational evidences while many still lie beyond our ability to test rrliably and efficiently. Fractal pattern, Fibonacci sequences and Golden fraction are such three elegant concepts which can address many of these issues and can help us to discover the fundamental processes which underlie nature's way of constructing symmetries from the smallest to the largest possible scales in an interconnected web of architectonic harmony. Nature is a great architect and there are instances throughout the natural world that most if not al its components of creation are in fact bound with each other by a web of almost mystical interconnectedness. Many of its forms of manifestation are balanced, ordered and aligned with finest imaginable precision. Whether it's the manmade objects or the natural wonders there is an inherent beauty in the symmetry of the objects and not just their size and shape. Aristotle was perhaps the first to point out the universal interplay of order, symmetry and limitation underlying any processes which give birth to symmetry. Symmetries come in different flavors like the rotational or radial one where we rotate our frame of reference around a single axis like as in a bicycle's wheels; reflection symmetry where two halves of an object impress us as being perfect mirror to each other as is found in the wings of a butterfly; or the tip of a snowflake which can inform us about the structure of all other flakes or one petal of a lotus teaching us about all the other petals and one cell of a honeycomb telling us about the nature of all others. So symmetry is in fact a manifested quality which can teach us about the underlying complexities giving birth to the ultimate superstructure in the world of senses. One of the most beautiful insights that any theory on the nature of symmetry has given us is the Noether's theorem which basically states that any symmetry in nature has a corresponding conserved quantity e.g., the wheels of a bicycle has angular momentum as its conserved quantity which in turn provides the rider with stability. Einstein's theories of General and Special Relativity have also taught us about the fundamental symmetry of space-time and mass-energy. Now with the luxury of increasingly sophisticated forms of scientific experiments we have the Super symmetry which states that each particle in nature has a corresponding super-partner particle. All these and more have pointed out the need for a more simple and yet powerful theory of symmetry which can act as a source code for uncovering the deeper level organizational principles that underlie the

architectonics of the cosmos. Now symmetry does not always function only as a universal and unifying principle but also as an agent which expresses the individuality of the creator or the subject. The quest to discover the origin and nature of this type of individuating force of symmetry which can both distinguish between and unify two contradictory strands of binary dualities has led to the formulation of many landmark theories. There are certain patterns in nature which recur over and over again across different scales of phenomena and a theory which can predict the emergence of all these recursive patterns is a holy grail for scientists. The spherical organization of cells in an embryo, the tentacle pattern of Hydra, the arrangement of petals in a flower, the spots and stripes on the bodies of leopard and zebra respectively and waves of different kind etc. show such a type of pattern recurring over and over. Turing wanted to find out a mathematical pattern which can describe the complex process of generation of recurring patterns underlying an embryo's development. So in 1952, Turing in his paper titled "The Chemical Basis Of Morphogenesis" proposed a "reaction-diffusion system" to explain the origin and development of those recurring patterns. These morphogenese continuously diffuse throughout the cell and create patterns like spots, spirals, hexagons, whirlwind-like shapes etc. In fact any chemicals like proteins, enzymes, hormones or acids can be labeled as morphogenes as they help to activate or deactivate any specific set of reactions occurring within cells and it is these morphogenes' ability to interact, diffuse or decay that eventually gives birth to the shapes like spirals, waves and spots etc. Turing never lived to see even whether his theory could successfully predict the development of patterns in an embryo. However in 2012, a study found that applying Turing's model to the formation of digits in an embryo of mouse did provide some useful insights. Turing's aim was to analyze and compute how from a set of some highly simple governing principles some highly complex and fascinating structure could emerge. In case of the mosquito embryo the digits were found to be series of stripes and this proved to be true for humans also. The entire process of digits formation begins when the paw starts out as nothing more than a simple blob of tissues from which by means of reaction diffusion process the cells change to create digits or die to create spaces between the digits. Here to genes were found to be responsible for creation of the morphogenes which caused digits formation and another was found to be responsible for causing cell deaths which in turn led to creation of gaps or spaces between them. Now whether Turing's model could also be applied to explain the pattern formation of various recurring symmetries in macroscopic world is not yet established by empirical researches but his visionary efforts have paved the way for many other kinds of theories to emerge. One such attempt to explain the symmetries found in the natural world is to explain the harmony in recursive pattern formation by means of application of the Fibonacci Sequence, Golden Mean or Golden Ratio and Fractal Theory.

