

THE METAPHYSICS OF PHYSICS**THE SPEED OF DARKNESS (S.O.D.)****ONE THOUSAND STEPS TO CHAOS****CHAPTER XXXV****THE PHYSICS AND METAPHYSICS OF SYMMETRICS****AXIOMS OF SIMPLEXITY****(THE SIMPLE & THE COMPLEX)**

The Physics of Symmetry (Symmetrics-Transformatics: The First 313 Simplicity Axioms). Before I can interpret the complexities of the combination of Symmetrics and Asymmetrics (Non-Symmetrics: The Grand Synthesis-Unification-De-Unification) in an Infinite, Unbounded, (open-closed) Universe; it is necessary to sum up the known facts of the Symmetric, Infinite, Unbounded Universe as interpreted by Physicists and Cosmologists in the 20th and 21st Century. Infinitism, Transformatics, Reverseamatics, Asymmetrics (Non-Symmetrics) and the Metaphysics of Structural Cosmology will be derived in the last 687 Axioms after I take a look at the special case of Symmetry (Axioms 1-313).

1. In the last decade there has been an attempt to merge GUT Theory (Grand Unification Theory) with TOE Theory (Theory of Everything) by combining their counterparts GUUT Theory (Grand Un-Unified Theory) and TON Theory (Theory of Nothing or

Theory of S.O.D. - Speed of Darkness Theory) incorporating SMGT Theory (Super Modern Gravitational Theory, which also includes the Forces and Interactions over and above the four know Forces), in order to discover the solution to all the major Interactions along with their minor Constituents. (See Axioms 314-1,000 on Asymmetrics and Non-Symmetrics).

A discussion of the Chronons, the Quanta of Time, Chronodynamics and their special relationships to Symmetrics, Asymmetrics (Non-Symmetrics) and to the S-Wave Quanta, is reserved for the later Axioms.

The basic solution to the structural composition of the Universe is not simple but complex like Complex Irrational Number Theory and consists of Tensor Analysis, computer driven Fractional-Fractal Geometry and Juncture Transformativ Geometry considerations. It is best visualized by viewing the graph (the Cosmological Map of the Infinite Universe) of the expanding nature of the Energy-Mass-Equivalence-Non-Equivalence formulae following Simplicity Axiom #505.

2. **INVARIANCE:** A geometric figure is Symmetric under operations if those operations leave it unchanged. These operations are geometrical in nature and have rotational features.
3. It is necessary to check Symmetry principles with computer designed rotations of geometrical figures through 360° via Fractional-Fractal analysis (Lewis).
4. Reflections leave simple geometrical figures invariant. A circle is invariant by reflections across any straight line that passes through its center just as a figure appears the same to two observers whose viewpoints are rotated away from each other at some angle. The square looks tilted, the circle remains the same.
5. Physical Laws are Invariant under rotations of any angle, which equals Rotational Symmetry.
6. The Four Fundamental Interactions are the Electromagnetic, the Gravitational, the Strong and the Weak. There is an additional one termed Superweak and recently a sixth has been unearthed that has to do with levels or Gradients of Gravity (Waves-Gravitonic

Action). This conjecture seeks to explain why Gravity is so difficult to link up with the other Forces because of the disparity between Gravity and the other Forces. **Eventually, as all the intervening Forces are unmasked between the Gravitational and the Electromagnetic-Weak-Superweak, the disparity will not seem all that large and the natural linkage will be recognized (Lewis).**

7. The Electromagnetic Force holds Atoms together and governs the propagation of Light and Radio Waves.
8. The Electromagnetic Force causes chemical reactions.
9. An Atom has an Electron and Proton and is located in a Nucleus.
10. The Gravitational Force holds the Contraction and Expansion of the Universe in check.
11. The Strong Force binds the Nucleus together.
12. The Weak Force causes certain radioactive Nuclei to Decay.
13. The Strong and Weak Forces do not play any role at the human scale.
14. All Four Forces may be studied independently or together.

15. The Strong Force is greater than the Electromagnetic, the Weak weaker than the Electromagnetic and the Gravitational is weaker than the other three.
16. Nuclear Spin. The thumb usually points up for direction of Spin when the fingers curl around the Atom's Nucleus in direction of Spinning orbit. The thumb or direction is down when direction of Spin is in the direction of the curled fingers.
17. Pauli's Principle. Nuclear Energy remains Invariant due to the creation of a Neutrino which carries away the unaccounted for Energy of the Interaction of Strange Particles during Decay under the influence of the Weak Interaction.
18. Yang Principle, 1986. With Spinning Nuclear Particles Nature shows a preference for direction of occasional emitted Particles.
19. Law of Rotation. Rotating our viewpoint necessitates that Reality remains the same or equivalent.
20. Physics does not pick out a special direction in Space during physical or mechanical rotation. This rule applies to Electromagnetic and chemical rotation but not to Radioactive and Gravitational rotations.
21. The Weak Force is the transformation of a Proton interacting with another

Proton, then transforming to a Neutron brought on by the Weak Force.

22. With the Electromagnetic Force, the Electrons and Protons hold Atoms together. The Strong Force binds the Nucleus together and the Weak Force causes the Radioactive Nuclei to Decay. Gravity becomes the strongest Force in the Macro World because it is additive in strength and Gravity becomes the weakest in the Micro World where the close proximity of the Strong and Electromagnetic Forces make the Charges involved stronger than Gravitons. Electro Forces are not additive but only as strong as the Charges involved. The Four Forces become one of varying degrees of Interactions.
23. Two Symmetries. The main Symmetries of Physics are Rotation and Reflection, the Left-Right Symmetry of Nature. If Nature doesn't show a preference between right and left then she is fully reflection Invariant and rotational Invariant. Up to 1956 Nature appeared to be Right-Left Symmetric. Strange Particles showed a preferred direction.
24. M. Abbott Lewis Postulate. It is during Discontinuities or Violations of Parity that the Particles under observation are looking for a place to "park" and therefore appear to be in Violation but it is in Reality only a special case of suspended "Particlization" in Hyper or Meta Space as shown by a Discontinuous cross section of Space at a given Time. This is an incomplete Interaction of volatile Particles with the 4th Dimension, a Dimension incidentally whose Nature is not to be confused with Group Theory's representation of

Dimensions beyond the Fourth Order. Group Theory Dimensions are simply geometrical and mathematical constructs in an idealized science.

25. In 1966 it was discovered that Parity Invariance does not apply to the Weak Interactions between Particles.
26. The Neutrino is responsible for Parity Violation. (Feynman & Murray-Gell-Mann).
27. AntiParticles exist. AntiElectron is the Positron or Antiproton. (Dirac, 1929).
28. Particles-AntiParticles have the same Mass but opposite Charges.
29. Dirac Principle. Physics does not favor Matter over AntiMatter.
30. Charge Conjugation, C, is the replacing of all Particles participating in a given physical Process with their reflective AntiParticles. Nature does not prefer Matter over AntiMatter so Charge Conjugation is Invariant.
31. The Weak Interaction violates Charge Conjugation Invariance.
32. CP is combined and Invariant. Charge and Parity are combined.

33. Nature violates CP (Lee, Yang & Cronin 1964).
34. CP Violation is due to a new Interaction weaker than the Weak i.e., the Super Weak.
35. Relativistic Invariance is Symmetry or the impossibility of defining Absolute Motion. Parity Invariance tells us that we cannot distinguish mirror image World from our World. Relativistic Invariance tells that we cannot distinguish mirror World from our World. Relativistic Invariance also tells us that it is impossible to decide whether we are at rest or moving at a constant rate.
36. **Collection of all formulae relating Velocity, Energy, Momentum, Temperature, etc., as measured by two different observers is known as the Galilean Transformation.**
37. Relativistic Invariance. Two observers in relative motion at constant velocity must arrive at the same physical Laws despite the fact that they differ in their measurements of various physical quantities.
38. **Basic issue of Symmetry is whether different observers perceive the same Structure of physical Reality?**
39. Symmetry Formula $E = MC^2$. Velocity Formula = Velocity = Velocity + u where u = steady State of Speed (steady acceleration or velocity). $V' = V + u$.

40. Coulomb's Law. The Electric Force between Electrified Forces varies inversely as the square of the distance separating them and is Symmetric with Gravity Law and the Laws of inverse proportion.
41. Electrical and Magnetic events are related or Symmetric with each other and give us the Symmetry of Electromagnetism.
42. Strength of an Electromagnetic Field is similar to Coulomb's Law. (It is Symmetric with it).
43. Maxwell's Equations specify how the Electromagnetic Field varies in Space and Time. One equation expresses how the Electric Field varies in Space in the presence of a Magnetic Field that is varying in Time producing Faraday's Law of Induction. By moving a magnet around a wire we produce an Electric Field that pushes Charges forward in the wire, generating a current. Coulomb's Law specifies how the surrounding Electric Field decreases with distance away from the Charge.
44. Electromagnetic Waves are Symmetric with Light Propagation. Electromagnetic Fields propagate Electromagnetic Waves, which produce Waves or fields in adjacent vacuums next to those same propagating Waves.

45. If we have in a region of Space, an Electric Field changing in Time, then a Magnetic Field is produced in the neighboring Space. This Magnetic Field is also changing in Time and it generates an Electric Field. An Electromagnetic Field propagates out in a Wave undulating between Electric and Magnetic Energy. The difference between the undulations is Symmetric.
46. The Speed of the Wave = the Speed of Light. Speeds are Symmetric in the accompanying gradients up to an including the Speed of Light.
47. Light is nothing more than the combination of Forces at work within the Electromagnetic Wave commonly called Photon Interactions.
48. Newton's Law is Galilean Invariant.
49. **Maxwell's Laws of Light or Electromagnetism are not Galilean Invariant.**
50. The observed Speed of Light is independent of how fast the observer is moving or is absolute or Asymmetric in comparison to all other factors, i.e., Nature does not prefer an absolute Speed. This rule does not apply in an Infinite Space (Lewis).
51. The Speed of Light is an intricate property of Nature and derived from the way an Electric Field varies in Time and generates a Magnetic Field and vice versa.

52. Symmetry has two distinct components--Invariance and Transformation. When physical Laws are Invariant we must specify the Law of Transformation that makes them Invariant. For Rotation Symmetry the Transformation is Rotation. For Reflection the Transformation is Reflection. Before 1956 these Symmetries were considered Invariant under the Transformations of Rotation and Reflection.
- 53. In Relativistic Invariance, the Transformation is used. In Electromagnetic Theory, Electromagnetism is not Relativistic Invariant under the Galilean Transformation with respect to Light propagation. The Speed of Light is Invariant and therefore it is not Symmetric in its consequences.**
- 54. Einstein proposed that Physics must be Relativistic Invariant and abandoned the Galilean Transformation.**
- 55. Absolute Time no longer exists.**
56. Different observers in relative motion at constant velocity perceive the passage of Time differently.
57. For a given interval, Proper Time, the Time of each individual Particle's own clock is always less than the Time measured by another observer. Time is dilated by movement. For each of us our own perception of Time is always less than that of anyone else's.

The higher the relative velocity between the observer and the observed, the larger is the ratio of Observed Time to Proper Time for Light Speeds. Photon Speed Time is instantaneous or Photon Time never changes.

58. Events in the physical World = location in Time and Space of t, x, y, z where t = Time, x, y, z are the three Dimensions of length, width and depth. t is according to a given reference Time and x, y, z are according to a given reference point. The observer of a given event, or in, or on an event equals t, x, y, z . The observer on the outside of that event = t', x', y', z' . The Transformation Laws of Space and Time are the formulae relations t, x, y, z to t', x', y' and z' . The Galilean Transformation is $t = t'$. The Einstein or Lorentz Transformation is $t =$ and/or $t \neq t'$, (where \neq does not), or $t = t'$ within the event but $t \neq t'$ outside the event.

Space and Time transform the event so that Speed = the c & c' of the observer and the observed. Therefore Space = Time or SpaceTime. When v or velocity between observers is small compared to the Light, t' is approximately = to t . t' depends on t and on the coordinates of Space $x, y, \& z$. Transformed Time depends on Space and Transformed Space depends on Time.

59. Maxwell's Theory of Electromagnetism is Relativistic Invariant under the Lorentz Transformation or is Lorentz Invariant.

60. $E=MC^2$ as the Momentum of Newtonian Mechanics is Mass in motion and under the Lorentz Transformations becomes liberated.
61. The Particles' opposite in Charge to those properties of the Electron is the AntiElectron or Positron-AntiMatter. (Dirac, 1929, Carl Anderson, 1932).
62. Schrodinger's Equation is Lorentz Invariant when discussing erratic behavior of Electron circulation about a Nucleus in an Atom of a Molecule.
- 63. Gravity is Lorentz Invariant since it involves the movement of Particles.**
64. The attempt at the ultimate Symmetric Transformations, i.e., of the Symmetric relationship between Celestial Mechanics, Terrestrial Mechanics, Acoustics, Heat, Optics, Electricity and Magnetism leaves out Gravity and Radio-Activity. For Newton the same Laws governed Celestial Mechanics as governed Terrestrial Mechanics.

In the Science of Acoustics, sound is due to Wave motion of Molecules and friction. Other Interactions are mechanical. Interactions are also Electromagnetic in nature between Atom and Molecules of objects. The motion of Particles is mechanical in nature but Gravity and Radioactivity are not yet within this Unification of Symmetry.

65. **Einstein's Equivalence Principle.** In a small region of Space the physical effects of a Gravitational Field as perceived by an observer are indistinguishable from the physical effects reported by another observer accelerating at a constant rate in the absence of a Gravitational Field. Equivalence applies only in a region over which the Gravitational Field is unified in magnitude and direction.
66. Equivalence allows us to work out formulae in local regions--to know the Laws of Electromagnetism in the presence of a Gravitational Field or the study of Photons in the vicinity of a Black Hole by working out Maxwell's Equations for an observer accelerating at a constant rate.
67. To deduce the effect of a varying Gravitational Field in SpaceTime apply the Law of Equivalence to SpaceTime divided up into small regions so that in each region the Gravitational Field is constant and is described by the mathematics of transforming coordinates.
68. A theory of Gravity must deal with all possible Gravitational Fields. t', x', y', z' , depends on t, x, y, z in all possible ways. A Calculus or change of SpaceTime coordinates t, x, y, z to t', x', y', z' , with (t', x', y', z') depending on (t, x, y, z) in an arbitrary way or in any way we want, is a general coordinate transformation. Lorentz Transformations are two Sets of coordinates related in a specific way. To study the Physics in any Gravity Field we can study the Physics of the field in the absence of Gravity and then perform a general coordinate transformation.

69. Einstein stated that the Laws of Physics preserve their structural form and is a general coordinate transformation, which he termed the Principle of Covariance.
70. Not only is Lorentz Invariance a Symmetry but general Covariance Theories are Symmetric.
71. Lorentz Invariance says that two observers in relative uniform motion perceive the same physical Reality or is similar to the Symmetry of rotation. Covariance Symmetry states that an accelerating observer would also see the same physical Reality but that the observer can interpret the difference between the physical Reality he experiences and the physical Reality the non-accelerating observer experiences as being due to a Gravitational Field. General Covariance is a statement about the nature of Gravity.
72. Covariance is a dynamical Symmetry as opposed to the static Symmetry of the other Symmetries of Physics (Weinberg).
73. The Physics that governs dynamical behavior of the Gravitational Field itself is not explainable by Covariance at first glance. Only the Physics of the Matter moving through the Field fits Covariance because the Forces of the Field itself are too weak for observation. Eventually it was seen that Covariance did describe the Field itself.

74. Gravity warps SpaceTime to make the Covariance Principle hold under all experimental conditions.
75. Gravity bends Light according to the Equivalence Principle even though Photons have no Mass. Gravity objects fall at the same rate regardless of Mass.
76. A Closed Universe (Einstein) is one that is curved-Finite like the surface of a sphere. An Open Universe, likened to a saddle or a sphere with bubbles protruding, is an Infinite one in direction. A traveler in a straight line would not arrive back at his original starting point. The compound of the open and closed Universe gives the pulsating-expanding-contracting Universe. Only the closed Universe is completely Symmetrical. Today's view supports an open-Infinite Universe in the expansive phase. When expansion reaches its zenith and contraction begins, the Universe becomes closed in a direct relationship to the passing of Time.
77. Einstein favored the Steady State Theory or the Stable, stagnant theory of the Universe.
78. Einstein's theory uses the Cosmological Constant to maintain Stability and to stop expansion. The Constant prevents contraction due to the equal distribution of Matter thereby keeping Gravity in check, Stable and non-collapsible. The problem remains unresolved in theory of how we can have a Cosmological Constant and still have an expanding and contracting Universe?

79. Since Symmetry unifies Space and Time into SpaceTime and Electric and Magnetic Fields into the Electromagnetic Field, we cannot have an equation standing all alone describing the variation of the Electric Field in Space. That equation can only be one piece of a unified equation describing the variation of the Electromagnetic Field in SpaceTime.
80. Einstein's Symmetry dictates design of Universe.
81. Fermat's Principle. Light chooses the path that allows it to arrive at its destination in the least amount of Time. In Relativity Theory Light chooses the path that allows it to travel along the Geodesic in the least amount of Time. Light chooses the path that allows it to arrive at its destination with the accumulation of the most amount of Time. In Relativity Theory, Light chooses the path that allows it to travel along the Geodesic in the most amount of Time which it does as Fermat's Theory envisions. **Therefore, Light has ample Time to accelerate to a limiting velocity but Darkness does not have to realize its darkening Potential in the same framework. Therefore, Dark arrives at Infinity abruptly whereas Light does so gradually (Lewis).**
82. **M. Abbott Lewis Principle. The Universe is indifferent to or independent of Quantum Mechanical considerations in respect to the governing properties of Light (Photon Emissions) notwithstanding the resolution of the Singularity problems in deep Space surrounding Black and White Holes via Wheeler, Hawking and Penrose. Therefore, the Structure of the Universe does not depend on the Thermodynamic nature of Light propagation per say. Thus it can be structurally Infinite. (This principle becomes self-evident after the consideration of Asymmetrics and Fractology, Lewis).**
83. **Principle of Least Action (Action Principle) operates in Mechanics. Particles follow histories of the least Action. Principle of Most Action. Particles follow histories of the most Action in Darkness (Lewis).**

84. Action formula for the Universe is the Classical notion: where $1/GxR$ represents Gravity and $1/g^2F^2$ represents the other Interaction formulae needed to tie all Actions together. They are listed as the six separate Actions of this formula:

$$s = Sd_x \sqrt{g[1/GR + 1/g^2f^2 + Y \otimes Y + (D \quad)^2 + V (\quad) + Y \quad Y]}$$

85. Physical Reality can appear different to different observers but the Structure of physical Reality must be the same.
86. Several different Actions Invariant under the same Symmetry Transformations would have the same Conservation Laws.
87. Noether's Theorem. Energy is conserved if the physical Laws do not change with Time. Angular Momentum is conserved. Energy is conserved and Momentum is conserved and all are Symmetric. Symmetry constitutes Transformations such as Reflection, Rotation and Lorentzian movements that do not change fundamental physical Action.
88. Quantum Symmetry. Energies move from lower to higher and higher to lower orbits in Symmetric or Quantum leaps like Wave fluctuations.