A. Fibonacci Sequence and Its Significance

We shall start with the Fibonacci Sequence and try to analyze if this theory really qualifies to be one of the most fundamental descriptors of the essential pattern of harmony in natural world. In 1202 Leonardo Pisano Bigollo, commonly known as Fibonacci described a thought experiment in his book titled 'Liber Abaci' which was one of the first books to present before Western world the Hindu-Arabic system of numbers. Here Fibonacci tried to calculate how many pairs of rabbits could born from a single pair in one year. While doing the though experiment Fibonacci relied on two assumptions that none of the rabbits would die and that each pair of rabbits would produce one more pair of both sexes per month. This second pair then would be fertile from the second month after birth. So following this course of thought and the above-mentioned assumptions from the first pair of rabbits there would be one more pair and at the end of the first month and there would be 2 pairs of rabbits then. At the end of the second month the original pair would give birth to another pair and another pair became fertile, thus making the number of pairs three. Of these three pairs two would be fertile and one infertile at the end of the third month and thus the two pairs of fertile rabbits would give birth two new pairs each and as such there would be five pairs of rabbits altogether. Of these five pairs three would be pregnant and at the end of the fourth month there would be eight of such pairs. Fibonacci observed the basic pattern which underpinned this process of multiplication of pairs. According to him one just has to add up the sum of the pairs of rabbits of the two previous months. There was one pair of rabbits at first and two pairs at the end of the first month. After two months there were 1+2 or 3 pairs of rabbits; after three months 2+3 or 5 pairs of rabbits; after four months there were 3+5 or 8 pairs of rabbits and so on. This was the birth of Fibonacci sequence. Fibonacci sequence is basically thus a string or series of numbers that begins with 0 or 1 and which can be extended indefinitely by adding up any two consecutive numbers to find the next number in the sequence. By adding 0+1 we get 1, the third Fibonacci number and by adding 1+1 we get 2 which is the fourth Fibonacci number and if we continue to follow this pattern of addition we should get the following series of numbers 3, 5, 8, 13, 21, 34, 55, 89 etc extending all the way up to infinity. This method now needs to be understood from a geometrical point-of-view in order for us to understand its true importance in the unfolding of patterns of events across various scales in the natural world. We should first construct a simple square whose sides measure 1; now we should construct another square of the same size beside the first one. Next we have to attach another square to it

whose length of the side is 2; to this square we have to add another square whose length of the side is 3 and to this we have to add a square with length of the side 5 and then another square whose length of the side is 8. The numbers here are 1, 2, 3, 5, 8 – all belonging to Fibonacci Sequence. Now we have to draw a quadrant or half a semicircle in each square and this would finally result in a spiral called Fibonacci Spiral. This was the bottom-up process of visualizing the emergence of Fibonacci Sequence and Fibonacci Spiral. Now let us visualize in a top-down way. A rectangle of length and width of any last two of the digits of Fibonacci Sequence forms the Golden Rectangle or a perfect Rectangle. The Golden Rectangle can be broken down into squares whose size is equal to that of the next Fibonacci numbers down and below. So if we break a Golden rectangle into smaller squares based on Fibonacci sequence and divide each with a quadrant the Fibonacci Spiral emerges. Now as we have seen and understood the way the Fibonacci Sequence emerges let us now explore its deeper significance and how it reveals itself through various recursive patterns in the architectonics of the natural world. Our first example is the organization of florets in a sunflower. Its florets are organized in spirals of 55, 34 and 21 and this is the Fibonacci Sequence. Seed pods on the pinecone are organized based on the same principle of Fibonacci Spiral. In the phyllotaxy of the sunflower we find the spirally arranged seed cases of the sunflower form a clear example of Fibonacci Sequence in nature. Besides the usual 55 and 34 spirals in the outer areas of the sunflower there are also 55 and 89 and even 89 and 144 spirals in case of larger specimens. In case of the arrangement of florets in sunflowers if we consider the number of arcs which turn counterclockwise and clockwise we shall see consecutive Fibonacci numbers appearing. The arc however can be turned in either clockwise or counterclockwise direction. The petals of lily, buttercup, chicory and daisy follow the arrangement pattern based on Fibonacci Sequence – lily, buttercup, chicory and daisy have 3, 5, 21 and 34 petals respectively. Snail shells and nautilus shells along with the cochlea of the inner ear also follow the logarithmic spiral pattern dictated by Fibonacci Sequence. Nautilus' case is an especially interesting one. With each segment of growth the nautilus adds to itself one more value which follows Fibonacci Sequence of numbers. The currents that flow through the oceans, the tides that flood the shores and the waves that carry the tides along all curve into a spiral shape that can be mathematically diagrammed onto a plot at the points 1, 1, 2, 3, 5, 8, 13, 21, 34 and 55. So again we see the Fibonacci Sequence emerging in the spiral pattern of the currents of waves and tides. Buds on trees, sand dollars, and starfishes all are built according to the blueprint provided by Fibonacci Sequence.

III. GOLDEN RATIO AND ITS SIGNIFICANCE

Now we should see what Golden Ratio or Golden Mean means for us and how they connected with the idea of Fibonacci Sequence and how they also provide the nature with some important blueprint for structures to emerge. Golden Ratio, simply put is a mathematical term used to describe the relationship of two figures in which the numbers seem to be in some form of complementary ratio. Suppose we have a higher number 'a' and a lower number 'b'. Now the numbers will be in a Golden Ratio if the ratio between 'a' and 'b' is equal to the ratio between the sum of 'a+b' versus 'a' or 'a+b' has to be to 'a' as 'a' is to 'b'. Now the Greek letter ascribed to this ratio is Φ (Capital Phi) whose value is 1.618 or 1.618304 to be precise and φ (Small phi) denotes 0.618 (or 0.618304 to be precise) which is roundabout way of saying 'b' is to 'a' as 'a' is to 'a+b'. Now we should focus on describing its relation to the Fibonacci Sequence. To find the connection between the Fibonacci Sequence and the Golden Ratio we first have to inspect the ratio between two consecutive Fibonacci numbers and analyze the pattern that the ratio takes as we continue to find the ratios of various consecutive numbers in the sequence. The further along the Fibonacci Sequence one goes the closer to the ratio between any two numbers gets to the Golden Ratio. The ratio between 3 and 2 is 1.5, between 5 and 3 is 1.66667, the ratio between 8 and 5 is 1.6 and so on; and now if we skip along the sequence and go right the 10^{th} and 11^{th} Fibonacci numbers which are 89 and 144 respectively, we shall see how the ratio between 144 and 89 becomes 1.617977 and the ratio between 144 and 233 becomes 1.618025. So we see how the ratio continue to progress in the Fibonacci Sequence towards the Golden Ratio of 1.618304. So the connection between Fibonacci and Golden Ratio is quite clear. The Fibonacci Sequence is also expresses by DNAs. For each full cycle of its double helix spiral the DNA molecule measures 34 angstroms long by 21 angstroms wide and so is based on Fibonacci Numbers. Now the Golden Ratio has lots of role to play in defining the basic architectural patterns which manifest themselves in various forms and shapes throughout our natural world. In man-made objects and architectural artifacts too we find this use of Golden Ratio. In various works by some of the greatest artists of different periods of time we find this expression of Golden Ratio happening in different ways. Plato's studies on Golden ration was used in the construction of the Parthenon. When we create the right triangle using the basic phi relationships or Golden ratios we can get structures akin to the Great Pyramids of Giza. A pyramid based on areas and rules of Pythagorean Theorem is after all akin to a pyramid based on 'phi'. Notre Dom of Paris, Taj Mahal of India and some parts of Kairouan Mosque all have Golden Ratio proportions in a number of their key proportions of design. In Zurich's Main Station we find a conspicuous expression of Fibonacci Sequence in Mario Merz's artwork named 'The Philosopher's Egg'. This installation is suspended in the west end of the main train station in Zürich. It's a vivid and concretely illustrated