89. Energy and Momentum of a Photon are determined by the Wavelength of the associated Electromagnetic Wave. (Planck, Einstein).
90. Quantized Wavelengths related to Energy leads to Quantization of Atomic orbits. (De Broglie).
91. Physics in order to possess Symmetry has to have the Action Invariant under the Transformation associated with Symmetry.
92. Symmetry Theory is the Invariance of the Action under various Transformations.
93. **M. Abbott Lewis Principle. It is only under Infinite Transformations that Non-Symmetric properties are able to function in a religiously Symmetric Universe.**
94. Symmetry dictates the form of Action (Einstein).
95. Two major types of Symmetry are continuous Symmetries-rotation and discrete Symmetries such as Parity. One can continue the Transformation corresponding to a continuous Symmetry. In rotation one can vary the angle of rotation continuously. With Parity there is reflection or there is not.

96. Noether's Principle. For every continuous Symmetry in the Action there results a conserved quantity. Conservation Laws apply to Symmetry.
97. The Symmetry responsible for Charge Conservation is Gauge Symmetry.
98. In Sub-Atomic Particles there are Actions of corresponding Symmetry.
99. Electrons can occupy only certain orbits. Energy of Electron is Quantized and does not lose its Energy continuously but by leaps and bounds or Discontinuously (Bohr).
100. Probability Quantum Mechanics. Waves (or Wave Mechanics) specify the probability that the Electron would be found in a particular place (Born).
101. Uncertainty Principle. When we observe a system we disturb it and therefore Position and Speed (Momentum) are not determined simultaneously but Symmetry is left intact (Schrodinger, Born).
102. The Law of The Quantum. The probability amplitude of a given path being followed is determined by the Action corresponding to the path.
103. Path Integral Formulation For Quantum Mechanics. Action is Invariant under certain Symmetry Transformations and that same Action controls Quantum Physics (Noether). Thus the Action continues to possess the same Symmetry. The Classical Action

determines the probability amplitude for a specific chain of events to occur and the probability that either one or the other chain of events occurs is determined by the probability amplitudes corresponding to the two chain of events.

104. The symbol $1 >$ represents the classical State. The symbol $1 <$ represents the probability State in Quantum Physics.
105. The Quantum States of an Electron in an Atom belongs to representations of the rotation group. Rotational Symmetry tells us that the States belonging to the same representations all have the same Energy because the various States can be rotated into each other. **(See Asymmetric Transformations for a discussion on conversion of physical quantities into other physical quantities. It goes without saying that topological manipulations accomplish the same feat).**
106. Rotational Symmetry can by the notions of Group Theory turn out to be Zero under certain conditions. The Selection Rule comes into play when an Electron cannot make a particular Energy leap.
107. Selection Rules are tied to Symmetry and Conservation. The presence of Symmetry implies the Conservation Law (Noether). Processes that do not conserve Energy are forbidden and certain Quantum leaps are forbidden because they violate Conservation Laws (Wigner).

108. Symmetry restricts possible forms of basic Laws. We can add Quantum States due to the probabilistic Waves of Interaction.
109. States belonging to the same representation must have the same Energy. Symmetry regulates the Quantum leaps between States. Symmetry tells us about the underlying Laws and about the actual physical States.
110. Matter is made up of Electrons, Protons and Gravitons. Chadwick added the Neutron in 1932.
111. Protons and Neutrons = Nucleons. Interaction between Nucleons is the Strong Force and is 100 Times stronger than the Electromagnetic Interaction.
112. Strong Interaction is short-ranged. Weak or Electromagnetic Interaction is long-ranged.
113. If there is no Strong Interaction there will be no Nuclei except Hydrogen (one Proton and one Electron). If there is no Electromagnetic Interaction there are no Atoms.
114. Weak Interaction is 1,000 Times shorter than the Strong Interaction.

115. **Short range of Strong and Weak Force prevents Interaction on Macroscopic level. The Electromagnetic and Gravitational Forces are long-range and are evident on the Macroscopic level.**
116. **M. Abbott Lewis Principle. The transition stages between the Macro, Micro, Super-Macro and Super-Micro (that is the area between the Discontinuities or Fractal Basins of the short-range of Strong and Weak Force and the longer-range of the Electromagnetic and Gravitational Forces) are filled with transformational factors which allow the mechanical communication between these modalities. The connections between these perceptions of Reality are susceptible to a Fractional-Fractal analysis.**
117. Atomic States may be rotated into each other with the same Energy.
118. A Proton can be rotated into the Neutron. A strong Interaction is Invariant and conserved (termed IsoSpin). The Group is called SU(2) where "2" is the Group defined by transforming two objects into each other (Heisenberg).
119. IsoSpin applies only to the Strong Interactions termed Internal Symmetry. Protons and Neutrons have different Electromagnetic properties. The Strong Force between two Protons is the same between two Neutrinos. Or two observers see it as either a Neutron or Proton depending on their angle of rotation.

120. A conserved quantity must be associated with IsoSpin Symmetry (Noether).
121. Particles that Interact strongly carry IsoSpin and that IsoSpin is Symmetrically conserved (Noether).
122. Particles that interact Electromagnetically carry an Electric Charge.
123. Strong Interaction Processes that do not conserve IsoSpin are forbidden and the relative probabilities of allowed Processes are determined by Group Theory.
124. Constant exchange of Photons between the two Electrons produces the observed Electric Force or Charge.
125. Strangeness is conserved in the Strong Interaction. Strange Particles always occur in pairs after the Nucleons collide.
126. **Classical Physics applies to Reality and the Macro World of Molecules. Quantum Physics applies to the Microscopic World of Atoms and the Nucleus and Infinitism applies to the Sub Atomic and Nuclear and Sub-Nuclear World as well as the Supra Macro World of Astronomical occurrences. Some Particles that strongly interact are Strange. Some are not. Just as some Particles carry an Electric Charge and some do not. Proton, Neutron and Pion (the shuttle Particles between the Proton and Neutron that maintains the Strong Interaction and properties of Conservation**

and Symmetry in these Interactions) are Zero in Strangeness or have no unexpected Particles created upon impact. Strangeness is conserved and therefore Symmetric beyond IsoSpin (Noether).

127. **M. Abbott Lewis' Model of Analysis. This Model is designed for three different levels or Tangents of Interaction. The Macro World of basic Reality is Existential, Psychological, Classical and Symmetrized. The Micro World of the Atom and Molecules is Symmetrized, Phenomenological and Quantumized. The Super Microscopic World of the Nucleus is Quantumized, Classical and Infinitized; wherein parallel and perpendicular Universes in 3 plus Dimensional rotations have an effect on the Super Micro World while acting on the range of Interactions of Transformation Depots forcing the results to be a combination of the Symmetric and Asymmetric (Non-Symmetric) described by the new Science of Transformatics and Symmetries termed Asymmetries (Lewis).**

128. Strangeness Conservation signals a Symmetry beyond IsoSpin (Noether).

129. Particles that interact strongly are Hadrons. (Nucleons, Pions and Strange Particles). Particles that interact weakly are the Electron and the Neutrino or Leptons collectively.

Hadrons are the Pi Meson or the Pions and are intermediate in Mass between the Nucleus and the Electrons. Particles similar to the Pion are Mesons. Particles similar to the

Nucleons are Baryons. Nucleons are in ordinary Matter so are subdivided in the Baryon class into Nucleons and Hyperons. **The Hyperons are Sigma + and/or** /-/

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The Groups separated out in regards to their Yields in the following manner before 1960. Hadrons yielded Baryons and Mesons, where Baryons yielded the Nucleons, i.e., Protons and Neutrons and Hyperons. The Meson yielded the Pion.

The Lepton yielded the Electron and the Neutrino.

The Photon and Graviton were in a class by themselves.

130. All Hadrons must belong to IsoSpin Multiplets. For example: there are three types of Pions, T^+ , T^0 , T^- . T^+ is positive. T^0 is Neutral and T^- is negatively Charged. All 3 have the same Mass. As far as the Strong Interaction is concerned they are the same except for their Charge. Two Nucleons form a Doublet--the Proton and the Neutron. Hadrons can be ordered into IsoSpin Multiplets. The Strong Interaction has a Symmetry larger than IsoSpin in regards to Strangeness Conservation, i.e., Strangeness properties are Symmetric (Noether).

131. Summary of Subnuclear Particles, 1960: 8 Baryons-Nucleon Twins-Photon and Neutron. Sigma & xi Hyperons, Sigma in three States-positive, neutral and negative. (Sigma Symbol +, Sigma Symbol 0 and Sigma Symbol Negative $^-$). Sigma Hyperons belong to IsoSpin Triplet, xi Hyperons to an IsoSpin Doublet. A Hyperon called Lambda = Λ with a tail as symbol--IsoSpin Singlet.

Summary Diagram. 8 Baryons are indicated by a dot plotted on a Two-Dimensional World Grid. The Baryon corresponds to dots joined by horizontal lines and belong to the same IsoSpin Multiplet. Baryons on the same horizontal level have the same Strangeness. Nucleons have Strangeness Zero.

For the Meson Diagram there are eight Mesons, besides 3 Pions, four Mesons, called K Mesons or just Kaons, which belong to 2 IsoSpin Doublet and a Meson called Eta by itself in an IsoSpin Singlet (1961). Mass in the following diagram of the Baryons and Mesons is in MEV Units () after the letter denoting a given Baryon or Meson. Members of the same IsoSpin Multiplet have almost the same Mass as dictated by IsoSpin Symmetry. All 8 Baryons have the same approximate Mass, give or take a few hundred MEVs. Pions are radically Light. All the Particles are related to each other in more than superficial ways pointing to a continuous Symmetry.

132. If the fundamental Action is Invariant under Group Transformation then there are Quantum States that transform into each other and represent the multiplicative structure of the Group. These Quantum States are Particles since the Masses are only approximate. The Symmetry involved is more approximate than IsoSpin Symmetry.
133. $SU(2)$ transforms 2 objects into each other. In general, the Group $SU(N)$ transforms N objects into each other in its defining representations (Heisenberg).
134. The higher Symmetry of the Strong Interaction is $SU(3)$ and is a higher Symmetry Group than is $SU(2)$ where the Baryons belong to an Eight Dimensional representation of $SU(3)$ labeled the Octet (Gell-Mann and Neeman, 1961).
135. $SU(3) = (8 \text{ yields } 3 + 2+2+1)$. Eight Baryons yield Sigma () (Hyperons) and form an IsoSpin triplet. The Nucleons and the () Hyperons form 2 doublets and the () Hyperson forms a Singlet.
136. Extremely short-lived Particles are called Resonances. In 1962 nine Resonances existed. Resonances are related by IsoSpin and the rows are related by the Eight Fold Way.

137. Omega minus (Ω^-) is the tenth missing Resonance when SU(3) has a Ten Dimensional representational representation (Gell-Mann).
138. Quarks are Up, Down and Strange and have different Charges that are smaller than the Electron and are the Triplet Particles in the SU(3) representation (Gell-Mann, Zweig and Neeman, 1964).
139. Hadrons are the stronger Interacting Particles and are made up of Quarks and Anti quarks the same way in which an Atom is made of Electrons and Atomic Nuclei and they themselves are made of Protons and Neutrons.
140. Quarks located in Hadrons have not been observed.
141. Non-Abelian Gauge Symmetry is also termed Non-Abelian Gauge Theory (Yang-Mills).
142. A Symmetry involving Transformations that vary from point to point in a Gravity Field is Local. To deal with Gravity Fields divide SpaceTime into smaller and smaller regions where the Coordinate Transformations vary from point to point. A Symmetry involving Transformations that do not vary from point to point is Global. Global Symmetry means that all the Transformation transactions are exactly the same leaving the structure of physical Reality Invariant (Einstein). IsoSpin Invariance is an example of Global Symmetry.

143. Strong Interaction Physics is Invariant under Transformations when the Proton becomes a Neutron and the Neutron becomes a Proton. Strong Interaction does not distinguish between the Proton and the Neutron (Heisenberg).
144. If we perform an IsoSpin Transformation rotating the Proton into the Neutron we have to perform the same rotation everywhere in the Universe in order to leave the Action Invariant.
145. Symmetry responsible for Electric Charge conservation is Local (Weyl).
146. Light is a case of Local Symmetry or Gauge Symmetry.
147. The Symmetry actually responsible for Electric Charge conservation are the Transformations involving the Quantum Probability Amplitude.
148. **The Action of the World including Electromagnetism possesses a local Symmetry called Gauge Symmetry. Local Symmetry determines the form of the Action or Symmetry creates the design (Einstein). Internal, as well as External Symmetry is exact and Local or Non-Abelian Gauge Symmetry (Young, Mills, Heisenberg, Einstein and Weyl).**
149. Quantum Field Theory. Particles are described by the Probability Amplitude Waves governing their motion. The Waves are specified at each point in Space in Time.

Particles in the Quantum World are described by Fields (Faraday). The Action is constructed out of Fields combined in such a way that the Action will satisfy whatever Symmetries are desired. To construct a Quantum Field Theory describing the Interaction of Electrons and Protons--combine the Electric Field and the Photon Field (the Electromagnetic Field) into an Action, which satisfies Lorentz Symmetry and Gauge Symmetry.

150. Massless Particles in Yang-Mills Theory are Gauge Bosons. Electromagnetic Theory is a special case of Yang-Mills Theory. The theory postulates one Gauge Boson--the Photon.
151. When a Particle emits or absorbs a Gauge Boson, it changes to another Particle. A Gauge Field transforms Particles into each other.
152. The four fundamental Interactions are characterized by a coupling constant that measures the strength of the Interaction. In Quantum Physics the probability that two Particles will interact determines the strength of the Interaction. The constant varies with Energy scales at which it is measured and is termed Coupling Strength or Coupling. In Quantum Physics the Wavelength of a Particle used as a probe decreases as the Energy of the Particle increases and the Coupling strengths of the various Interactions will vary.

153. If the Coupling becomes weak in a Strong Interaction (Energy is increased as Coupling gets weaker) it tends towards Zero and the Particles become free to move independent of other Particles. A theory whose Coupling Strength moves towards Zero under the influence of higher Energies is called Asymptotically Free Theory.
154. The Electromagnetic Coupling increases as the relevant Energy of the Electromagnetic Process increases.
155. Yang-Mills Theory is asymptotically free (Gross, Willizek and Politzer, 1963).
156. The probability of Electron-Positron (AntiElectron) annihilation into strongly Interacting Particles should decrease in a definite way as Energies of the colliding Electron and Positron increase.
157. There are three Times as many Quarks that are simply copies of each other in the Hadron Strong Interaction and they may be represented by an artificial coloring. Each Quark comes in three Colors--red, yellow and blue. There is a red Up Quark, a yellow Down Quark, etc. Color then means triplications or exact copies of the Quarks (Gell-Mann).
158. A Quark of one Color can transform into a Quark of another Color but remain the same.

159. Each Quark carries two attributes-Flavor and Color. The same kind of Quark means it is the same Flavor but a different Color. Flavors = Up, Down and Strange. The three Flavors come in three Colors or nine Quarks in all. The Mass of a Quark is the same regardless of Color but varies from Flavor to Flavor.
160. Yang-Mills Symmetry changes the Color carried by the Quark but not the Flavor. 3 different Colors are transformed into each other or SU(3) becomes Color SU(3).
161. Eight Gauge Bosons are Gluons because they glue the Quarks into Hadrons (Quantum Chromodynamics, Gell-Mann).
162. Force between Quarks is mediated by the exchange of Gluons the same way that the Electromagnetic Force between Charged Particles is mediated by the exchange of Photons.
163. Asymptotic Freedom is the Force becoming weaker when two Quarks collide at high Energies or when they get very close to each other. As the two Quarks move away from each other the Coupling Strength moves away from Zero and prevents Quarks from separating. In the opposite manner the Electromagnetic Interaction between two Electrons decreases as the Electrons move apart. The Gluons operate under the Asymptotic principle and have not been seen.

164. **The Strong Force is not mediated by the Pion but by Gluons. The Gluons glue the Hadrons into Nucleons, Pions and other Hadrons. The path of the Strong Interaction is from Molecules to Atoms, Atoms to Nuclei, from Nuclei to Hadrons, from Hadrons to Quarks. Quarks and Gluons cannot be observed directly.**
165. **IsoSpin. The Eightfold Way and Strong Interactions are all incidental Symmetries. IsoSpin Transformations change the Up Quark and the Down Quark into each other. The Transformations of the Eightfold Way change the Up, Down and the Strange Quarks into each other. They change Flavor but not Color. They are Symmetrical only to the extent that these 3 Quarks have approximately equal Masses. The Masses of differently Flavored Quarks are not controlled by the Strong Interaction and there is no reason for them to be equal, i.e., they point to an Asymmetry. Quarks with other Flavors exist and their Masses are different from the Up, Down and Strange Quarks.**

- 166. A Quantum Field Theory is one in which we can sensibly add up all the amplitudes and thereby is Renormalizable. Yang-Mills Theory is Renormalizable. The negative and positive Quantum amplitudes of the Waves can be added to give a sensible sum (t'Hooft). One does not add numbers up to Infinity. One adds some numbers and subtracts some numbers in Quantum Physics. Therefore the sum approaches a definite number instead of Infinity.**
167. From the notions of Parity and Rotational Invariances comes the notion of Exact Non-Abelian Symmetry.

168. The four main Interactions of the Universe, the Strong, the Electromagnetic, the Weak and the Gravitational, have disparate Coupling Strengths and differ in their properties.
169. The Strong Interaction is 100 Times stronger than the next in strength—the Electromagnetic.
170. If the actual History of an Action of a Particle is not Invariant under Symmetry Transformations that leave the Action Invariant; the Symmetry is Spontaneously Broken.
171. Spontaneous Symmetry Breaking is different from Explicit Symmetry Breaking. If the Action is approximately Symmetrical the Symmetry is broken Explicitly. Explicit Symmetry Breaking is where one puts the Symmetry Breaking into the Action.

172. One can have a design that has Symmetry as well as lacks Symmetry. One can have a Symmetrical Action but its History can be Non-Symmetrical.
173. It is possible to have an Action shaped by Perfect Symmetry yet the manifestations of that Action can be totally Non-Symmetrical.
174. The Weak and the Electromagnetic Interactions are related.
175. The Electromagnetic Interaction is long-ranged. The Weak is short-ranged. The Interaction of Particle is accomplished by a Mediator Particle shuttling back and forth. The range of the Interactions is determined by the Mass of the Mediator Particle. The Nuclear Interaction is short-ranged because the Pion is Massive. The short range of the Weak Interaction has a Mediator more Massive than the Pion. It is the Intermediate Vector Boson or W (Yukawa, Rubia & Van der Meer).
176. W and the Photon (the Mediator for the Electromagnetic Interaction) are similar in some respects for W and the Photon Spin at the same rate. However, W, is much more Massive than the Photon. The Photon is Massless. When a Particle emits a Photon, Parity is conserved. The Weak Interaction does not respect Parity so when a Particle emits a W, Parity is not conserved.
177. In Quantum Physics, the Strength of an Interaction is measured by the probability amplitude that the two Particles separated by a certain specified distance would interact and that Interaction is due to the Mediator going between the two Particles. The probability amplitude is equal to the product of the three probability amplitudes, i.e., the

Amplitude for one of the Particles to emit the Mediator, the amplitude for the Mediator to get to the other Particle and the amplitude for the other Particle to absorb the Mediator. In Quantum Physics, as in the Real World, the probability that a chain of events will occur is equal to the product of the individual probabilities for each event.