portrayal of the Fibonacci sequence: 0, 1, 1, 2, 3, 5. Just by analyzing the silhouettes of the birds and the window frames one can decipher easily the 1, 2, 3, 5 pattern. The Swiss architect Le Corbusier use of the golden ratio is conspicuously present in his Modulor system for the scale of architectural proportion and he thought his contribution to this field as comparable to Da Vinci's "Vitruvian Man". He also based his system on Fibonacci numbers. Corbusier developed in 1940 a uniform measuring tool which could replace the prevalent metric scale with a scale of harmonious dimensions derived from the most appropriate proportions of the human body and the Golden Ratio. In his book 'The Modulor' (1950) Le Corbusier writes that the human figure with a raised arm creates, at the main junctures of spatial displacement, these being the foot, solar plexus, head and the fingertips of the raised arm, three intervals, which result in a series of golden sections named after Fibonacci (Le Corbusier, 55). Even Bible mentions about things constructed according to the principles based on Golden Ratio as is evident in the construction of Noah's Ark and the Ark of the Covenant both built according to the Golden Ratio as laid down in the Commandments by God Himself. In the following section we will also see the reason why Pacioli used the term 'Divine' for the Golden Ratio thus instead of the then popular Greek sense of the term "dividing a line in the extreme and mean ratio". Da Vinci's "The Last Supper" was also based on Golden ration which was known at that time as The Divine Proportion as can be seen in the major dimensions of the room, the tables and the shields and in his "The Annunciation" the brick wall in the courtyard is in Golden Ratio proportion to the top and bottom of the painting while the emblems on the table also appears to have been constructed in accordance with the Golden Ratio proportion of the width of the table. In Vinci's painting 'Salvator Mundi' or Christ, the Savior of the World we also find the application of Golden Ratio. Vinci seemed to have planned and measured each and every aspect of his painting and in his quest to capture the essence of the Divine on a two-dimensional piece of board he had to measure elements like the facial proportions, the positions of the hands and the fingers, the design and draping of the robe, the fine amount of details encoded in the pattern of the embroidery and even the position of the lights which the glass orb placed in the hand of Jesus reflected. If we start with the height of the head, every line drawn will be a golden ration to the ones either side of it. Pacioli and Da Vinci's insightful work titled '*The Divine Proportion*' opens with a statement: "A work necessary for all the clear-sighted and inquiring human minds, in which everyone who loves to study philosophy, perspective, painting, sculpture, architecture, music and other mathematical disciplines will find a very delicate, subtle and admirable teaching and will delight in diverse questions touching on a very secret science" (Pacioli, 2). The book 'The Divine Proportion' is comprised of three texts: 'Compendio de divina proportione' (Compendium of divine proportion), 'Tractato del' architectura' (Treatise on architecture) and 'Libellus in tres partiales tractatus divisus quinque corporum regularium et dependentium' (Treatise on the five regular bodies). By using the term 'Divine' instead of the 'extreme and mean ratio' Pacioli intended to highlight some key aspects of the Golden Ratio like singularity of being or that just like there is only God, so is there only one value for Golden Ratio; the geometric expressions of this Ratio involves three lengths and so is God's Trinitarian nature existing as Father, Son and Holy Ghost; just like God the Golden ratio cannot be described by any rational number but by an irrational one and omnipresence and eternal aspect of God is just like the self-similarity of the Divine Proportion. In music too the Golden Section or Golden Ratio occurs in various forms. In a piano keyboard the interval of an octave from 'C' to 'C' above of 13 keys comprises of 8 white and 5 black keys, with black keys split into groups of 2 and 3. Thus we see how all numbers and proportions here are constructed from the basic principle of Fibonacci Sequence. In the writings of famous musicologist Erno Lendvai, namely in his book titled "Symmetries of Music: An Introduction to Semantics of Music" (1993) we see how he explains that the Golden Ratio and Fibonacci Numbers appear in the works of then Hungarian composer Béla Bartók. This is quite evident in Bartok's composition of "Sonata For Two Pianos And Percussion" in which the parts of the form follow the proportions of the Golden Ratio. Careful and detailed analysis of the works of immortal composers like Bach, Mozart, Schubert and De Bracy also reveal the underlying principle of Golden Ratio. In the construction of musical instruments too there are examples where Golden Ration has been used. In the The New Oxford Companion to Music Volume 2, we find mention of how Stradivarius and Guarneri violins were designed using phi, the golden ratio or golden section. The sound holes in those violins were placed in a most desired position following the principle of Golden Ratio. In nature too we find frequent occurrences of Golden Ration and Fibonacci Sequence in many cases. These structure reappear in the phyllotaxy or the pattern of arrangement of leaves and seed-cases in the stem of a plant. Now here plants follow the rule of the Golden Angle which can be obtained if we dissect the circumference of a circle according to the Golden Ratio. Once the sectioning is done two angles are created and the Golden Angle is the angle subtended by the smaller arc when two arcs that make up a circle are in the Golden Ratio. In many developed species of plants the angle between spirally shaped consecutive leaves is on average about 137.5 degrees and in this case the 137.5-degree divergence angle, the ratio is $1/\varphi$, which is approximately 0.618. This 137.5 is the Golden Angle and this arrangement of leaves is dubbed as the Fibonacci Phyllotaxy. The Golden Angle being an irrational number, no single leaf will ever cover another thus enabling the free flow of sunlight to caress each leave equally and maximum amount of raindrops can be transferred to the roots. In Astronomy and