178. The amplitude for a Particle to emit a W is no smaller than the amplitude for the Particle to emit a Photon. Because W is Massive the probability amplitude for it to pass from one Particle to another is small and it turns back. Thus the Weak Interaction is weakened or much weaker than the Electromagnetic Interactions.
179. W Boson and Photon are Gauge Bosons of the Yang-Mills Theory (Schwinger, Bludman and Glashow).
180. In Yang-Mills Theory, one Particle is transformed into another upon emitting or absorbing a Gauge Boson.
181. In the Weak Process of Radioactivity Decay, a Neutron disintegrates to a Proton, an Electron and a Neutrino. The Neutron emits W and transforms to a Proton. On a more fundamental level a Down Quark, the Neutron, emits a W and then transforms into an Up Quark. Another Weak Process sees a Neutrino and Neutron colliding and turning into an Electron and a Proton. The Neutrino emits a W and transforms into an Electron. The Neutron absorbs the W emitted by the Neutrino and transforms into a Proton. The Weak Action then becomes merely a question of what happens when a Particle emits or absorbs a W.

182. The Feynman Diagram is used to depict what is happening when Particles collide.
183. The Group representing the Young-Mills Theory determines the number of properties of Gauge Bosons to fit the pattern of the Electromagnetic and Weak Interactions or is $SU(2) \times (U1)$ or $SU(2)$ with additional Transformations that use up an extra Gauge Boson—the Z Boson. When a Neutrino emits or absorbs a Z Boson it remains a Neutrino. Likewise, An Electron or Neutron or any Particles for that Matter remain the same when it emits a Z Boson. Z and the Photon are alike except that the emission or absorption of Z violates Parity.
184. Neutral Current Process. The Mediator of Z produces a different Weak Interaction. When a Neutron and Neutrino collide they scatter off each other since the Z exchange between the two leaves them unchanged. In the Standard Weak Process, the colliding Neutrino and Neutron is changed to an Electron and a Proton (1973).
185. Neutral Current Process can explain the Electromagnetic and Weak Interactions.
186. In Gauge Theory, the Group Symmetries require the corresponding Gauge Bosons to be Massless.
187. When the Gauge Symmetry is Spontaneously Broken, the corresponding Gauge Boson becomes Massive (Higgs Phenomenon).
188. In Spontaneous Broken Gauge Theory, some Gauge Bosons become Massive while others remain Massless.

189. Higgs Phenomenon explains differences between the Weak and Electromagnetic Interactions (Salam and Weinberg). The Standard Theory uses the method of summing an Infinite number of histories, (not by hand-explicit breaking) but by plusing and minusing alternately the ascending numbers in the series. This yields a final sum by using Spontaneous Symmetry Breaking and is called the Electro-Weak Interaction.
190. W, Z and the Photon are related as the Gauge Bosons of the Yang-Mills Theory and transform into each other under Group Symmetry. After Spontaneous Symmetry Breaking, they appear disparate but W and Z are Massless. At low Energies their Coupling Strength is Weak but as Energies increase their Masses become smaller and the Coupling Strength becomes stronger.
191. The Strong, the Electromagnetic and the Weak Interactions are unified at some Energy level, namely 10^{15} , and at that level Grand Unification occurs and is distinguished from Electro-Weak Unification. At higher Energies Electromagnetic Force becomes stronger while the Strong Force becomes weaker. At some level the Electromagnetic Force will become just as strong as the Strong Force. At high Energies the W, Z and Photon are Massless. The difference of Masses at lower levels of Energy is the result of Spontaneous Symmetry Breaking. At high Energies the Gluons of the Hadrons become weaker (Pati, Salam, Georgi and Glashow, 1973).
192. 10^{15} Energies x the Nuclear Mass will convert the Electromagnetic into the Weak Interaction. The reverse Process is also possible.

193. Grand Unification unites the W, Z, Light Gluons and Photons and all belong to the Gauge Boson Family of a single Yang-Mills Theory. Photons, W and Z are Gauge Bosons of Group Theory $SU(2) \times U(1)$. The Gluons are Gauge Bosons of a theory with the Group designation $SU(3)$. $SU(3)$ transforms 3 objects into each other. $SU(2) \times U(1)$ and $SU(2)$ transforms two objects into each other. $3+2=5$. We need $SU(5)$ for Grand Unification—the Photon, W, the Z, eight Gluons and 2 more Gauge Bosons X&Y.
194. $SU(5)$ yields Spontaneous Symmetry Breaking into Color $SU(3)$ and $SU(2) \times U(1)$ or two Yang-Mills Theories $SU(3)$ and $SU(2) \times U(1)$. X and Y Bosons have extra large Masses or 10^{15} Nuclear Mass. The Gluons dissipate with the W, Z and the Photon remains Massless. As the Energy decreases we come to the Electro-Weak Energy scale. This is Energy which no more than a few hundred times the Nuclear Mass. Young-Mills Theory $SU(2) \times U(1)$ is Spontaneously Broken again. W and Z become Massive while the Photon remains Massless. Only Gauge Bosons in $SU(5)$, the Photons and 8 Gluons appear as Massless excitations at low Energies. The Gluons are confined in the Infrared Slavery inside the Hadrons leaving the Photons to produce Light. $SU(5)$ Young-Mills Theory, together with all of its Gauge Bosons lets Symmetry be broken down Spontaneously. All Massless Gauge Bosons turn into Infrared Slavery and the remaining visible Gauge Boson is the Photon.
195. The remaining Quarks and Leptons transform into each other furnishing representations of $SU(5)$. The Dimension of the representation is the number of entities belonging to that representation as it is 5 Dimensional.

196. The Electron carries a Charge opposite but equal in magnitude to the Charge of the Proton because of Grand Unification.
197. The exact equality of the Magnitude of the Charge carried by the Electron and the Proton is derived from the Group Theory of SU(5) (Georgi Glashow).
198. Gauge Bosons. The Gluons transform a Quark into another Quark with the same Flavor but a different Color. When a Quark emits or absorbs a Gluon it retains Flavor and changes Color. The Gluons leave the Leptons alone. The W Boson transforms a Quark into another Quark with the same Color but different Flavor and transforms a Lepton into a different Lepton. The W Boson transforms the Electron into a Neutrino. The Photon transforms an Electrically Charged Particle into itself. When a Charged Particle such as the Electron emits or absorbs a Photon it remains an Electron. The Photon leaves Electrically Neutral Particles alone. The Z Boson, like the Photon, transforms a Particle into itself but does not limit or interact with Charged Particles.
199. Quarks always change into Quarks and Leptons change into Leptons.
Transformations of Quarks are manifested as transformations of Hadrons.
200. Baryon Number remains constant no Matter what Transformation occurs. Baryon Number is conserved. The Proton, Neutron and Hyperon together constitute the Baryon Number.
201. The effect of the X and Y Bosons is Super Weak but will cause a Proton to Decay into the Pion and Positron (AntiElectron) leading to the destruction of the Universe.

202. Coupling Constants move very slowly and they meet only at high Energies.
203. A Proton can be made of a Positron and a Pion.
204. The Universe is not empty of Matter.
205. The Universe is almost empty of Matter.
206. Before Grand Unification, the number of Baryons in the Universe, Proton, Neutron and Hyperons-could not change.
207. Symmetry, Local or Global, has to be responsible for Baryon Number Conservation (Noether).
208. Grand Unification dispenses with Absolute Baryon Number Conservation. The Proton does not last forever.
209. Parity falls.
210. CP-Operation of reflecting Particles into AntiParticles and vice-versa is violated. CP Invariance violation discovered in the decay of K-Meson (1964).
211. The amount of Matter in the Universe depends on the extent of CP Invariance Violation. Since CP Violation is small the Universe is almost empty of Matter.

212. Local Symmetry with Violation of Baryon Conservation and CP Violation, together with Gravity, to make Universe expand, produces Grand Unification (without taking into account Acceleration at this juncture).
213. The Muon is more Massive than the Electron and Decays into the Electron via the Weak Interaction.
214. The Muon is to the Electron what the Strange Quark is to the Down Quark. They are both more Massive than their respective counterparts.
215. The Heavy version of the Up Quark is the Charm Quark as required by the Yang-Mills Theory of Weak Interactions (Iliopoulos, Marani and Glashow, 1974).
216. Neutral Current Interaction. The Charm Quark, Local Symmetry and Spontaneous Symmetry Breaking are connected and essential for the Universe.
217. Matter is composed of Electron, Electron Neutrino, Up Quark, Down Quark, Strange Quark, Gauge Bosons and the Gravity acting on these Quarks and Leptons transforming them into one another.
218. Electron is repeated in the Muon. The Electron Neutrino is repeated in the Muon Neutrino. The Up Quark is repeated in the Charmed Quark. The Down Quark is repeated in the Strange Quark giving the Electron and Muon Family.

219. A Third Family is more fundamental and that is the Tau Neutrino, the Top Quark and the Bottom Quark. Tau is heavier than the Electron but is otherwise like the Muon and Electron and has the same similarities to the other two Families. Each Family is more Massive than the other.
220. Questions. Why are the Replications in triplicate? Why is each successive Generation more Massive? Answers. The Asymmetric Infinite Universe completely accounts for an Infinite amount of Families. This fact, although not yet observed, in its own way accounts for the Infinite properties of the Universe (Lewis 1960, 2008).
221. Mirror Particles mirror the image of the known Quarks and Leptons and are present. There are Mirror Electrons, Mirror Neutrinos, etc. Mirror Particles behave as if they are the Mirror Image of the known Particles. In a Grand Unified Field Theory all Quarks and Leptons belong to a single representation after Spontaneous Symmetry Breaking. The representation decomposes into copies of 3 or more of the five and ten Dimensional representations of SU(5).

W Boson transforms the Electron into a left Spinning Neutrino and the Mirror Electron is transformed into a Neutrino Spinning right. Mirror Particles are more Massive than Quarks and Leptons.

Design thereby is Parity Invariant and Parity Violation is the result of Spontaneous Symmetry Breaking and that violation is resolved on the Mirror Particles level.

222. The Fourth Force Interaction is not like the others. The Graviton is not like the Gauge Boson although it acts as a Mediator in the Gravity Interaction. The Graviton Spins twice as fast as the Photon.
223. Quantum Principles appear not to apply to Gravity Principles.
224. Quantum Gravity is not renormalizable.
225. To sum an Infinite number of amplitudes connected with Gravitational Processes that is additive and therefore the Infinite sum of $1 + 2 + 3 + 4 \dots$ to Infinity cannot be computed. Either Quantum Physics falls or Gravity Theory must be modified.
226. SpaceTime is five Dimensional (Klein-Kaluza).
227. Unity Diagram

228. Space is Four Dimensional with Time as the 4th Dimension.
229. Every point in the Third Dimension of Space, on a Super-Microscopic level, is in Reality a circle with an extremely small radius. We see these circles as points and deduce our World of Three Dimensions (Klein-Kaluza).
230. In the 5 Dimensional World an observer would perceive Gravity differently, that is in two ways—Gravitationally and Electromagnetically (Klein-Kaluza).
231. If Space-Time is 5 Dimensional, Maxwell's Electromagnetic Energies emerge as a piece of Einstein's Gravitational Action (Klein-Kaluza).
232. In a 4 Dimensional Space, Gravity can pull in more than 3 directions—at least 4. We interpret that pulling as another Force but in effect it is the Electromagnetic Force of our Four Dimensional SpaceTime or an approximate representation of SpaceTime. An Action describing Physics in 5 Dimensional SpaceTime splits when viewed as a Four Dimensional Approximation. One piece of it is Gravity and the other is Electromagnetism.
233. The disparity in strength between the Gravitational and Electromagnetic Interactions can be accounted for if the radius of the circle is extremely small of 10^{18} Times smaller than that of the Proton. The 3 Dimensions of Space are Infinitely large while the 4th Dimension is Infinitely small. The Action of Time is all embracing.
234. Gravity begets Electromagnetism linking it to Superconductivity (Lewis, 1987).

235. Einstein's Theory is based on Local Symmetry. Weyl's Theory for Electromagnetism is based on Local Symmetry. The Action written as 5 Dimensional SpaceTime possesses a Local Symmetry Invariance under Five Dimensional Local coordinate transformations. When SpaceTime is reduced to 4 Dimensions the Local Symmetry that Action possesses is maintained so the results are the Actions that possesses Local Symmetry or the Einstein Action and the Maxwell-Weyl Action. Since the other two Interactions-the Strong and the Weak, are based on Exact Symmetries of Yang-Mills, this implies that generalizing of the Klein-Kaluza Theory is necessary to include the Yang-Mills Action.

236. Each point in the Kaluza-Klein Theory is actually a tiny sphere. SpaceTime is Six Dimensions because a sphere's surface is represented in Two Dimensions and yields the Yang-Mills Action.

The Einstein Action for the Six Dimensional SpaceTime representation splits into 2 pieces when viewed in Four Dimensional SpaceTime. One of those pieces is the Four Dimensional Einstein Action, i.e., Gravity and Electromagnetism. The other piece is the Yang-Mills Action-the Strong and Weak Interactions. These extra 4-Dimensional curled up Spaces are called Compact Spaces. Where each point in our 3 Dimensional Space is a tiny d-Dimensional compact Space so Space is $[3 + d]$ -Dimensional and SpaceTime is $[4 + d]$ -Dimensional. All these compact Spaces are Invariant under geometrical transformation. The sphere is Invariant under rotation. The geometrical Symmetry of the Compact Space yields Local Symmetry of Yang-Mills Action.

237. Geometry can be converted into Physics for Geometrical Symmetry yields Physical Symmetry.

238. The opposing view to Klein-Kaluza is that Gravity is not fundamental but a manifestation of the Grand Unified Gauge Interaction. Gauge Interaction yields Gravity. It is also harder to renormalize Einstein's Theory of Infinite Sums if we add more Dimensions to be summed.
239. The World is composed of Matter and Light. Quarks and Leptons are known as Fermions, Gauge Bosons and the Graviton, collectively known as Bosons. Matter is Fermions. The fundamental unit of Light is the Photon or the Boson. A Fermion can emit and absorb a Boson. It can remain unchanged or transform into another Fermion. Bosons act on Fermions. The shuttling of Bosons back and forth between Fermions produces the Forces in the Universe that we observe. In Gauge Theory, the Symmetry Group fixes the number of Gauge Bosons but with Fermions one can assign any representation of the Symmetry Group. Group Theory alone does not determine the number of Quark and Lepton Fields. All that is required is that they have to fit into the representation of the Group.
240. Super Symmetry links the Fermions to Bosons where Fermions are transformed into Bosons and vice-versa. Matter and Light have a common origin.
241. Supersymmetry links known Fermions to Bosons yet unknown and known Bosons to Fermions yet unknown. In Supersymmetry it is required that every known Particle be associated with a Super Particle producing double the amount of Particles.

242. Super Particles of the Quarks and Leptons are Squarks and Sleptons. Super Particles of the Bosons are the Photino and Gravitino. The W Boson is a Wino. No Super Particles have been found because of their Super Masses and the lack of high Energy levels to detect them.
243. The Super Symmetry interpretation of Einstein's Theory of Gravity has made Gravity Super and includes the Gravitino.
244. The Super Symmetry Theories are broader than Symmetry Theories and therefore more restrictive and cannot readily be described in Four Dimensional Space-Time (Kaluza-Klein interpretation).
245. Quantum Physics is built up on the notion that Particles are like tiny balls that can be represented as mathematical points.
246. Super String Theory looks at Particles as if the mathematics involved for fundamental entities are represented by line segments (Theory of Strings, Schwarz, Green, et als).
247. Fundamental Particles are represented as a bit of a vibrating String. If the resolution of the String is shorter than the resolution of our detection methods the String looks like a Particle. As the String vibrates differently the Particles become different. Vibrating one way produces a Graviton, vibrating another way produces a Gauge Boson. Thereby a Graviton is tied to the Grand Unified Interaction.

248. Supersymmetry Theory imposed on String Theory produces Super String Theory and can be formulated only in a Ten Dimensional Space-Time (Schwarz, Kaluza-Klein).
249. Superstring Theory reduced to a Field Theory contains Einstein's Theory of Gravity and Yang-Mills Gauge Theory. The Quantum version of Superstring Theory is renormalizable and thereby may solve the problem of renormalizing Gravity (Schwarz and Green, 1984).
250. Georgi-Glashow's SU(5) Grand Unified Theory fits the observed Particles seamless behaviors but these advanced theories involve unobserved Particles so Grand Unification has not been established.
251. Nature is invariant under Time Reversal if the Laws of Nature do not determine the Arrow of Time. This Principle is known as the Symmetries of Physics Laws under the Reversal of Time flow. As long as the Process is a backward moving Process and does not contradict any physical Laws the Law governing that physical Process is Time Reversal Invariant.
252. All physical Processes can in theory be run backward both on the Micro and Macro level.
253. There seems to be an Arrow of Time.
254. In some circumstances the Weak Interaction violates Time Reversal Invariance and prefers a one way direction of Time where the Process cannot be run in its entirety backwards.

Nature violates Parity and Charge Conjugation (the proposition that Matter and AntiMatter behave exactly the same).

255. P = Parity, C = Charge Conjugation and T = Time Reversal. Nature respects the combined CP Operation of Reflection, left, right and turning of Particles into AntiParticles at the same Time except for the Weak Interaction (i.e., in the Decay of the K Meson, 1974).
256. The CPT Theorem States that in a World described by a Relativistic Quantum Field Theory, one can violate Parity, Charge Conjugation and Time Reversal Invariances at will but one cannot violate Invariance under Combined CPT Operations, i.e., taking any physical Process and turning it into another Process by reflection, left-right or replacing Particles with AntiParticles and reversing Time flow. That Process must also be allowed to take place.
257. Relativistic Quantum Field Theory is the result of the Principle of Relativistic Invariance combining with the Principle of the Quantum. Up to date CP can be violated but CPT has not been seen to be violated. There is evidence that it may be. Psychologically we view Time as flowing in one direction although Physics only detects this in the Weak Interaction of a few Decay Processes of certain Sub-Nuclear Particles. Therefore, any theory dealing with the Grand Unification has to link up Consciousness and Physics (Lewis, Zee).

258. Since the Photon's Time clock does not move, Velocity = the object's traveled distance divided by the Time which yields $x/0$ or Infinity. The Proper Speed of Light is Infinite. The Improper Velocity is the Speed noted by an observer outside the system where Time changes and therefore the solution is Infinite in any given instance or approximately 186,000 miles per second per/s. The Proton travels an Infinite distance divided by a Zero Time limit.
259. Under certain circumstances a Quantum Theory may not have all the Symmetries possessed by the corresponding Classical Theory and is denoted as an Anomaly (Adler, Bell and Jackiw).
260. **Quarks have Fractional Charges. Therefore Matter, Time and Space have Fractional Dimensionality as well as Fractal Dimensionality and those types of Dimensionalities have to be plugged into all Physical Equations. (Lewis).**
261. Groups in which the order of multiplying Transformations together does not matter are called Abelian. In Non-Abelian Groups the order of multiplying does make a difference. Gauge Theory is Non-Abelian or is called Non-Abelian Gauge Theory. Electromagnetism is Abelian Gauge Theory.
262. When an Asymptotically Free Theory's Coupling Strength arrives at Zero it tends to stay at Zero.
263. Spontaneous Symmetry Breaking and Super Conductivity are related (Lewis).

Superconductivity is where a metal wire loses its resistance under very low temperatures.

264. Though the Electromagnetic Interaction unifies the Electromagnetic and the Weak Interactions, it still contains two different Coupling Strengths.
265. A Neutron actually Decays into a Proton, an Electron and Antineutrino.
266. The Arrow of Time in our consciousness is linked to the expansion of the Universe.
267. In Mechanics, the Momentum of a moving object is equal to the Mass Times Velocity. Physics requires quantities to transform neatly under the relevant Transformations. In the Lorentz Transformation, the denominator is the definition of Proper Velocity. The Proper Time of the moving object does not change or is an intrinsic property of the moving object and does not depend on the observer. The elapsed Time clocked by the observer (the Improper Time) depends on the observer. Einstein chose to define Momentum using Proper Velocity or $E=MC^2$. Once Momentum is fixed the definition of Energy follows. Lorentz Transformations make Energy and Momentum related. Momentum is conserved using Proper Velocity. The Momentum of an object is equal to Mass times Proper Velocity. A Massive object cannot move at the Speed of Light for if it did it would have Infinite Proper Velocity and hence Infinite Momentum. Since Momentum, as opposed to Proper Velocity, is a measurable physical quantity, an object cannot carry Infinite Momentum. Conversely, a Massless Particle, like a Photon or a Neutrino, travels at the Speed of Light so it can carry its own Momentum.

268. **The Science and Philosophy of Curved and Semi-Curved Velocities, Momentums, Masses and Energies as viewed from the Symmetric and Non-Symmetric Perspectives is taken up in Axioms #314 to #1,000 (Lewis).**

268. Supersymmetry (SUSY): For every ordinary Particle there exists a Super Partner having similar properties except for Spin.

269. Summary of Known Physics: Basic constituents of ordinary Particles are Leptons and Quarks. There are two kinds of ordinary Particles, those that are the basic constituents of Matter and those that mediate the Forces or the Interactions among the constituents. The basic constituents of Matter are the Leptons and Quarks or in general, Fermions. A Fermion is a Particle that carries a Spin or an intrinsic Angular Momentum equal to half integer units ($1/2$, $3/2$, etc.) of Planck's Constant, which itself is the fundamental unit of Angular Momentum in Quantum Theory.

The basic Particles that mediate Forces are the Bosons, Particles whose Spins are integer units (0,1,2, etc.) of Planck's Constant.

The Electron's are of the family of Leptons. There are six Flavors of Leptons, the Electron, Muon, Tau, Electron Neutrino, the Muon Neutrino and Tau Neutrino.

Interaction between Leptons and Quarks can be accounted for by the Four Forces. The Electromagnetic binds Electrons and Nuclei to make Atoms. The Atom is Electrically neutral and interacts through Residual Electromagnetic Force to form Molecules. The

Strong Force binds Quarks to make Protons, Neutrons and all other Hadrons. The Residual Strong Force between Protons and Neutrons is the Nuclear Force that binds them into Nuclei. The Weak Force is responsible for some Nuclear decay and the Fusion Process that releases Energy from the sun. The Electroweak combines the Weak and the Electric Force. The Forces are transmitted by the exchange of a number of Particles. The Photon is the Quantum of Electromagnetic Radiation and is the carrier of the Electromagnetic Forces. The 8 Gluons mediate the Strong Force.

The Photons and the Gluons are Lines of Force and are Particles of Zero Mass. The Weak Force is mediated by the W^+ , the W^- and the Neutral Z^0 and are heavy Particles with Masses 100 Times the Mass of a Proton. The mediating agent (unobserved) of Gravitational Force is the Graviton (up to and including the year 2006).

270. The theory that describes the Quark, Lepton and their Interactions is the Standard Theory Model.

The Higgs Particles must exist for the theory to stand up mathematically. The Masses of the W^+ , W^- and Z^0 and the Quarks and Leptons are generated through the Higgs Particle. The Higgs Particle Interacts with the other Particles but its Mass is unknown (2006).

Fermions occupy different Energy States. Bosons clump together in the same Energy States. Each Fermion should have a Super Partner, a Boson and each ordinary Boson should have a Superpartner, a Fermion. An AntiParticle must be considered for each entity and the Graviton should be Massive. An AntiParticle is identical with another Particle in Mass but with opposite Electric Charge. W^- is the AntiParticle of the W^+

Boson.

271. Leptons and Quarks are Spin $\frac{1}{2}$ Fermions. (It is necessary to compare and synthesize the equations relating to Leptons and Quarks of Spin $\frac{1}{2}$ with Fractional Fractal Dimensions of these same Magnitudes (Lewis, 1995).
272. Photon, W^+ , W^- , Z^0 and Gluons are Spin-1 Bosons.
273. Higgs Particle is Spin-0 or a Spinless Boson.
274. Local Symmetry is where in the Fields of subtle interchanges the Particles remain Invariant and where the same interchange is made at all points in Space. Generalized Symmetry is where the interchange varies from point to point in SpaceTime and belongs to Gauge Theory.
275. For every ordinary Particle there exists a Superpartner with identical properties except that the Spin differs by half a unit thereby relating the Fermions and Bosons to each other. Strengths of the Interaction Forces among the Superpartners are the same as the Interactions among the normal Particles.

Spin-0 Superpartners of the Fermions all add s to the Particle names. Spin $\frac{1}{2}$ Electron and the Quark have Spin-0 Partners—Selectron and Squark. The Spin $\frac{1}{2}$ Superpartners of the Bosons add the letters “ino” to the Particle names. Spin-1 Photon is Spin- $\frac{1}{2}$ Photino. Spin-1 Gluon is the Spin- $\frac{1}{2}$ Gluino. The Higgs Particle has yet to be designated (2006). Theory requires both Electrically Charged and Neutral Higgs

Particle, a positively Charged H^+ , a negatively Charged H^- and three Neutrals, collectively denoted H^0 .

276. Supersymmetry can account for the fact that two important Energies or Masses differ by a large Magnitude. These Energies are the W^+ , W^- , Z^0 equaling 10^{11} E.V.'s Particles and the Planck Mass 10^{28} E.V.'s. Planck Mass describes the Mass or Strength of the Gravitational Force. In Super Symmetric Theory the W and Z^0 are allowed to be 10^{17} Times smaller (10^{12} - 10^{29}) than the Planck Mass, via cancellations and via the Infinite Summing Theory of plus and minus.

Super Symmetry is also related to Einstein's Theory of Gravity

A Quantum Mechanical Theory of Gravity will be Super Symmetric.

277. Fundamental Particles can be categorized as Baryon Number (B) Lepton Number (L) Spin (S) and R Number (R). The R Number is given by the formula $R = 3B + L + 2S$. Lepton, Baryon and Spin vary among Particles types but R is even for all ordinary Particles and odd for all Particles that are Superpartners. R Number cannot change from even to odd even during reactions among Particles.
278. Feynman Diagrams show reactions among Elementary Particles. (Straight, wavy, curly line, broken and combinations thereof represent Interactions or scattering among Particles). When the lines join they represent Interactions or scattering among Particles. Vertexes are building blocks of more complex Reactions. Interactions in Super Symmetric Theory replaces any two vertexes of the Feynman Diagram with the

Corresponding Super Symmetric Partners. The Feynman Diagram determines or delimits in a Calculus probing sense the probability that any given scattering Process will take place.

279. In Super Symmetry, the Super Symmetry is a Broken Symmetry or a Symmetry that is true approximately or is true for parts of the theory only if Nature was totally Super Symmetric. Selectrons would have the same Mass as Electrons and would bind to Protons by the Electromagnetic Force. The properties of the Atoms so derived would be different than the ones we observe in Reality.

As Fermions, Electrons must occupy different Energy-Mass levels in Atoms. As Bosons, Electrons would occupy the same Energy levels. If Atoms contained Selectrons instead of Electrons the Period-Table of Elements would be different. Since that is not the case the Mass of the Selectron will be larger than the Mass of the Electron and thereby the Symmetry is Broken but “by hand” explicitly.

280. In the Electroweak Force, W^+ , W^- and Z^0 are all Massless when the Symmetry is Broken. The W^+ , W^- and Z^0 Particles gain Mass. In a Super Symmetric Theory, Super Symmetry is broken to allow the Masses of the Super Partners to be much larger than the Masses of the corresponding Standard Model of Particles and still maintain experimental and mathematical integrity.
281. Super Symmetric Particles can be detected by their missing Momentum and missing Energy. Their direction after the collision is given by the vector sum of the Particles' Momentum.

282. Conservation Law applies to Super Symmetry. Super Symmetric Particles cannot be produced alone. They must come in pairs and their Decays must contain an odd number of Super Symmetric Particles. The least Massive of all Super Symmetric Particles are Stable since there are no Lighter Super Symmetric Particles into which they can Decay.
283. The least Massive Super Symmetric Particles may be the Photon (Photino) and Cosmologically speaking may account for the Dark Matter and missing Mass in the Universe—i.e., the Quantum structure of Black and White Holes. The Energy of the least Massive Super Symmetric Particles is missing or carried away by the same Particles.
284. The Photino or Higgsino, the Super Symmetric Partner of the Higgs Boson, is assumed to be the least Massive Super Symmetrical Particle. The question of whether Nature is Super Symmetric on the scale of the Electroweak has not been answered. Super Symmetry could be nothing more than a mathematical property of Quantum Field Theory relevant to Energies greater than we can probe directly.
285. Particlization of the Symmetric Universe Summary

These Axioms cover Particle knowledge up to the year 2000.

There are six varieties of Quarks with Flavors Up, Down, Charm, Top (Truth) and Bottom (Beauty).

The Protons and Neutrons and other Particles are made up of Quarks. Quarks combine in threesomes or with Anti-Quarks to form Particles but never appear alone.

Leptons-Electrons underlies Electric Current. The Muon is a heavier version of the Electron derived from Cosmic Ray bombardment and includes the Tau and its AntiParticles.

The three Neutrinos—the Electron-Neutrino, the Muon-Neutrino and the Tau-Neutrino are Light with possibly no Mass. If they had any Mass they would outweigh the Galaxies and cause Collapse in an expanding Universe Cosmology. The Symmetric Universe is composed of 6 Leptons, 6 Quarks-12 Particles in three Particle Generations—Up and Down Quark with the Electron and its Neutrino, the Charm and Strange Quark with the Muon and its Neutrino and the Top and Bottom Quark with the Tau and its Neutrino. They exist at different Energy levels. In the Macro Universe only the first Generation survives. So Atoms consist of the Proton, Neutron (Up and Down Quark) and Electron. At high Energies Exotic Matter is built from the Third Generation Particles.

286. The Forces that are carried by the Action are the Gauge Bosons and they cluster Particles into Matter and fuel the cycle of the Universe. Forces are the Photons in the Electromagnetic Force. Electromagnetic Radiation produces Gamma Rays through to X-Rays, Ultraviolet, to Infrared, Heat, to MicroWaves and Radio Waves. The only difference in these Radiations being in their Wavelengths. Gamma is short and Radio Waves are long. All are mediated by the Photon. Gamma has high Energies and Radio has low Energies.

Electromagnetic Force keeps Negatively Charged Electron in orbit around Positively Charged Nucleus making Matter solvent. QED Theory describes this binding Action.

The Weak Force is Radioactivity and transmutes the Nucleus of Radioactive Atoms by converting Neutrons within Nuclei into Protons, Electrons and Neutrinos. W and Z Particles carry the Weak Force like the Photon but the Photon has Zero Mass W and Z are very heavy. The third Sub-Atomic Force is the Gluon and is the most powerful and mediated by Gauge Bosons gripping Quarks within Neutrons and Protons and holds Atomic Nucleus together. The Strong Force acts only in the Nucleus and is 100 Times more powerful than the Electromagnetic. Together with the Weak Force, the Strong Force is responsible for Interaction of Protons, which initiate Nuclear Fusion in the Stars.

Gravity is the Fourth Force and has no Action within individual Atoms and yet has most influence on the Macro Universe. Its Gauge Particle is the Graviton operating via Gravity Waves yet unobserved (2005).

287. The release of Electrons from Atoms by the Photon is known as the Photo-Electric Effect. The Photon liberates Electrons, which can flow and carry an Electric Current (Einstein).

288. Standard Model.

Matter built from Quarks and Leptons is held together by Fundamental Forces mediated by Particles called Gauge Bosons.

The Strong Force is a Color Force.

289. Quantum Chromodynamics. Quarks carry Color and are bound together by Particles called Gluons, which mediate the Color Force.

Charm is the Fourth Quark bound to its AntiQuark in conjunction with the Neutral Currents. Charm of Quark and Charm of AntiQuark cancel each other in producing Charmonium. As long as a Quark or AntiQuark do not come too close they exist. Charmed Quark and AntiQuark move around each other like the Electron and Proton or like the Positron in Positronium.

290. Different orbitals of different Energies are possible. Quark and AntiQuark of high Energy form a Heavy Particle since Mass equals Energy. This Heavy Particle emits Energy as a Quark and AntiQuark thereby going to a State of Lower Energy and so becomes a Lighter Particle. The Energy emits as Pions, Muons, Electrons or Photons. When they arrive at Lowest Energy State they can't radiate Particles so they mutually attract and annihilate and the Energy rematerializes as Lighter Particles. J/Ψ is the Lowest Energy State of Charmonium and is directly accessible in Electron-Positron Interactions. J/ψ is the second Lowest State. The Strength of the Strong Force—the Force between Quarks diminishes as the Energy increases so that at ultra High Energies the gap between the Electromagnetic Force and the Strong disappears. The Force between the Quark may be as Strong as the Force between the Electrically Charged Particles. **The Equivalence of the Fundamental Forces at High Energies is central to the Grand Unified Theories (GUTs). Here is where the Science of studying the Interactions (likened to Interfaces, Interface Mechanics ((measuring Superconductive Resistances that result in the same Mechanics that measures Plasma Surfaces in Deep Space)) and the Four Forces comes into play (Lewis).**

291. Gluons. Quantum Theory implies that all the Fundamental Forces are transmitted by Carrier Particles or Gauge Bosons. In the Strong Force there are eight varieties of Gluons, which are Massless bundles of Strong Radiation just as Photons are Massless bundles of Electromagnetic Radiations. Gluons operate only in Spaces of 10^{-15}fm . (FemoUniverse wherein 1 Fentometre is the Radius or the generalized size of a Proton or Pion).

Gluons are confined in Hadrons as the Quarks are. Quarks carry Electrical Charge and feel the Electromagnetic Force but carry a form of Charge known as Color. QCD or Quantum Chromodynamics is modeled on QED (Quantum Electrodynamics) and is described mathematically and statistically by Group Theory and optically observationally by Rotational Transformations. Quantum Mechanics is simply Group Quantum Mechanics where Color Charge can be Positive and Negative.

Quarks are Positive and Antiquarks are Negative. Identical Electric Charges repel and opposite Charges attract and neutralize. So Quarks attract Antiquarks to form Middle Particles or Mesons (Particles like Pions, Kaons and J/Psi and Upsilon).

291. Color Charge comes in three types unlike Electric Charge, which comes in 1 type— Positive and Negative. Each of these types can be Positive and Negative. The 3 types of Color Charge are red, blue, yellow (or green) like the 3 primary colors. Unlike Colors attract while like Colors repel. Red attracts Blue and Yellow, but repels Red. Three Quarks of different Colors form Baryons-Proton-Neutron and Omega Minus and consists of any combination of the six available Quark Flavors—such as 2 Up and one Down of the Proton or the three Strange Quarks of the Omega Minus. But they always

consist of three differently Colored Quarks. Particles only exist on which the overall Color Charge is Neutral or White. In Baryons the three Primary Colors combine to form a White Particle, in Mesons, the Positive Color of a Quark neutralizes the Negative Color of an AntiQuark and gives a White Particle. We cannot observe Particles that display, at once 2 Quarks or two Antiquarks. Color is hidden in Baryons and Mesons.

Pauli's Exclusion Principle states that a Particle cannot contain more than one Quark in a given Quantum State. Therefore, Quarks come in different Flavors, Up, Down and Strange and 3 different Colors. In the Omega Minus Particles the Strange Quarks each have a different Color and are not identical and do not violate Pauli's Principle.

It is the Colors not the Pions that transmit the Strong Force. The Color within the Proton and Neutron attracts and builds up the Nuclei. Just as Electrons are exchanged between Atoms bound within the Molecule, so to are Quarks and Antiquarks-Pion Clusters exchanged between the Protons and Neutrons in a Nucleus.

Gluons are the Carrier of Color similar to the Photon. The Photon does not have Electrical Charge but it is Neutral so it does not interact with other Photons. Gluons are Color Charged and Interact strongly with each other and with Quarks. The Neutrality of Photons enables them to transmit Electromagnetic Force throughout Space. The power of the Force decreases with distance. The Gluons tend to pull on each other because they are Colored Charged.

293. The Tau is an Electrically Charged Lepton, a heavier version of the Electron and Muon. It weighs twice as much as the Proton, 20 Times the Muon and 4,000 Times the Electron.

It has a Negative Charge and has an AntiMatter equivalent with a Positive Charge. It is not affected by the Strong Force but takes part in the Electromagnetic and Weak Interactions. It has, like the Electron Muon, its Partner, the Tau Neutron (undetected, 2005) which brings the total number of Leptons to 6.

294. The Electroweak Theory needs the Existence of four Gauge Bosons (Force carrying Particles)—the Photon, which mediates the Electromagnetic, the Weak, 2 W Particles—one plus, one Negative and the Neutral Z.
295. In the Quantum World the balance of Energy need not be conserved over very short distances during very short Time span. W links Radioactivity with Electricity and Magnetism via the Electroweak Theory, which states that we perceive phenomena as diverse because we live in a low Energy Universe. At higher Energies the heavy Ws and Zs can be produced as readily as Photons and the Weak Interactions occur as often as Electromagnetic Interactions. So the Electroweak Theory ties the two Forces together while Quantum Chromodynamics based on Gluons describes the Strong Interactions.
296. Charm and Bottom Quarks manifest themselves via Charmonium and Bottomonium where they are bound to their Antiquarks. Charm and Bottom Particles combine with other Quark Flavors. The Sixth Quark is the Top Quark. The W Particle is capable of decaying into Top and Bottom Quarks as does the Electron and Neutrino. The Weak Force acts on Leptons and Quarks the same. The bound system is known as Toponium where a Top Quark and AntiQuark are tied together and is equal to the Mass of W's and the Z's.