Space Sciences too we find mention of the Golden Ratio. A research article titled "Strange Nonchaotic Stars" by J. F. Linder published at the American Physical Society reported the discovery of a class of RR Lyrae variable stars that pulsate in a fractal pattern at frequencies close to the golden ratio. The ratio of two of their frequency components is close to the Golden Ratio or the value 0.614 and this is why they have been dubbed as Golden. Another interesting thing about them was the existence of a "strange nonchaotic attractor", a system with a fractal structure but is strange as most fractal structures in nature are non-orderly or random. A group of Scientists at 'quantumgravityresearch.org' posits a theory called the Emergence Theory which attempts to unify General Relativity and Quantum Gravity under a unified, overarching framework. We can easily visualize the entire creation or the universe as a profound simulation built primarily from bits of information. This picture is supported by theories like Digital Physics and Simulation Hypothesis. Whether the e tire Universe can be thought of as primarily composed of information is a highly debated issue but we can get hints from the theories like Emergence Theory which employs Golden Ratio/ Golden Mean, Fibonacci Series and Information theory to unravel the fundamental mysteries of the Universe. In fact the Golden ratio is an irrational number whose rational form of expression is the Fibonacci Sequence. Golden ratio appears in Cosmology in case of Black Holes where positive temperature changes from positive to negative and this might hold true for higher dimensional Kerr-AdS Black Holes in rainbow gravity. The equation governing the Lower bound on Black Hole entropy (proportional to the area of its event horizon divided by the Planck area) also includes the Golden Ratio or "Phi" and it is also conjectured that loop quantum gravity parameter can also be related to black hole entropy via the Golden Ratio. In Binary Matrices the largest nontrivial eigen-values are the Golden Ratio (Φ) and -1/ Φ. The deep relation between Black Holes and Quantum Mechanics is thus also a result of the Golden Ratio. The essential architectonic principle underlying our physical reality can best be conveyed using a potent geometric language and according to Emergence Theory Principle, the basic code for writing this language can be the Quasicrystals which are in turn based on Golden Ratio. So if the entire structure fo reality can be interpreted as being built primarily of 3D Quasicrystals, then even Time and motion can be thought of as parts of that great sequence constructed with 3D Quasicrystals. Now the entire structure of reality if conceived along the analogy of a 3D film strip, then its basic constituent elements are 1D Quasicrystals and the Golden Ratio can appear in the arrangement and distribution of lengths of the 1D Quasicrystals which in turn follow the Fibonacci Sequence. In fact in certain theories the densest possible 3-D Fibonacci chain can ac as computationally most efficient 3D space. So we see how deep and intricate levels of interactions occur and reoccur in nature in the nuclear, quantum and Planck level to give shape to the macroscopic symmetry we see above and around us. Now another principle which is quite popular now-a-days is the Holographic Principle and according to this from the lower dimensional manifestations of some surface realities we can derive knowledge about the higher dimensional and massively complex realities which underlie all manifested properties of space-time. Now Emergence Theory is built around the basic tenet of possibility of recovering the actual or core-level object in 3D (e.g., a 3D cubic lattice) by analyzing with proper mathematical and trigonometric operations any 2D object. Now Emergence Theory states that if a 8 Dimensional 8-D crystal of a E8 lattice (Gosset Polytope) is projected to 4D two identical shapes are created with slightly different sizes and the ration of their size is in the Golden Ratio. Now these 4D shapes can also be created by rotating the 3D quasicrystals from one another by an angle based on Golden Ratio. These 3D Quasicrystals form the fabric of our space-time and tetrahedrons are the smallest possible 3D shapes or building blocks of natural reality existing on a Planck Length (10^35 times smaller than a metre). So now we see how from the largest to the smallest scales, various forms of reality are nothing but holographic manifestations of some highly complex and quantum-level principles operating on a higher dimensional plane. The g-factor of an Electron (ratio of its magnetic moment to its spin angular momentum) is caused by the stretching of space-time fabric as Electron travels almost at the speed of light and this g-factor can also be calculated according to the Golden Ration principle. The g-factor of an Electron being -2 / sin (Ø), while the g-factor of a Proton is 2Ø / sin (1/Ø). So this Golden Ratio or Ø can also be interpreted as a constant produced by Time itself. David W. Thomson of Quantum Aether Dynamics Institute theorizes the possibility of this g-factor itself arising out of the Golden Ratio principle which itself in turn is a product of Time. Even Spiral Galaxies like our Milky Way follows Fibonacci Sequence and each of the arms of Milky Way has a logarithmic spiral of 12 Degrees. The stars on the outside of the Milky Way rotate at a higher speed thus avoiding the winding of the spiral arms around the galaxy. Saturn's rings show a pattern of division at a Golden Ratio of the width of the rings. A research conducted in 2003 even suggested that the entire shape of Universe is actually a dodecahedron or a twelve sided geometric solid with pentagon faces, all based ultimately on Golden Ratio. If all the points of a pentagon are connected to form a 5-pointed star, then the ratios of the lengths of the resulting line segments are all based on Golden Ratio (phi), or 1.618. In case of living beings the Golden ratio is expressed in the design of the face. The position of both the mouth and nose follow the ratio of Golden section as each of them is positioned at golden sections of the distance between the eyes and the bottom of the chin. The eye and the ear also follow the Golden Section rule. In fact a person's body will appear to be more symmetric and attractive if his/her proportions of various parts of the body adhere to the Golden Ratio. So now we clearly see how