297. Our Universe with 6 Quarks and six Leptons gives three possible Universes. Our Universe has the Lightest Particles—the First Generation is where the Nucleus consists of Up and Down Quarks forming Protons and Neutrons orbited by Electrons and decaying Radioactively by emitting Electrons-Neutrinos. The Second-Generation Universe would be heavier with Strange and Charmed Quarks-Muons and Muon-Neutrinos. The Third generation is heavier with Bottom and Top Quarks—the Tau and Tau Neutrinos.
298. One factor that distinguishes Matter Physics from the Force carrying Particles is Spin. SUSY (Super Symmetry) attempts to link the Particles of Matter (Quarks and Leptons) with the Force carrying Particles (the Gauge Bosons).
299. Quantum Theory dictates that Particles have to Spin at allowed rates specific to each Particles just as Electrons within an Atom can only have certain allowed Energies. The Spin is expressed in units of Planck's Constant: where $h/2\pi = 1.055 \times 10^{-34}$ Joule seconds.
- Electron and Proton have Spin $\frac{1}{2}$ and W's and Z's have Spin 1. The difference between Matter Particles and Force Carriers is that the Quarks and Leptons have Spin $\frac{1}{2}$ and the Gauge Particles have Spins of 1.
300. Super Symmetry requires the incorporation of additional Matter and Force Carriers to link Particles of different Spins wherein SuperMatter Particles have integers of 0,1,2..., rather than half integers, $\frac{1}{2}$, $\frac{3}{2}$...Spin. The Super Forces have half integer Spins rather than integer Spins.

301. Kaluza-Klein suggested that Electromagnetism was the effect of Gravity spilling over from a Fifth Dimension where the Fifth Dimension curls into a small area. The Weak and Strong Forces may be Gravity expressing itself from higher Dimensions. Their theory proposed one of Ten Dimensions where Four Dimensions expanded to form our SpaceTime Universe and the other six remained in a coiled-spring contractive stage. Here Particles arise not as points but extensions of lines in Space with Dimensions of 10^{-36} referred to as Strange or Super Strings of Super Symmetry. **They resonate all of Existence out from itself like a tuning fork resonates outward sounds when vibrating. The Asymmetry of the Universe on the Micro and Macroscopic level is nothing more than the result of Super Symmetry breaking down to Symmetry and Asymmetry either Spontaneously or Explicitly. Superstring Theory yields our Universe and a shadow Universe running parallel to where both Universes have Gravity in common tugging at each other's Matter Fields in both the White and Black Exotic Black Matter and Energy of Deep Space.**
302. Quarkmatics Summary Chart (2006).

The Ten Resonances arranged according to their IsoSpin and Strangeness form a Decuplet. An Octet is formed when Eight Baryons—the Proton, the Neutron and their related Particles are grouped according to their IsoSpin and Strangeness.

The Eight Mesons also form an Octet. There are the three Pions, four Mesons called K Mesons or Kaons belonging to two IsoSpin Doublets and a Meson called Eta (η) belonging by itself to an IsoSpin Singlet. The Mass is denoted in parentheses. Members of the same IsoSpin Multiplet have almost the same Mass in accordance with IsoSpin Symmetry. All 8 Baryons have almost the same Mass. The Mesons also have the same Mass but the Pions are Light so that Eight Mesons are related to the First Approximation.

The Eight Baryons on the Diagram below are indicated by a dot plotted on a Two-Dimensional grid. The Baryons corresponding to dots joined by horizontal level have the same Strangeness so that the Nucleus has a Strangeness Zero, Sigma, A, -1, and -, -2.

303. Leptons.

Electrons, Symbol E^- , Mass 0.511 MEV, Life, Stable, Charge -1 , Spin $\frac{1}{2}$. First Generation, Constituent of Atom, Carrier of Electricity.

Positron, Symbol e^+ , Mass 0.511 MEV, Life Stable, Charge $+1$, Spin $\frac{1}{2}$, 1st Generation AntiParticles of Electron derived from Cosmic Rays.

Muon, Symbol, μ^- , Mass 105.6 MEV, Life Stable 2×10^{-6s} , Charge -1 and $+1$, Spin $\frac{1}{2}$ 2nd Generation, derived from Pion Decay, Kaons and Cosmic Rays.

Tau and Anti-Tau, Symbol, τ^- , τ^+ , Mass 1.784 GEV, Life 3×10^{-13s} , Charge -1 , $+1$, Spin $\frac{1}{2}$, Lepton of 3rd Generation.

Electron Neutrino and Anti-Neutrino, Symbol ν_e , $\bar{\nu}_e$, Mass 0 (?) and less than 50 MEV, Life Stable (?) provided it doesn't move too close to its AntiParticle and annihilate itself. Charge 0, Spin $\frac{1}{2}$, Lepton 1st Generation produced by Weak Interaction.

Muon Neutrino and Anti-Neutrino, Symbol ν_μ , $\bar{\nu}_\mu$, Mass 0 (?) and less than 0.5 MEV, Life Stable (?), Charge 0, Spin $\frac{1}{2}$, Leptons of 2nd Generation, produced by Weak Interaction.

Tau Neutrino and Tau Anti-Neutrino, Symbol, ν_τ , $\bar{\nu}_\tau$, Mass (?) and less than 70 MEV, Life Stable (?), Charge 0, Spin $\frac{1}{2}$, Lepton of 3rd Generation.

304. Quarks Up and Anti-Up, Symbol u , u^- , Mass -5MEV , Life*, Stable (*Appears only in pairs, ((Meson)) or Triplets (((Baryons))) lifetime variable depending on the nature of the individual Meson or Baryon, Up Quark is the Lightest and as Stable as the Proton which contains it) Charge $+2/3$, $-2/3$, Spin $\frac{1}{2}$, Quark of First Generation: Up is Constituent of Protons, Neutrons and other Particles.

Down and Anti-Down, Symbol d , d^- , Mass -10MEV , Life * Variable, Charge $-1/3$, $+1/3$, Spin $\frac{1}{2}$, Quark of 2nd Generation, Constituents of Charmed Particles.

Strange and Anti-Strange, Symbol s, s^- . Mass—100 MEV, Life*, Variable, Charge $-1/3, +1/3$, Spin $1/2$, Quark of 2nd Generation, Constituents of Charmed Particles.

Charm and Anti-Charm, Symbol c, c^- , Mass—1.5 GEV, Life* Variable, Charge $+2/3, -2/3$, Spin $1/2$, Quarks of 2nd Generation Constituents of Charmed Particles. (Bottom) or (Beauty) and Anti-Bottom, Symbol b, b^- , Mass—4.7 Gev, Life* Variable, Charge $-1/3, +1/3$, Spin $1/2$ Quark of 3rd Generation Constituents of Bottom Particles.

Top (or Truth and AntiTop, Symbol t, t^- , Mass—730 GEV, Life* Variable, Charge $+2/3, -2/3$, Spin $1/2$ Quarks of 3rd Generation Constituents of Top Particles.

305. Gauge Bosons. Photon, Symbol V , Mass 0, Life Stable, Charge 0, Spin 1, Carrier of Electromagnetic Force Packet of Electromagnetic Radiation.

W, W-plus). (W-minus), Symbol W^+, W^- , Mass 83 GEV, Life 10^{-25s} , Charge $+1, -1$, Spin 1, Carrier of Weak Force together with Z.

Z, Symbol Z , Mass 93 GEV, Life 10^{-25s} , Charge 0, Spin 1, Carrier of Weak Force along with w^+ and w^- .

Gluon, Symbol g , Mass 0, Life Stable, Charge 0, Spin 1, 8 types of Gluon: Carrier of Strong Color Force.

306. Mesons. Pion (pi-Zero), Symbol K^0 , Mass 135 MEV, Life $0.8 \times 10^{-16}s$, Charge 0, Spin 0, Quark Content uu^- or dd^- , Nuclear binding, Decays into Photon; a source of Cosmic Gamma Rays.

Pion, (pi-plus), (pi-minus), Symbol K^+ , K^- , Mass 140 MEV, $2.6 \times 10^{-8}s$, Charge +1, -1, Spin 0, ud , du , Nuclear Binding.

Kaon (K-Zero), Symbol K^0 , Mass 498MEV, Life Short $10^{-10}s$, Long $5 \times 10^{-8}s$, (the K^0 and the \bar{K}^0 form a Quantum System whose superposition yields two Physical Particles, the short lived K^0_s and the long lived K^0_L which reveal Matter-AntiMatter Asymmetry ((CP Violation)), Charge 0, Spin 0, Quark Content ds , Strange Meson.

Kaon (K-plus), (K- minus), Symbol K^+ , K^- , Mass 494 MEV, Life $1.2 \times 10^{-8}s$, Charge +1, -1, Spin 0, Quark Content us , su , Strange Mesons.

J/Psi, Symbol J/ψ , Mass 3.1 GEV, Life $10^{-20}s$, Charge 0, Spin 1, Quark Content $c\bar{c}$, first known member of Charmonium Family.

D (D-Zero), D-plus), Symbol D^0 , D^+ , Mass 1.87 GEV, Life $10^{-12}s$, $4 \times 10^{-13}s$, Charge 0, +1, Spin 0, Quark Content cu , cd , Charmed Mesons.

Upsilon, Symbol Y , Mass 9.46 GEV, Life $10^{-20}s$, Charge 0, Spin 1, Quark Content $b\bar{b}$, first known member of Bottomonium Family.

307. Baryons. Proton, Symbol p, Mass 938.3 MEV, Life Stable (?) and greater than 10^{32} years, Charge +1, Spin $\frac{1}{2}$, Quark Content $uu\bar{d}$, Charged Constituent of Atomic Nuclei.

AntiProton, Symbol \bar{p} , Mass 938.3 MEV, Life same as Proton, Charge -1, Spin $\frac{1}{2}$, Quark Content $uu\bar{d}$, AntiParticles of Proton.

Neutron, Symbol n, Mass 939.6 MEV, Life in Nuclei Stable, Free 15 minutes, Charge 0, Spin $\frac{1}{2}$, Quark Content $dd\bar{u}$, Neutral Constituents of Atomic Nuclei.

AntiNeutron, Symbol \bar{n} , Mass 939.6 MEV, Life same as Neutron, Charge 0, Spin $\frac{1}{2}$, Quark Content $dd\bar{u}$, AntiParticles of Neutron.

Lambda, Symbol Λ , Mass 1.115 GEV, 2.6×10^{-10} s, Charge 0, Spin $\frac{1}{2}$, Quark Content uds , Strange Baryon: replaces Neutron in Nuclei to make Hypernuclei.

AntiLambda, Symbol $\bar{\Lambda}$, Mass 1.115 GEV, Life same as Lambda, Charge 0, Spin $\frac{1}{2}$, Quark Content uds , AntiParticles of Lambda.

SIGMA (sigma plus), Symbol Σ^+ , Mass 1.189 GEV, Life 0.8×10^{-10} s, Charge +1, Spin, $\frac{1}{2}$, Quark Content $uu\bar{s}$, Strange Baryon.

SIGMA (sigma-minus), Symbol Σ^- , Mass 1.197 GEV, Life 1.5×10^{-10} s, Charge -1, Spin $\frac{1}{2}$, Quark Content $dd\bar{s}$, Strange Baryon.

SIGMA (sigma-Zero), Symbol E^0 , Mass 1.192 GEV, $6 \times 10^{-20}s$, Charge 0, Spin $\frac{1}{2}$, Quark Content uds, Strange Baryon.

XI, (xi-minus), Symbol $=^-$, Mass 1.321 GEV $1.6 \times 10^{-10}s$, Charge -1 , Spin $\frac{1}{2}$, Quark Content dss^- , Strange Baryon.

XI, (xi-Zero), Symbol $=^0$, Mass 1.315 GEV, Life $3 \times 10^{-10}s$, Charge 0, Spin $\frac{1}{2}$, Quark Content uss^- , Strange Baryon.

Omega Minus, Symbol m^- , Mass 1.672 GEV, Life $0.8 \times 10^{-10}s$, Charge -1 , Spin $\frac{3}{2}$, Quark Content sss^- , Strange Baryon—confirmed Theory of Eightfold Way.

Charmed Lambda, Symbol Λ_c , Mass 2.28 GEV, $2 \times 10^{-13}s$, Charge 1, Spin $\frac{1}{2}$, Quark Content udc, Charmed Baryon.

308. Categorization of Fundamental Particles.

Fundamental Particles are categorized by B (Baryon Number), L (Lepton Number), S (Spin) and R (R Number), where $R = 3B + L + 2S$. L, B and S vary among the Particles types but R is even for Ordinary Particles—Quarks, Leptons, Photons, Gluons, W^+ , W^- , Z^0 Particles, Gravitons, Higgs Particles and odd for the Super Partners—Squarks, Sleptons, Photinos, Gluinos, Winos, Zinos, Gravitinos and Higgsinos.

For Quarks— $B_{1/3}$, $L_{1/2}$, R_2 —For Leptons, B_0 , L_1 , $S_{1/2}$,

R_2 —For Photons, B_0 , L_0 , S_1 , R_2 —For Gluons, B_0 , L_0 , S_1

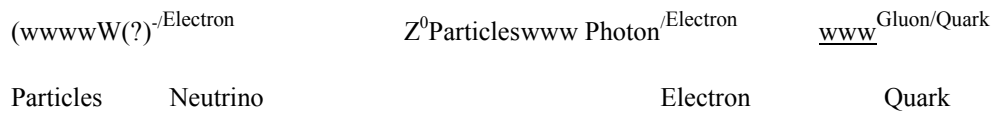
R_2 —For Z^0 Particles, B_0, L_0, S_1, R_2 —For Gravitons, $B_0, L_0,$
 S_2, R_4 ,--For Higgs Particles, B_0, L_0, S_0, R_0 ,--For Squarks, $B_{1/3},$
 L_0, S_0, R_1 —For Sleptons, B_0, L_1, S_0, R_1 —For Photinos, $B_0,$
 $L_0, S_{1/2}, R_1$ —For Gluinos, B_0, L_0, R_1 —For Winos, Zinos,
 $B_0, L_0, S_{1/2}, R_1$ —For Gravitinos, $B_0, L_0, S_{1/2}, R_1$ —For Higgsinos,
 $B_0, L_0, S_{1/2}, R_1$.

R cannot change from even to odd or odd to even during reactions among Particles. When Protons are colliding, Super Symmetry Particles must be produced in pairs or R would change from even to odd. The Decay Products of Super Symmetry Particles must contain an odd number of Super Symmetry Particles, the least Massive of which must be Stable since there are no Lighter Super Symmetry Particles into which they Decay.

309. Representing Super Symmetric Interactions.

Straight, wavy, curly, broken lines and their combinations represent particular Particles. Where lines are joined they represent Interactions called scattering among Particles. **(Where the lines are related through 360^0 , they may be used in Transformations according to the equations from Transformation and Rotational Theory (Lewis).**

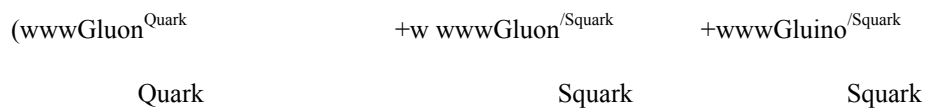
310. Standard Model.



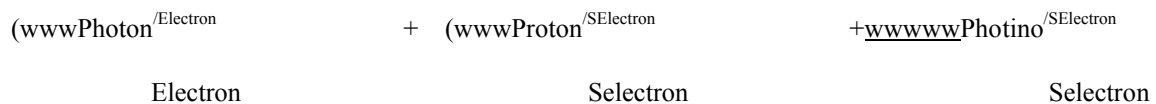
Supersymmetric Interactions.

Replace any two lines of the vertex with corresponding Supersymmetric Particles.

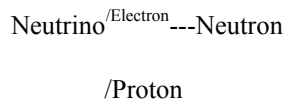
Replacing the Gluon-Quark-Quark vertex yields:



Replacing the Photon-Electron-Electron vertex yields:

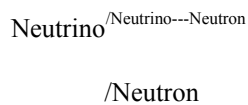


This gives a mathematical procedure for determining the probability that any given scattering Process will take place.

311. Neutral Current Representations

A Charged Current Process where an Electron and Proton are produced when a Neutrino and Neutron collide.

Neutral Current Process where



In the Charged Current Process the Neutrino emits a W Boson and turns itself into an Electron. The W then converts the Neutron into Proton.



In the Neutral Current Process the Neutrino emits a Z Boson and stays a Neutrino. The Z is absorbed by the Neutron.

312. Charge Related To Particles, Super Particles, Forces and Super Forces

Basic Particles of Matter

Quarks, Fermions with Spin $-1/2$, $+2/3$, (UP(.3)), (Charm ((1.5)), (Top ((?)),

Superpartners, Bosons: Spin-0, $+2/3$ for Squarks, (T((?)), (U((?)).

Leptons, (Neutrinos), Charge 0, Spin $-1/2$ Particles (Fermions), Electron Neutrino (V_e ((0)), Muon Neutrino, (V_u ((0)), Tau Neutrino, (V_t ((0)).

Superpartners for Sleptons (Sneutrino), Charge 0, Spin-0, Particles, (V_t ((?)), (V_u ((?)), (V_e ((?)).

Quarks, Charge $-1/3$, Spin- $1/2$, Particles (Fermions), Down ((.3)), (Strange ((.5)), (Bottom ((5.0)).

Superpartners, Charge $-1/3$, Spin 0, Particles (Bosons), Squarks, (Bottom ((?)), Strange ((?)), Down((?)).

Leptons, Charge -1 , Spin $-1/2$, Particles, (Fermions), Electron, (e^- ((.0005)), Muon, (μ^- ((.1)), Tau Particles, (τ^- ((1.8)).

Superpartners, Charge -1 , Spin -0 , Particles, (Bosons), Sleptons, (τ^- ((?)), u ((?)), e ((?)).

313. Bosons: Particles That Mediate Forces Related To Charge.

Spin-0 Particles, Charge = 1, Higgs Particles, ($H^+(?)$), Spin -1, Particles W^+ Particles, ($W^+ ((81))$).

Superpartners, Charge = +1, Spin -1/2, Particles Wino ($W^+(?)$), Spin -1/2, Particles Higgsino, ($H^+(?)$).

Charge 0, Spin -0, Particles Higgs Particles, ($H^0(?)$), Spin - 1, Particles Z^0 Particles, ($Z^0((93))$), Gluon, ($g((0))$), Photon, ($\gamma((0))$), Spin-2, Particles Graviton, ($G((0))$).

Superpartners, Charge 0, Spin 0, Spin -3/2, Particles Gravitino, ($G(?)$), Spin -1/2 Particles Photino, ($\gamma(?)$), Gluino, ($g(?)$), Zino, ($Z^0(?)$), Spin -1/2, Particles Higgsino, ($H^0(?)$).

Charge -1, Spin-0, Particles Higgs Particles, ($H^-(?)$), Spin-1, Particles W^- Particles, ($W^- ((81))$).

Superpartners, Charge -1, Spin -1/2, Particles Wino ($W^0(?)$), Spin -1/2, Particles Higgsino, ($H^-(?)$).

AXIOMS OF ASYMMETRYPART II

314. **Characteristics of Strings**. Superstrings are 10^{-33} cms. Strings can rotate and vibrate and are extended in five + Dimensions up to 26 but preferably to 10 as opposed to Dimensionless points and are not continuous but discontinuous. Shadow Matter yields Parallel Universe. Feedback loops are similar to Chaotic Interactions. (John Schwarz, Michael Green, Yochira Nambu and Edward Witten).
315. Mass is not fundamental, Massless Strings are. Basic Laws of Nature Asymmetric to avoid Symmetric Symmetry Breaking (Penrose). Quantum of Gravitational Fields twists to left and right Asymmetrically (Penrose). Zero Mass Curvature equals the Cosmological Constant.
316. **Empty Space does not curve. The link between Relativity and Quantum Mechanics is Chaos (Lewis, 1987). For Einstein Space was continuous. For Penrose, Lewis et als, Space is continuous in some of its aspects and discontinuous in others. Space is Fractional, Fractalized (Lewis et als). Quantum Electro-Fractional-Fractalization explains this concept. (Heisenberg, Lewis). SpaceTime can borrow Energy or Virtual Photons provided they are returned. This borrowed Energy curves SpaceTime but uncurves it after the debt has been repaid leading to fluctuating Universe of contraction and expansion underlying the expansion that takes place on the Microscopic and Astronomic Levels at 10^{-33} cms. SpaceTime = Blackhole. Topological description of Universe shows how similar objects can be transformed**

into each other and thus maintain Quantum continuity by stretching, contracting and deforming objects and their Transformations can then be formed at a distance.

317. Particles are classified by their Spins. Spin increases by 1/2 orbits, others have Whole Spins. Fractional Spins are Electron, Proton and Neutron (Fermions). Whole Spins are Bosons. Photon is Spin 1.
318. Fermions stay away from each other and have different Phase States and Wave Functions. Bosons congregate like Lasers and Superfluid dynamic behaviors are manifest.

Fermions make up Matter and Bosons constitute Forces. Bosons carry Weak, Strong, Electromagnetic and Gravitational Forces.

Quantum level Forces take form of Boson Particles being exchanged between Fermions. Bosons can turn into Fermions and vice-versa via Supersymmetry and Superstring Theory.

319. **2nd Classification of Elementary Particles by Strength of Interaction - Four Forces.**

Leptons-Electrons, MU Mesons (Muons) Taus, Neutrinos and other Fermions use Weak Nuclear Force and EM Force but never Strong Nuclear Force. Hadrons, Protons, Neutrons, Hyperons, Mesons use Strong Force.

Hadrons heavier than Leptons where their Mass is related to the strength by which they Interact. Leptons are Lighter because they don't feel Strong Force. Leptons and Hadrons divided into further families of Quarks. Resonances, Double Resonances, Ghost Particles and Virtual Particles are temporarily excited States or composite States explaining some Anomalies of Elementary Particles.

320. Superstrings of SUSY said to underlie the Quark structure of Strings. Spinors or Twistors generate our Particle World. SD Matrix Theory describes all Scattering Processes including Excitations and Resonances. Wheeler (1937) via the Feynmann Diagrams shows that a Whole series of approximations taken together add up to the total Interaction where a complicated quantity is calculated by adding up a series of approximations known as Perturbation Theory. Quantum Electrodynamics describes what happens when two Particles collide Electromagnetically. (Feynmann Diagrams calculate all possible ways in which particular Interactions add up. Virtual Interactions occur at short Time and high Energy intervals. Virtual Particles are borrowed Particles and at end of interacting Energy sums balance. There are an Infinite number of Interactions or Infinite number of ways in which Virtual Particles can be borrowed and then paid back but each reaction or result is smaller than the one that came before. It is still possible to add the series and produce a Finite result.

$$1 + 1/2^2 + 1/3^3 + 1/4^4 + 1/5^5 + \dots = \pi^2/6$$

Feynmann Method fails in Hadron Hadron Interactions of S Matrix calculations where an Infinite number of Finite terms yield Infinity because Strong Force too strong in Interactions.

Leptons and Leptons collision work-Electrons & Positrons.

Leptons and Hadrons work-Electrons and Protons.

But Hadrons-Hadrons do not work-Proton Proton.

Hadron-Hadron Interactions successive terms so large that their sums are Infinite.

321. Weak Interaction involves exchange of Intermediate Vector Boson-large Mass, short range. Hadrons are made out of Quarks. Electromagnetism Unified via Strong Nuclear Force so Physics in 1970's did not need Strings, vibrations, Spinning, twisting, extra-Dimensional extended objects. Particles are characterized by Electrical Charge, Spin and IsoSpin (in Abstract Space called IsoSpace or Internal Space and is both a physical and mathematical entity).
322. Partners to the Proton are called Hypersons and Strangeness covered them.
323. Superstring Theory works in 10 Dimensions. Dual Resonances works in 26 Dimensions but produce Ghosts in 4 Dimensions.
324. Dual Resonances indicate that Elementary Particles behave as if they are extended in Space. Quarks underlie dual Resonances and create extended objects.

Nambu, 1970. Elementary Particles are not Quarks, points, etc., but are vibrating and Rotating Strings. Strings had to conform to Quantum Relativity Theory. Strings had to be Co-Variant Spinning at the Speed of Light and are called Light Strings. They are Massless and are Rays of Light generalized which can vibrate and Spin. But Quantum manifestations do have Mass. At small distances Nature can take form of Massless, vibrating Strings whose ends whip around at the Speed of Light and reproduce characteristics of Hadrons.

325. [1-D-2/24] $1-(26-2)/24$ yields correct String reaction for One Dimensional String operating in 26 Dimensions. 4 Dimensions large and 22 ultra small. (Penrose Twistors and Spinors). 4 Dimensions are Really Complex Dimensions as in Complex Math where Negative Numbers resemble Massless One Dimensional Ray of Light.
326. Strings interact joining and splitting. Closed Strings or Loops are Spin Vector Bosons or possible Carriers of the Gravitational and Supergravitational Force because Gravity is curved SpaceTime and would indicate Circular Strings. String Theory predicted Particles faster than Light Speed or Tachyons with Negative Masses. Quarks were postulated as the ends of Strings to explain why Quarks cannot be seen. Break a String and another pops up. Spinning String Theory accounts for Hadrons as Fermions or Hadrons changing to Bosons and uses 10 Dimensions instead of 26. Bosons and Fermions now link up via Superstring and Supersymmetry Theory. Quarks may be the ends of Strings connecting up with Microscopic World of Particles with the Compact Dimensions.

Strings were Supersymmetric and Superstrings were where every Boson had a Fermion mirror image partner (Gliozzi, Scherk and Oliver). String Theory through 1976 accounted for only 2 Particles the Pi and Rho Mesons. The Pi Meson moved faster than Light and was a Tachyon and the RHO Meson had no Mass. Physics moved back to the Point Theories in the 1980's where the Point Theories were being used Supersymmetrically.

327. Quantum Theory allows for probabilistic fluctuations of the components of Basic Reality, i.e., Energy in SpaceTime becomes smeared out. The distance or metric between two points is no longer well defined. That means the Light Cone becomes smeared out. Twistors can be defined in terms of a pair of Spinor points and are effected in Penrose's picture by Quantum fluctuations. However, Global structure of Light Cone remains unaffected.
328. Initial Twistor Theory suggested that Quark States are made out of 3 Twistors. However, with the introduction of Charm the Quarks jump to six in number. Twistor and Quantum Theory allows all Mass values for Particles. Mass problem of the Elementary Particles seems to require deeper theory than Twistor, Quantum or Relativity Theory. 6 Twistors used for the building blocks are too general. In addition, several Elementary Particles have the same characteristics but different Masses. Quantum Theory predicts Particles for all possible Mass values. So does Twistor Theory, i.e., Infinitism explains this better than either Twistor or Quantum Theory.

329. In String Theory, a graph of the Angular Momentum of Elementary Particles and Resonances when plotted against the square of their Masses, produces a straight line, i.e., Regge Trajectories. All experiments that measure Angular Momentum only measure its square so one does not know the actual Angular Momentum of a Particles. The Particle's square root value could be a negative result. The Regge Graphs of Particles and Resonances do appear on a straight line. This is Nambu's idea of String Theory where Hadrons are vibrating and rotating Strings that yield both positive and negative values for Angular Momenta.
330. Conformal Invariance can be destroyed by non-linear Interactions and Mass can be created or developed by breaking Non-Conformal Invariance. The appearance of some Interactions are tied together.
331. The Twistor Network does introduce Mass and Elementary Particles Symmetries into the picture. Twistors account for Dimensionality of +++- rather than ++++ or ++-- and accounts for the Chirality of Nature. The Trouser Diagram represents what happens when 2 String Loops meet, merge into a single Loop and then separate into 2 Loops again. Families of diagrams can be created by adding holes in the Trousers which means that the math developed for String Theory can be used for Twistor Theory.
332. The next step in Twistor Theory is to create a new form of SpaceTime, one with Complex Dimensions that explains the Wave Function of a single Quantum

of Gravitational Curvature. Twistors eliminate Field Equations because one has the entire function built into it.

333. The Contour Integral Complex Function blows up to Singularities. Position of Singularities in Twistor Space is related to the physical behavior of the field and is SpaceTime Contour Space Integral and allows us to calculate the way Twistors can be changed by a single Quantum of Gravitational Curvature. Integral (summing up) or the Contour Integral is Zero when there is no Charge. The same number of lines of Force leave as enter the Contour Boundary, i.e., the drawing of the Contour Boundary around the Electric or Magnetic Charge Forces. When there is an Electrical or Magnetic Charge in the Contour, more lines of Force leave than enter and the Contour Integral does not vanish and the Charges are sources of the EM Field.
334. Singularities can be found where Field lines begin and where they end there is no Singularity in a closed Contour. Then it vanishes. When a Contour Integral does not vanish its values are related to the Charges and or Singularities inside. When the Contour is shrunk the same number of Field lines cross its surface as long as it always surrounds the Charge. A Contour can be shrunk until it surrounds 2 Charges or Field Singularities which are sinks (Basins-Lewis) or sources for the Field lines. Values of a Contour Integral do not depend on its shape but its properties. The EM depends on Sheaf Cohomology much like Twistor Space depends on Cohomology and Superstrings also depends on Cohomology.

335. Heterotic Strings. $E_8 \times E_8$ breaks down as it compactifies in our World. Each E_8 occupies its own Universe leading to a Grand Symmetry $E_8 \times E_8$. The $E_8 \times E_8$ is a Shadow Universe. E_8 breaks down to $E_6 \times SU(3) \times SU(2) \times U(1)$ or Grand Unification in a 10D Space.
336. Heterotic Strings are topologically Symmetric through most Transformations.
337. Twistor Theory Twistor Theory of Quantum objects create their own Space, i.e., their own Geometries and explains the double slit experiment. The Geometry of the World depends on one's viewpoint. Though beams of Photons of Light pass what seem to be two slits at 2 different places at once, actually to the Photon the slit compresses into one as it passes through. Therefore 5 phase crystals can be Symmetric because they are Quasi-Symmetric. As we view Reality one way with seeming anomalies from another perspective, say a Quantum perspective, no anomalies need to be occurring (as described in Perspectivism and the Theory of Infinitism).
338. Basic Particles create their own Space. The Universe is built up on a conglomeration of Basic Particles building their own SpaceTime called Spinors utilizing addition and subtraction not continuity (i.e., Finitude rather than "Infinitude"). Spin Networks generate proper views of angular directions in a 3D Space generated at the Quantum level via combinatorial addition and subtraction Processes. When 2 Spin networks meet, the mathematical relationship turns out to be Euclidean with a reflective relativistic outlook

in the Space generated, i.e., the Spaces are not Symmetric but Asymmetric which leads to Relativistic Curvature, i.e., Discontinuities at the edges. The mathematics of fitting regions of Space together to cover some large curved Space is Cohomology. Twistors convert extended Spin Networks Quantum Spaces into a general notion of SpaceTime because they only create Euclidean angles and not distance and separation. These are Static and Non-Relativistic.

339. Underlying the Universe are products of Complex Numbers and their Conjugate pairing up of Complex Numbers with Conjugates to give Real Numbers. Mandelbrot Sets are complicated images that can be generated from a simple Complex Number or Iteration (Iterations).

340. The Complex Wave Function Y (Complex Wave Function X is its Complex

Conjugate Y^* gives a Real location or probable location in Quantum Mechanics.

Times is written as:

-ct

$$AB^2 = X^2 + (ict)^2$$

$$AB^2 = X^2 - C^2t^2$$

$$X^2 = C^2t^2$$

$$\frac{\quad}{AB^2}$$

$$X = \frac{CT}{AB}$$

$$AB$$

$$V = \frac{D}{T}$$

$$T$$

$$D = VT$$

$D = \text{square root of } i^2 c^2 t^2 \text{ for } V \text{ less than } C$

$$X = ct \text{ when } v = c$$

$$\text{so } D = 0$$

= Finite line but Zero length

or null line (Finite in velocity)

(Zero in length)

$$v = \frac{d}{t}$$

$$t$$

$$d=vt$$

substituting vt for x in the SpaceTime equation gives

$$\text{square root of } V^2t^2 = \text{square root of } t^2(v^2 - c^2) = D$$

i of $v=c$ SpaceTime length = 0

341. Conformal Geometry vs Non-Conformal Fractal Geometry

Null Lines = paths taken by Light and Massless Particles. Changing scale of Universe all physical quantities remain the same. The property of being unchanged under changes of scale is called Conformal Invariance = Chaos Theory.

342. Conformal Transformations leave causal connections unchanged and leads to a Quantum Geometry or a Universe of Massless bodies moving along Null Lines via Interaction with other Null Lines and breaks down to Conformal Invariance. Then Mass was born into the Universe.

343. Twistors lie between Relativity and Quantum Theory. More general than Spinors, Twistors combine Linear and Angular Momentum and occupy World of Complex Dimensions (Fractal Dimensions). Matter is built up out of primitive

Quantum entities. SpaceTime is built not out of points but out of twisting congruences created out of straight Null Lines.

344. The lines (Basic Twistors are not only components of Geometry but of the Elementary Particles as well. Twistors are generalizations of Quantum Mechanical Spinors and are dynamic not static with Angular and Linear Momentum and are extended object lines. Fundamental points are secondary and created through the Interaction of lines, i.e., non-local description of SpaceTime replaces point local visualization of Space. Twistors relate both the Conformal Geometry of Null Lines with the physical and non physical or unphysical Complex positive and negative solutions of Quantum Field Theory.
345. Fundamental properties in Quantum Field Theory are directly related to fundamental Geometrical and Relativistic properties of SpaceTime creating a Twistor structure for the Elementary Particles. Generalizing Spinor Networks, using Twistors and understanding the single Graviton in SpaceTime helps create the basis and math for Massless Particles and Massless Fields.

Just as Matter is founded in the Elementary Particles, SpaceTime will originate in Twistor Space. Twistor Space as Penrose envisioned it (called Projective Space) has 3 Complex Dimensions. A full Twistor Space has 4 Complex Dimensions. Even if you describe just this Universe from a Complex 4 Dimensions doesn't mean you have ultimate descriptions for all possible Universes.

346. Z (Twistor) is a point Twistor Space and has a Partner Z^* (Complex Conjugate) Z . $Z^* = \text{Real number}$. S (Helicity) or degree of twist of the Twistor. $1/2Z.Z^* = S + \text{or} - \text{Zero}$. Zero being Light rays or Null Lines, plus being Matter and Energy Components and negative being non-Real properties i.e., they have positive, negative and Zero twist and Chirality or natural Right and Left Handedness.

A $1/2Z.Z^*=0$ line in Special Space PN which divides Twistor Space in half.

PT^+ & PT^- above PN lies PT^+ or positive helicity. Below PN lies PT^- or negative helicity. $PN=0 = 0$ helicity degree of twist.

347. When 2 Spaces include Curvature, SpaceTime of individual Gravity Wave Function is Right and Left Handed Curvatures. There is a duality between null line in SpaceTime and a point in Projective Twistor Space TN. Local structure points of Twistor Space encode global information (large scale) about SpaceTime. Secondary points represent intersections of Twistors. SpaceTime is fundamentally non-local.
348. Superstrings vs Twistors. Superstrings are Massless, one Dimensional objects with very short length. Twistors as Null Lines or Light Rays have no length, no Scale and no Mass. Superstrings are defined in 10D compactifying down to 4D SpaceTime. Twistors are defined in a Complex Space of Complex Dimensions and then they generate 4D SpaceTime together with Null Lines. Superstrings have many internal Symmetries which are broken as 10D moves to 4D. Twistors do not need to occur in Twistor Space.

Right handed and left handed Photons and Gravitons are broken in the beginning twist of the Twistor indicating a basic part of its Chirality and is not caused by Implicit or Explicit Symmetry Breaking. Closed Loops of Superstrings Interact with the Vacuum of Space by the creation and annihilation of Gravitons. Twistors' Quantum Processes and Gravity Interact differently. Superstring Theory accepts Quantum Theory. In Twistor Theory and Quantum Theory, SpaceTime must be altered.

349. A Relativistic String corresponds to a General Curve in Twistor Space or Relativistic Strings can be derived from Twistor Space. Certain Twistor Transforms or Transformations can be generalized to the 10D Space of Superstrings or Twistor formulation is the starting point for Superstring Theory and is investigated by Complex Geometry and Complex Analysis--Cohomology.
350. Conformal Invariance means no sense of Scale. Distances in flux and other components remain unchanged. It is a property of Null Lines or Light Rays. Conformal Invariant Spaces leave structure of Light Cone unchanged. Changes in Conformal Transformations leave a Light Cone unchanged. Gravity breaks the Conformal Invariance to produce Mass, Curvature and Elementary Particles or collection of Null Lines or Twistor Networks. Twistors behave like Quantum Operators and passage of Gravitational Wave looks like a **Quantum Soliton Process**.

351. In Twistor Space, a Twistor and its Complex Conjugate looks like a Momentum and Position Operator of Quantum Physics. Wave of Curvature is SpaceTime and looks like a Quantum Process in Twistor Space, i.e., connecting Gravity and Curvature in SpaceTime to Quantum Processes in Twistor Space and connecting General Relativity, Gravity, SpaceTime and Quantum Processes. (This is apparently a stronger attempt at Grand Unification than one of the earlier Axioms but this still falls short). For Finite N , the series blows up when $X=0$ right at the point that the series becomes Infinite the shift of the blowup is from $x=0$ to $x=1$, i.e., the weakness manifested in Perturbation Theory. Penrose suggested that each Graviton carried its own measure of Curvature. The Gravitational Field splits in 2 parts. A helicity of +2 Graviton and helicity of - 2 Graviton. The Field or Wave Function for the helicity +2 is generated using Contour Integral wrapped around the Twistor Function with a homogeneity of -6. To obtain a Graviton of helicity of -2 use a Twistor Function with a homogeneity +2 and the Field is determined by sliding the Contour Integral around the Function and to make sure all Singularities are enclosed. Non-linear Gravity in Twistor Space distorts that Space and Complex SpaceTime straight lines now become distorted, curved or holomorphic curves which remain unchanged along with Twistor Transformation by Non-linear or Quantum Gravity.