various patterns of manifested reality are actually modeled on the Golden Ratio or its more rational expression the Fibonacci sequence.

Much like the self-similar nature of the Golden Ratios we find fractals in nature formed from the chaotic equations and they are famous for containing certain self-similar patterns of complexity which increase as we attempt to magnify them more and more. No matter into how much tiny parts we divide a fractals shape what we finally get is a nearly identical, albeit reduced-size copy of the original whole. The inherent beauty of the fractals is in the fact that an infinite amount of complexity can be encoded with simple sets of equations. Art also tries to do that when it tries to establish a sense of harmony over our chaotic and frenzied world of senses. Only by repeating the fractal-generating equations multiple times, one can derive some random yet highly recognizable and beautiful outputs. In fact it is not just our planets which harbor some amazing natural examples of fractals but certain theories attempt to portray the entire Universe as fractal. Starting first with the publication of Andrei Linde's "Eternally Existing Self-Reproducing Chaotic Inflationary Universe" the fractal universe theories seem strongly to favor a Multiverse theory. According to Linde's 1986 theory the evolution of a scalar field can create certain peaks which later transform into points of nucleation that cause inflating patches of space to exist as separate and self-contained bubbles in a frothy sea of an infinite Multiverse, each of these bubbles being a Universe itself. These "bubble universes" thus make the universe fractal on one of the theoretically largest scales conceivable. Alan Guth in his 2007 followed this idea "Eternal Inflation and its implications" and this has led to Inflationary version of Multiverse theory. In other new theories like "Causal dynamical triangulation" and "Quantum Einstein gravity" Universe is posited to be fractal at smallest possible scales i.e. at Planck Scales; while certain Quantum Gravity Theories treat spacetime as fractal implying that dimensionality of Space evolves with Time. Coming back to Earth we find fractal patterns in Romanesco Broccoli whose pattern is natural representation of Fibonacci Sequence or Golden Spiral which gets wider or goes further from its point of origin by a factor of φ or the Golden Ration for every quarter turn it makes. Then Salt Belts like Salar de Uyuni in Southern Bolivia, Ammonite Sutures and shells of Ammonites, various kinds of Fold Mountains like the Himalayas, trees like Ferns all follow fractal patterns. In fact Michael Barnsley was first to discover through the self-similar patterns of the Ferns that though chaos is inherent in nature in a most unpredictable form yet it is possible by means of following a set of equations to derive knowledge about the deterministic nature of the chaos. These equations are called nonlinear iterative equations by following which if we generate random numbers time and again following Berns equations then at some point we should get a unique and self-similar object like a Fern. In their branching shapes and leaf patterns many plants seem to follow this recursive, fractal-like formula. Clouds, Canyons and even the structure of a lightning also follow the fractal pattern of ordering. Lichtenberg figures deal with such branching electrical discharges can be seen in lightning formation and the branching, self-similar patterns observed in Lichtenberg figures bear close parallels to fractal properties. Lightning can be thought of as a naturally occurring 3-dimensional Lichtenberg figure exhibiting fractal properties. Snowflakes, waterfalls, peacock feathers etc. all display fractal properties. Benoit B. Mandelbrot's works on fractal geometry and chaos theory are of enormous significance in the study of properties of fractal sets. In fact fractal geometry unlocks the possibility of producing artworks of great aesthetic appeal using simple algorithms and Madelbrot Set is one such example where similar but repeatedly new and aesthetically appealing structures are revealed in the area of their edges as one keeps magnifying them more and more. Now here Fibonacci Numbers has a deep relation with Madelbrot Sets. The Apples in Mandelbrot Set not just vary in size but arise in different periods of the repetition of mathematical algorithms. If one examines these Apple shapes one can find that of all the Apples between one Apple of period 2 and one Apple of period 3, it is the Apple of period 5 which proves to be the largest and in exactly the same way of all the Apples between period 5 and period 3, it is the Apple of period 8 which is the largest and between period 8 and period 5 it is the period 13 Apple which is the largest. Thus all the numbers here follow Fibonacci Sequence – 2, 3, 5, 8, 13 and so on.

IV. CONCLUSION

So from our discussion we can see how nature always seems to be little partial towards the most symmetrical and the most harmonious. These patterns of symmetry and harmonious arrangement of parts in the most desired kind of proportion follow some basic set of rules and Fibonacci Series, Golden Ratio and Fractal Shapes are three perfect examples of such rules. Among many shapes and sizes in natural world which especially tend to adhere to the pattern of symmetry as dictated by these three principles seem to have an upper hand from both evolutionary and aesthetic point-of-view. The systems which are most symmetric also tend to be most energy efficient also and consequently most stable. So the fingerprints of one Eternal Creator if they are ever to be found in His Creation, i.e., in the Universe they are there lying latent in the forms of Fibonacci Sequence, Golden Ratio and Fractal Geometry waiting for us to unveil their trove full of beautifully designed patterns of most elegant complexities. To delve deep into the mysteries of space time we have to interpret if first as an architectural construct and then try to an analyze its substructure or

base of creation by separating into its individual components which from an informational perspective can appear like a pixilated fabric where some basic geometric symbols can leak information about much deeper aspects of reality; while according to more traditional theories energy is the basic quanta of space time fabric and according to String Theory certain Planck-scale loops or segments of energy are vibrating and particles emerge from different resonant oscillation modes of those Strings. However there is a pattern of symmetry which combines and unifies several disparate aspects of reality into one elegant and unified whole and understanding the pattern of that emergent universal symmetry is of parmount significance.