Holomorphic curves in Twistor Space corresponds to a Superstring in SpaceTime. Though Gravity disturbs Global structure of Twistor Space you can use the complimentary Twistor SpaceTime pictures. Local points are not well defined Globally but Null Lines and Light Rays are. The Light Cone remains intact. The Metric of Space

is in fact, i. e., its order of length is in fact and solves the Einstein Field Equations. The pattern of fibers at each point in Twistor Space is encoded in an ordered way by the Transformations. The encoding of fibers in Twistor Space corresponds to the Gauge Field Transformations in SpaceTime. The basic order or code in Twistor Space is the Gauge Field in SpaceTime. Nature's Fields can be seen in terms of the Geometrical or Cohomological properties of Twistor Space. The appearance of the Graviton causes the collapse of the Wave Function. **Sparling's Five Force Theory can be deduced from Twistor Theory (Sparling, *Nature* , 1986). Gravity, Super Gravity, 4D and 11D, Einstein's and Maxwell's EM Theory combine using coding of fiber bundles in Twistor Space. This Axiom is the next attempt at Grand Unification but once again falls short.**

352. Any Massless Field is defined by a Contour Integral in Twistor Space. The Contour Integrals are determined by the Singularities of a General Twistor Function in Twistor Space, i.e., for EM Fields these Singularities are the Charge sources where Field lines begin or end. The Fields of Nature are determined by the Singularities present in General Functions of Twistors. The Field is given by the Contour Integral around this Function and the Contour Integral is determined by the value of the Singularities of this Function.
353. Once the Twistor Space is known one can recreate the Field in a corresponding SpaceTime picture because Twistor SpaceTimes are complimentary points in Twistor Space and correspond to Global properties of EM Field in SpaceTime such as Light Rays or congruence of Light Rays. A General Function of a single Twistor reproduces EM in SpaceTime or any other Massless Field in nature (Yang-Mills-Instantons). EM=Contour

Integral around a Twistor Function. Origin of Mass has not yet been defined.

354. In EM Fields there are 2 indices and the Quantum Particles or Photons corresponding to this Field have Helicity of +1 or -1 or the Homogeneity of the Twistor Function. The Homogeneity of a Function is the number of powers it contains $X^2y + Yx^3 =$ Homogeneity of +3, $X^5xx^2x^3 = +5$ Homogeneity.

$1/x^4$ has a Homogeneity of -4. In the case of a Field whose Quantum Particles have a Helicity of 1 the Twistor Function is -4 or the General Twistor Function having this Homogeneity contain powers like $1/x^4$. Wrap a Contour Integral around these functions and look for the Singularities inside. The result is a complete definition of a Photon of Light in Twistor Space. One thereby gets rid of Differential Equations i.e., the inability to cover a Complex Space with overlapping regions that are smooth.

355. The Sheaf allows us to move the ragged edges of Space around until they fit together. The Twistor Field is given Chomologically in terms of the way a Contour wraps around a Function in Twistor Space. Light is polarized right and left handed. Photons have 2 forms of Helicity +1 or -1. Photons have helicity +1 and are represented by a Contour Integral around Twistor Function of Homogeneity of -4 or $1/x^2y^2$. For a Photon of helicity -1 a Twistor Function of 0 is needed or they are Asymmetric. A beam of Light has 2 different Twistor Functions and they are not mirror images of one another. There is no Symmetry between +1 and -1 Helicities. The Light Beam polarizes in different ways which means its

Speed cannot be Symmetric if its Speed of Polarization is made of two different components. Its velocity could not be constant because it utilizes Twistor Function of a different Helicity. It is a Chiral handed picture of Nature.

356. Penrose's picture is that Nature's Basic Laws are Asymmetric to begin with and not Symmetric. They do not become Asymmetric with Symmetry Breaking. Right handed Photon is given by a Contour Integral in Twistor Space taken around a Twistor Function of Homogeneity -4. The left handed Photon has a Function of 0 Homogeneity.

357. Quantum Theory allows Axiom 356 for any linear combination of Quantum solution that must correspond to a physical solution. Single Photons of mixed Helicity right and left handed Photons are valid.

<u>Particles</u>	<u>Homogeneity</u>
------------------	--------------------

Graviton + 2 (?)	- 6
------------------	-----

Photon + 1	- 4
------------	-----

Antineutrino +1/2	+ 3
-------------------	-----

0* Spin 0 Particles	- 2
---------------------	-----

Neutrino -1/2	- 1
---------------	-----

Photon - 1	- 1
------------	-----

Graviton -2 (?)	+ 2
-----------------	-----

*Does exist as is.

(?) Unobserved

358. The property of particular Quantum Particles (Fermion with Fractional Helicity or Spin 1/2) or a Boson (Whole number Helicity type 2) depends on the Homogeneity of Twistor Space, i.e., the connection between the division of Elementary Particles into Fermions and Bosons and the structure of Twistor Space.

Mass is created out of the Interaction of Twistors or generated using Contour Integrals around Functions of more than one Twistor using Trouser Diagrams of Superstrings.

$$R^{un-1/2} \text{ gunR} = -K_T \text{ un}$$

359. Quantizing Gravity A Twistor Function of homogeneity of +2 defines one half of the Gravitational Field of helicity -2, or is curved left handed and right handed flat. A single Graviton produces Curvature of Complex Time in one sense only. A Contour Integral around a Twistor Function with homogeneity of -6 creates a Graviton of Helicity +2 or left handed flat but curved right handedly. Quantum Theory allows for combination of solution. The most general Quantum Graviton is a linear combination of right and left handed Helicities.
360. There are Complex Spaces that contain both combinations of Curvature and flatness at one and the same Time (Infinitism). Gravity changes the Whole structure of SpaceTime and Quantum Theory. The Superstring approach has Quantum Theory remain unchanged even at short distances and background Space is linked to the Strings indissolubly. Penrose's Theory says that Gravity and Quantum Theory must transform each other.

The General Function in Twistor Space has been used to create the Wave Function for Photon, Neutrino and Graviton but not the Gauge Fields which explain the Forces that operate between Elementary Particles.

361. R.S. Ward added to each point in Twistor Space an additional geometric structure called a Fiber Bundle. The Forces between Elementary Particles are associated with Gauge Fields or Gauge Transformations in SpaceTime. Gauge Transformations in SpaceTime have the effect in Twistor Space of causing Fiber Bundles or combination of tiny arrows to become mixed up but it is an ordered mixing.
362. Traditional Process use Perturbation Process i.e., an Infinite number of tiny corrections add up to produce a Finite effect.
363. **Einstein's equations are Non-linear so that Gravity feeds back on itself. Traditional theories are Linear, i.e., when the Infinite number of corrections or perturbations have been added, the correct result will be established. Quantum Theory is assumed to be prior to General Relativity and SpaceTime structure. The problem is that in an Infinite Series the Gravitons do not have any effect on SpaceTime until the limit of Infinity is reached when SpaceTime suddenly becomes current. (The same problem arises in the transition Space between the Quantum and the Real or Macro World, Lewis).**

364. The Function $1/x$ for a large X when the Function is small is: $1/10, 1/100, 1/1,000$. For a small x the Function increases $1/x, 1/-1, -1, -1/2, -2$.

so when $X=0$

the r Function is Infinity

the same for the Function $1/x^2, 1/x^3, 1/x^4$ the sum of

$1/x + 1/x^2 + 1/x^3 + 1/x^n$ when n is a Whole number $10, 100, 1,000$, when $x=0$, the series is Infinite.

Letting the series go right on to Infinity:

$$1/x-1=1/x + 1/x^2 + 1/x^3 + 1/x^4 + \dots\infty$$

This series does not blow up to Infinity but equals a Finite number -1 . However, when $x=+1$ it blows up to Infinity.

365. Current Superstring Theory has to free the theory from Perturbation Theory and a flat background of SpaceTime by applying a Twistor approach and has to find ways to explain Relativistic Covariance and an account for how 10D SpaceTime compactifies so that various Symmetries of Nature and Elementary Particles Masses can emerge, i.e., the

derivation of the Chirality of Nature. Hughes and Shaw's approach shows a general curve (Holomorphic Curve or two curves) corresponding to a Relativistic String in SpaceTime because points in certain regions of Twistor Space become point lines in SpaceTime and lines in Twistor Space become points in Twistor Space. The most general of the well behaved structures in Twistor Space can be generated from the Relativistic starting point for Superstrings. A holomorphic curve corresponds to a minimal surface in SpaceTime producing The Principle of Least Action in SpaceTime. A Supersymmetric Twistor called a Super Twistor generates Gauge Theory in 10D. Singular points are used in the construction of the Orbifold in which a Torus develops from a flat 3D Space and is folded and then folded again creating Singularities (Conical Singularities) where properties blow up at these points to Infinity leaving a cross between a Torus and a 3D triangle or Orbifold. By combining three Orbifolds in a 2D surface in 3D Space it is possible to create $3 \times 3 \times 3 = 27$ singular points in a 6D Space. Orbifolds are used in String Theory to create or represent Space generalized when the original 10D Space compactifies, producing Quarks and Leptons in several generations, namely 32 (too many). Superstrings live in 10D SpaceTime describing the Bosons and Fermions, Chirality and Symmetry. The Particle equations break into 2 formats one for 4D and the other for compact 6D producing the equations for actual Mass of the Elementary Particles. The Electron, Proton and Neutron have their lives in 4D but their entire Masses in 6D as Superstrings in 6D Compact Dimensions or 10^{13} GEVs.

366. Superstrings are fluctuations on 2D World Sheets in 10D Universe. 6D compactifies the Strings on the SubAtomic Level and are the Elementary Particles moving in 4D SpaceTime and their shadow compactifies and shows up as Mass. Since Mass depends on Compactified Space, the smaller the Space the larger the Mass. When the SubAtomic World is approached, representing least compactification, the Mass becomes 0 (in Reality the Masses in 4D except for the Neutron are not 0 but a Finite small number). (Here again the **Transitional Problem** arises because of the rather large discontinuous jump between large Masses to 0 Masses, Lewis).
367. To get Massless Electrons and Protons the D of Space where $n=0$ is $2 \cdot 4N + 2$ or 2D Dimensions. The Superstring World Sheet when $n=1$, $4n + 2 = 6D$ sp, 6D is the first Dimensionality in which Elementary Particles Masses can exist. It is still necessary to go beyond the Fermion-Electron, Proton, Neutron and Neutrino to see if the Boson acts the same way to produce the Gauge Forces from 6 curled up Dimensional 4 flat ones. The Particles continue to remain Massless right down to the Energies at which the Electroweak Force breaks Unification. At this point Elementary Particles Masses make their appearance as tiny corrections to their Initial Masses.
368. Calabi-Yau Spaces or Kahler Manifolds can always be converted by well behaved coordinate systems but Orbifolds with their 27 singular points cannot be converted.

By putting Complex Spaces over the Singularities we have a smooth or Kahler Manifold or it is topological Manifold and has a series of generations for the Leptons and Quarks. Calabi-Yau Space is a smooth version of the Manifold or the radius of the 27 points shrinking to 0.

369. A Quantum Field is Set up with Symmetries, Grand Unified Symmetry, Super Symmetry and treats Elementary Particles as the excitations of the Quantum Field as Superstrings. The general Holomorphic Curves in Twistor Space are Classical Strings and created by First Quantization and according to the Action Principle Covariant which produces minimal surfaces on SpaceTime. The vibration and rotation of these minimal surfaces are quantized to produce the String Wave Function.
370. Using individual Wave Functions generated by Schrodinger's Waves produces a new Quantum Field or Second Quantization out of the Wave Function forming individual String vibrations and rotations and creates a Super Wave Function for the String Field. In case of Heterotic Strings the ground or vacuum State (no excitations) is a Super Wave of $E_8 \times E_8$ Symmetry written in 10D. Upon compactification of Space the Symmetry of the ground State of the Quantum Field would break. The theory then ends up describing excitations that have Grand Unified Symmetry. Distances that are large with respect to the Heterotic String Field Theory would look like a Quantum Field for point Particles and

the excitations would appear like Elementary Particles.

- 371. Is Physics just a 2D description of World Sheet? In other words, Reality begins in 2D, expands to 10D and compactifies to 6D and 4D. Dimensions are not fixed but evolve and Fractionalize as well Fractalize. Mandelbrot's World has the Dimension of a figure change as we move towards it and see it in even greater detail. Dimensions are no longer fixed Dimensions but are more mutable.**

- 372. Superstring Theory predicts the Existence of the Dilaton. Dirac predicted that the Constants of the Universe are changing with Time. The Dilaton should be Massless and but somehow contain a Mass and Violate the Gravitational Effect unless indeed the Fundamental Constants are aging with Time. Fischbach has proposed a Fifth Force to account for some Gravitational anomalies. It is repulsive rather than attractive--Anti-Gravity. These are small additional repulsions over a few hundred yards depending on the composition of the material, the total number of Protons, Neutrons or total IsoSpin.**

- 373. Cosmic Strings represent trapped Energies from the Big Bang or Symmetric areas of high Energy which have not yet been Symmetry Broken throughout the Universe. These Strings would curve SpaceTime and exert a Gravitational attraction**

explaining the clumping together of Matter on the Cosmic Scale. Such Strings exist in a Superconducting State and are of the order of 10^{-30} cms. with trapped primordial Energy in them causing cosmic bubble in Space. They bend Light to form double image around a String. In Twistor Space the Cosmic String Energizes as SpaceTime structures corresponding to Holomorphic Twistor Curves. The Relativistic Strings are the precursor of a Superstring and the Cosmic String and are different solutions to Nambu's Equations. Cosmic Strings produce mirages in the Universe (Fractometry, Lewis).

374. Topology & Asymmetry Topological objects explain dynamically systems mathematically where 2 points starting together can end up far part or vice-versa through the use of differentiable dynamic global analysis, manifolds and mappings of Differential Geometry and are the tools of Chaos. Chaos is a special form of self-organization not the converse. The route to Chaos can be reached via Strange Attractors of the Non-Chaotic Attractors.

375. 10^{24} is Poincare's estimate for Eternal Return of all Molecules in the Universe and the age of the Universe is only 10^{10} .

376 Strange Attractors are useful to describe the onset of Turbulence but not for fully developed Turbulence. Any system that passes through 3 or more successive Hopf Limit Cycles bifurcates regardless of the Initial conditions and will end up in the Chaotic State. (Ruelf and Floris Takens). The behaviors of Matter looks the same on all length scales as one goes to a critical point self similarity where Dimension is a continuous variable.

377. Newton's three body problem is the same body problem for Sub-Atomic Dimensions. Von Neuman had overlooked the possibility of Chaos with instability at every point.

This is the main question of Physics. What exactly happens at the Boundaries of the Microscopic Macroscopic Borders? Chaos and Unpredictability.

378. James Yorke proved that in any One-Dimensional System if a regular cycle or period three ever appears, then the same System will also display regular cycles of every other length as well as completely Chaotic Cycles. It is impossible to Set up a System that would repeat itself in a period three oscillation without ever producing Chaos.

379. Big Bang still possible every billion or so years. In order for Dark Matter to help form Galaxies it must consist of Particles that do not Interact with Electromagnetic Radiation Non-Baryonic Dark Matter (Darkons) Cold and Hot Dark Matter via Magnetic

Interactions.

380. The Noah Effect means Discontinuity when a quantity changes it can change arbitrarily Fast. The Joseph Effect means persistence, a trend in Nature that tends to stay in place. Noah and Joseph Effect working in tandem produce an orderly Chaos. Trends are Real but can vanish as quickly as they come. Noah and Joseph Effect also work in opposite directions.

381. A numerical result depends on the relation of object to the Observer and is relatively speaking consistent. The in-between boundaries then become Fractal Dimensions of 0 to 1, 1 to 2, and 2 to 3. The degree of irregularity remains consistent over different scales or the World displays a regular irregularity.

382. A simple One Dimensional line fills no Space at all. But the outline of the Koch Curve with Infinite length crowding into a Finite area does fill Space. It is more than a line yet less than a plane.

It is greater than One D yet less than 2D. The Koch Curve is the Infinitely extended multiplication by $\frac{4}{3}$ and has a Dimension of 1.2618.

383. Systems that lose Energy to Friction are Dissipative. Astronomical Systems are conservative or Hamiltonian. Without Dissipation, Phase Space would not fold and contract to produce an Infinite Fractal-Fractional layering (Lewis). Strange Attractors could not arise but Chaos could.
384. The behavior of Matter near the point where it changes from one State to another, from liquid to a gas, from Unmagnetized to Magnetized, from Macro to Micro or vice-versa are as singular Boundaries between 2 Realms of Existence. Phase Transitions tend to be highly non-linear in their mathematics. Allowing Mass to vary depending on scale one could recognize similarity across scales. By acknowledging self-similarity you can collapse Complexity i.e., using Renormalization Group Theory.

As things become small they become incomprehensible in Reality. Color, in opposition to Newton's view, is the interchange of Light and Shadow. Color is a degree of Darkness allied to Shadow (Goethe). Color comes from Boundary Conditions and Singularities. There is a definable Real World quality of redness independent of our perception. Tiny changes in certain features leads to big changes in overall behavior.

385. One way to define a Set is in terms of a test for every point, involving some simple iterated arithmetic. To test a point, take the complex number, square it add the original number, square the result, add the original number square the result; etc. If the total goes to Infinity then the point is not in the Mandelbrot Set.

If the total remains Finite, repeating, or wandering chaotically, then the point is in the Mandelbrot Set. Modeling feedback with numbers - take a starting number multiply it by itself, multiply the result, etc. The larger numbers lead to Infinity 10, 100, 10,000..., small numbers lead to 0 - 1/2, 1/4, 1/16... The Geometric picture is, define a collection of points that when fed into the equation do not go to Infinity or points on a line from 0 upward. If a point produces feedback color it is white otherwise it is black. The shape of the line is black from 0 to 1. For 1D Processes numbers greater than 1 go to Infinity and the rest do not. But in a 2D complex plane the shape by iteration can only be known by trial and error and plugging the values in the equation.

Standard geometry takes an equation and asks for the Set of numbers that satisfy it. The solution to $x^2 + y^2 = 1$ forms a shape or circle. Other equations form ellipses, parabolas, hyperbolas of conic sections or complicated shapes produced by differential equations in Phase Space. But when you iterate an equation instead of solving it, when a number goes into the equation a new number comes out, the new number goes in, etc. Points hop from place to place. It is dynamic. A point is plotted not when it satisfies the equation but when it produces a certain behavior, i.e., steady State or convergence to periodic repetition of States or an out of control race to Infinity. Mandelbrot Set equals the iteration in a complex plane of the mapping Z yields $Z^2 + C$. Take a number, multiply it by itself and add the original number.