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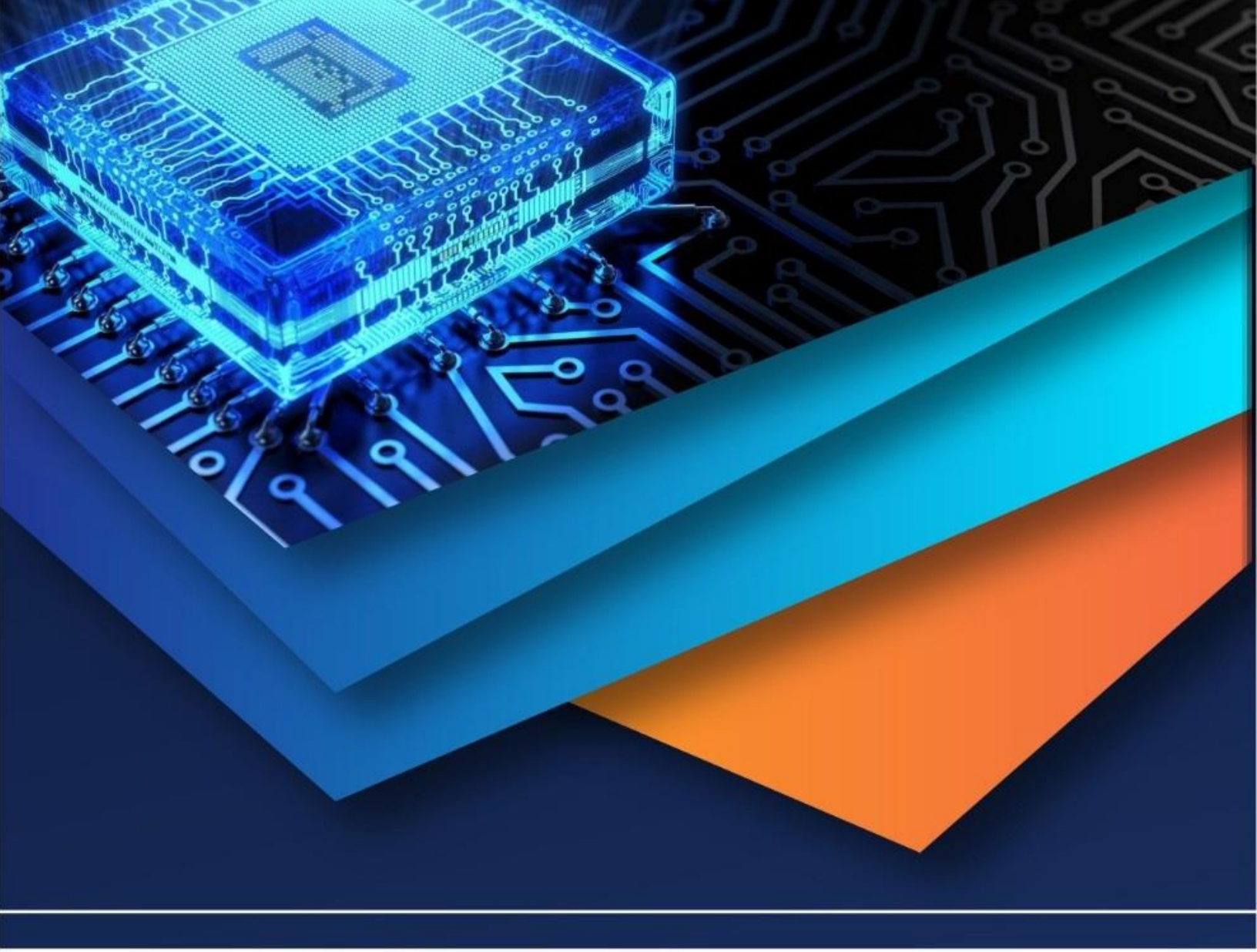

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