A Mandelbrot Set has a main engine-- a loop of instructions that takes starting complex numbers and applies an arithmetic rule to it - Z yields $Z^2 + C$. Z begins at 0 and C is the complex number to the point corresponding to the point being tested. Take 0, multiply it by itself and add the starting number, take the result-the starting number - multiply it by itself and add the starting number, etc. To add a pair of complex numbers add the Real parts to get a new Real part and the Imaginary parts to get a new Imaginary part.

$$\begin{array}{r} 2 + 4i \\ + 9 - 2i \\ \hline 11 + 2i \end{array}$$

To multiply 2 complex numbers multiply each part of one number by each part of the other and add the 4 results together. 1 multiplied by itself equals -1 -(Definition of an i number). One term of the complex number collapses into another.

$$\begin{array}{r} 2 + 3i \\ \times 2 + 3i \\ \hline 6i + 9i^2 \\ \hline 4 + 6i \\ \hline 4 + 12i + 9i^2 \\ \hline 4 + 12i - 9 \\ \hline -5 + 12i \end{array}$$

To break out of the loop, if the total heads off to Infinity in its plus Real or Imaginary part the number is not in the Set, i.e., if the number is greater than -2 or +2 it is heading to Infinity. If smaller, it is part of the Set.

The boundary of the Set is where the numbers are caught between two Attractors one at Zero the other at Infinity. This is known as the study of Fractional-Fractal Basin Boundaries, i.e., the way a system chooses between options. Predicting behavior at the Boundaries is not impossible (Lewis).

386. Sensitivity to Initial Conditions-- the tendency of nearby trajectories to pull away from each other. The Lyapunov exponent measures stretching, contracting and folding in Phase Space of an Attractor.. Giving the properties of all systems that lend Stability and Instability exponents greater than 0 lead to stretching. Nearby points would separate an exponent smaller than Zero and means contraction. For fixed point Attractors all exponents were negative since direction of pull was inward towards the final Steady State. An Attractor in the form of a periodic orbit had one exponent of Zero and others that were not Zero. A Strange Attractor had to have at least 1 positive exponent.

There are Fractal Dimensions, Hausdorff Dimensions, Lyapunov Dimensions and Information Dimensions. The feature that gave the amount of information necessary to specify the position of a point on the Attractor to within a given accuracy is a Fractal

Dimension and described the rate of Decay of predictability, the rate of information flow and the tendency to create mixing.

Simple Systems give rise to complex behavior. Complex Systems give rise to simple behavior. The Laws of Complexity hold universally irrespective of the details of a system's constituent Atoms (Lewis).

387. Fractal-Fractional Geometry helps to study the way things meld together, break apart or branch apart. The way they shatter (Lewis). Turbulence arrives in a sudden transition instead of a continuous piling up of different Frequencies. (Feed forward in Non-Linear Systems is where the equations have terms that are Discontinuously multiplied by Systems outside themselves).
388. Phase Space is composed of as many Dimensions and variables one needs to describe a System's movement. In Phase Space Systems contain several components each one free to move.

Using Nonlinear Models, it's possible to locate potential critical pressure points in such Systems. At these pressure points, a small change can have a disproportionately large impact. One difference between Linear and Non-Linear equations is feedback. Non Linear equations have terms which are repeatedly multiplied by themselves. Feed forward are Non-Linear Systems where equations have terms that are Discontinuously multiplied by Systems outside themselves.

Phase Space is composed of many Dimensions or variables. One needs to describe a System's movement. Phase Space Systems contain several components each one free to move in any three directions with a different Speed for each of the three directions. A single Particle requires a 6D Phase Space. 3 Space directions and 3 Speed directions. A System of n Particles will require $6n$ Dimensional Space. For most Systems movement is described by 3 directions of movement and 3 directions of Momentum.

389. Nature undergoes rigid repetitive movements and then at some critical point evolves a radical new behavior. Phase Space clarifies this behavior. The path of a Periodic System always returns to the same point in Phase Space no Matter how complicated the returning path is. It has one degree of freedom. Rockets have 3 degrees of freedom. It is possible to have Fractional-Fractal degrees of freedom (Lewis).

390. An Attractor is a region of Phase Space which exerts a Magnetic appeal for a System seemingly pulling the system towards it. Systems in Nature are attracted to Energy valleys and move away from Energy hills. 2 Attractors may have a saddle between them or a high peaked mountain which acts as a point repellor. Phase Space trajectories will avoid repellers and move toward Attractors. If a pendulum is given a periodic push or kick it remains stable where instead of slowing down or Speeding up it follows a steady rhythm; unlike a Fixed Point Attractor it is drawn to a cyclic path in Phase Space or a Limit Cycle or Limit Cycle Attractor.
391. Rational numbers are like $1/2$, $1/4$, $3/4$, or can be expressed in terms of a Finite number of decimals 0.5, 0.25, 0.75 or as a simple recurring decimal $1/3 = 0.3333333$. An irrational number cannot be written down as a ratio and its decimal expression contains an Infinite number of terms with no repeating pattern. The digits in an irrational number have a random order. Where the combined system forms an irrational number or Frequency the point in Phase Space representing the combined system will twist around the Torus and never join up with itself. A System that looks almost periodic but never exactly repeats itself is called quasi-periodic. There are an Infinite number of rational numbers but there is an Infinitely larger Infinity of irrational numbers so it would appear that in our Universe quasi periodic systems should be more prevalent than periodic ones.

In the Classical World the Attractors are regular. Systems Decay gently to Fixed Point Attractors or oscillate in well-behaved Limit Cycle Attractors around Tori shapes. There is predictive behavior of complicated Systems over the long run, or asymptotic predictability that if the exact position of System from moment to moment is not known one knows that no Matter how far into the future one looks the System will be somewhere on the Torus and not wandering around randomly in Phase Space.

By making Newton's Mechanics a three body problem, Poincare showed that there is a potential for Non-linearity, Instability and Chaos.

392. The KAM Theory Kolmogorov implied that the Whole Universe was potentially Chaotic, a fraction of a decimal point away from annihilation. However, it won't break up if the perturbation or influence of the 3rd body is a very small Gravitational influence. Second, as long as the orbits or years of the planets do not lie in simple ratios like 1:2, 1:3, or 2:3 to remain Stable the Planets must be quasi-periodic. The motion of their combined orbits loop around and around the Torus without ever linking up.

The critical number is one end of the spectrum that runs from smooth flow, to vortices, to periodic fluctuations, to Chaos and it holds true at different scales. Using the number, one can simulate complex systems such as wind or river flow. The approach of

Turbulence at a small scale reflects the onset of Turbulence in the large scale or the Reynolds Number is the same as the self-similarity of the Strange Attractor.

When the Speed of a brook is low its motion is described by a Point Attractor as the Speed increases the Limit Cycle Attractor applies at the point where the behavior jumps over from one Attractor to another and is know as the Hopf Instability. Further analysis of the System yields a cascade of further Instabilities. The first Instability is a jump from a Point Attractor to a Limit Cycle followed by a sudden change to a Torus Attractor, a doughnut shape in 3D, then to a Torus in 4,5,6, etc., Dimensions. The Bernard Instability shows that Instability moves much quicker than the Hopf iteration.

Ruelle argues that the 3rd bifurcation is not a System jumping from 2D surface of a Torus onto a 3D or 4D Torus. It is the Torus which breaks apart. Its surface enters a Space of Fractal-Fractional Dimension (Lewis). The surface of the Torus Attractor is caught between the Dimensions of a plane (2D) and a solid (3D).

Crumple a piece of paper, a 2D object. The more tightly it is compressed the more Chaotic are its folds and the closer the 2D surface moves to becoming a 3D surface solid likened to the Bernard Convection. Where the movement is back and forth between 2 Dimensions and 3D, the shape it traces in Phase Space is a Strange Attractor. Turbulence arises because all the pieces of a movement are connected to each other. Any piece of the

Action depends on the other pieces, and the feedback between the pieces produces still more pieces. The breakup of order into Turbulence shows that the Strange Attractor is a sign of the System's Infinitely deep interconnectedness or of its Wholeness.

393. At the smallest and most basic level of Matter, self-referential iterations occur. Elementary Particles generate themselves by a constant Process of creation and destruction through iteration from the Vacuum State. The ultimate entity owes its Stability not to some static quantity but to a dynamic cycling quality or Process in which the Particles constantly folds and enfolds within the Quantum Field. Iteration shows that stability and change are not opposites but mirror images of each other.
394. Intermittency is the memory operating in Non-Linear Systems- the Systems memory of its original Limit Cycle or Periodic Attractors. Iteration after iteration goes on as Chaos or Order moves through Phase Space. But in the intermittency regions the old Order (or Chaos) is discovered again momentarily and the very iterations producing Chaos or Order produce momentary regularity or Chaos.

Intermittency shows how the Whole range of Order from simple oscillations to the complexity of full Chaos can be present in one System with each extreme surfacing

alternately. A System's simple Order and its Chaos are both features of one indivisible Process or a familiar Order as an island of intermittency in the midst of a universal large Strange or Chaotic Attractor.

Everything from Stability, to change, to Time is generated by iteration. In deterministic causal dynamically Systems the potential for Chaos unpredictability is in every detail.

Because of the iterated nature of Non-Linear equations which represent the interconnected nature of Dynamical Systems no amount of additional detail will help perfect prediction (Lorenz).

395. Rational numbers are those that can be expressed in terms of ratios of integers $1/2$, $1/4$, $2/3$, $3/4$ and have Finite decimal forms or an Infinite logic like $= 01010101$. When rational numbers are fed into this number doubling iteration they generate ordered patterns. But irrational numbers which are not ratios of integers have Chaotic patterns.

This decimal expression contains no order. Each digit appears at random. It can be calculated to millions of decimal places. With repetition when an irrational number is used as the input for the number doubling sequence the result is an Infinite string of numbers containing no order. Each new number occurs at random. Chaos comes from the irrationality enfolded in the original number. The exponential growth equation or number doubling equation is one way of producing strings of random numbers.

Combined Chaos and Chance are enfolded or unfolded from the Infinite complexity in the original irrational number.

Iterative Equations are sensitive to Initial Conditions. If x in the number doubling equation is changed slightly the sequence will diverge from the original. Small errors are rapidly amplified (Lorentz). For instance, making a mistake in the 4th decimal place of the original iterative series makes a substantial error by the 11th iteration and the pattern no longer repeats itself by the 17th iteration like the original. This sensitivity applies to both rational and irrational numbers in Non-Linear Equations if iterated.

The Baker Transformation has the effect of moving neighboring points away from each other. The Baker Transformation governs the growth equation. The Verhulst formula is guided by 2 opposing effects, one a stretching factor x_n and the other a folding back $(1-x_n)$ of the output of the previous iteration becomes the input for the next iteration and the growth equation with Verhulst's added Non-Linear term generates totally Chaotic sequences with complete Determinism. Here is where you determine all the terms going into the equation but the calculations that follow are not accurate because of slight perturbations that become amplified with each new iteration, Although the iterations are Deterministic the round-off error in Real Systems of computers makes predictions meaningless where highly Non-Linear Equations are concerned. Chaotic Systems such as the Weather are said to be locally unpredictable but globally Stable. Global stability

means they always take the shape of their Strange Attractor. The Strange Attractor is not only the shape of Unpredictability it is also the shape of the Weather's dynamical qualities and a picture of its Interaction with the Whole. The Whole is not the sum of its parts. It is the round off error that eventually explodes the equations.

Iteration pumps up microscopic fluctuations to the Macroscopic World. The part is the Whole for through the Action of any part, the Whole in the form of Chaos or transformative change may infect or infest that transformative part and the incipient Whole is the missing information which through iteration traces out the System's Unpredictability. The shape it traces is the Strange Attractor. The Attractor is the shape created in Phase Space by the missing information. The shape of Uncertainty or Attractor shapes are the Infinitely complex order of the Whole revealing itself. There is a connection between the missing information and Godel's Incompleteness Theorem.

Where important Logical Systems like Arithmetic and Algebra will always contain Statements that are true but which cannot be derived from a fixed Set of Axioms; there will always be missing information.

Determinist Systems which maintain themselves by Oscillation, Iteration, Feedback, Limit Cycles are vulnerable to Chaos and face Indeterminate Unpredictable fates if

pushed beyond critical Boundaries. Regular Order is interspersed with Chaotic Order dragged to Disintegration, Transformation and Chaos maintaining themselves for long periods of Time. But eventually all Orderly Systems will return to the pull of Strange Chaotic Attractors. Qualitative rather than Quantitative Math describes this behavior. In the Quantitative Math the measurement of a System focuses on plotting how the quantity of one part of the System affects the quantities of the other parts. Qualitative Math plots the Shape of the System's movement as a Whole. The question is not asked how much of this part effects that part but what does the Whole look like as it moves and changes? How does one Whole system compare with another? The Lyapunov Number is a measure of how in Dynamical Systems, the Systems separate from each other. It measures how quickly correlations in Systems are broken down and how rapidly the effects of a small perturbation can spread. It measures how the System's information changes the original information where the original information is not lost but transformed. David Ruelle said that the Henon Attractor, the Rossler Attractor, the Lorentz Attractor and Strange Attractors of all kinds exist in the cracks of things in the Fractional Realm that lies between the First, 2nd and 3rd Dimensions of the familiar World of Point Attractors, Limit Cycles and well configured Tori.

Mandelbrot- one can create a measure of irregularity that is based on scales. Karl Weirstrass described a curve that could not be mathematically differentiated. The ability to differentiate a curve from point to point is crucial to Calculus. Slope is the gradient of

the rise and fall of altitude. Newton's Calculus is where the mathematical equation for the climbing road determines the gradient at each point. This determination is mathematically equivalent to differentiating the equation of a curve. If the road or curve was Discontinuous, the curves could be differentiated. Reymond then presented Weirstrass's Equations which showed that a curve was Continuous but so complicated that it could never be differentiated. Peano then discovered the Space filling curve or a curve so complicated that it filled the plane and thus from 1D became 2D. There was no point on the plane that Peano's curving line would not include. The very 2 Dimensionality of the plane lay in its Sets of points - Now all these points were on a One D line. Now an object could be one and 2D at the same Time.

Koch Curve is where a snowflake is created through the Process of iteration in which each step is taken on a smaller scale.

It is evident that the more detail that is included the longer a coastline gets. If all detail is included the measurement is Infinite. All coastlines are Infinite, that is all measurements are equivalent since all things are Infinite. It all depends on the scale. Instead of measuring the length quantitatively one uses a qualitative scale based on measure of the Fractal Dimension. Instead of quantity such as length, Mandelbrot puts the qualitative

measure of effective Fractal Dimensions first-- a measure of the relative degree of complexity of an object.

If a curve or coastline's Fractal Dimension is close to one, the coast is smooth and has no fine detail. The greater the number is above 1 the more irregular or Chaotic the coastline is with this irregularity persisting at smaller and smaller scales. Twisting Fractal Lines have Dimensions that are Fractional such as 1.2615, 1.1291, 1.3652, etc.

Peano's Curve is so extremely irregular at Infinitely decreasing scales, that its Fractal Dimension is 2 because in effect it becomes a plane because of the twists but it never crosses itself.

396. Fractals are characterized by Infinite detail, Infinite length, no slope or derivative, Fractional Dimensions, self-similarity and can be generated by iteration, Fractals and Strange Attractors are connected. In Phase Space Diagrams a Strange Attractor is traced by the point which represents the System. In its movement the System point folds and enfolds in the Phase Space with Infinite complexity. Thus a Strange Attractor is a Fractal Curve. Fractal Shapes have self-similarity at descending scales. For Systems under the folding and stretching influence of the Strange Attractor any single folding motion of the System represents in a unique instance a mirror of the entire folding operation. Wherever Chaos, Turbulence and Disorder are found Fractal Geometry is there. Chaos and

Turbulence come from the same Processes as mountains, clouds and coastlines or as organic forms such as lungs, nervous systems and blood supplies. They emerge from Fractal Order.

397. Fractals are highly complex yet simple . They are complex by virtue of their Infinite detail and unique mathematical properties. No two Fractals are the same yet they are simple because they can be generated through successive applications of simple iteration.
- $Z^2 + C = \text{Mandelbrot Set}$. Z is a complex number allowed to vary. C is a fixed complex number. Then keep resubstituting the result in the equation. The computer searches for all complex numbers that are not so large as to exceed the capacity of the computer to calculate them. The Set itself consists of complex numbers C for which the size of $Z^2 + C$ remains Finite no matter how many iterations the equation goes through.

The Boundary Area is the territory that lies between the Finite solid World of the black inside the Set and the Unstable limitlessness of the white and gray areas. This Boundary is Fractal. The journey starts high above the complex plane. The white numbers go to Infinity when iterated. The pure whites go very fast, the grays less fast, the black ones lie solidly inside the Set. The Set becomes self-similar zooming in on it but it is not self sameness. Each one is a little bit different. Natural growth is achieved through iteration and chance. The Mandelbrot Set has only iteration and is therefore too smooth to mirror Reality. Cantor's Set counts beyond Infinity and created TransFinite Numbers. For

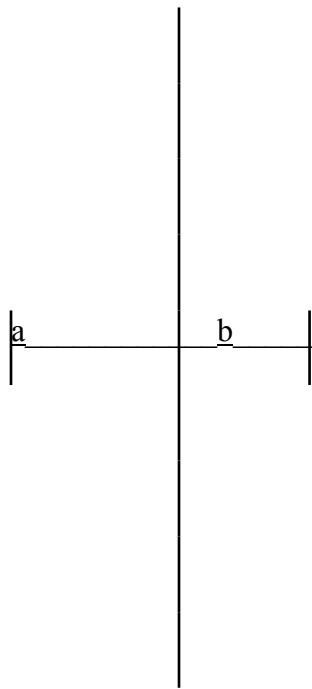
example there are an Infinite number of points in a plane or that lie on a line. Remove the middle third of a line, then remove the middle third of the remaining lines, ad infinitum. The result is a Discontinuous dust or a Discontinuum dust of points.

Cantor Dust has a Fractal Dimension of .6309 lying midway between a point and a line. The Cantor Dust is at one and the same Time Infinitely divisible yet Discontinuous.

Mandelbrot thinks it describes the night sky, the clustering of the Stars with corresponding gaps occurs on many scales right up to the Super Galaxies or Super Clusters--Clusters of Clusters of Stars or Galaxies.

Current data suggests a Fractal Dimension for the Universe of somewhere between one and two. Turbulence has been described by the Torus that breaks apart into a series of fine points. The Torus turns out to be Cantor Dust with Fractal Dimensions. In the World Turbulence comes in gusts, it is intermittent and the intermittency of Turbulence occurs on smaller and smaller scales, The Fractal structure of spatial Turbulence has another Fractal structure that varies in Time or Fractal Time. The atmosphere has a multiplicity of different Fractal Dimensions. Fractal trees illustrate the point that Fractal Geometry is a measure of change. Each branching of the tree, each bend in the coastline is a decision point.

The decision points can be examined in finer and finer scales, each scale having further decision points. Fractals become more organic when at each step there is a choice between several alternative forms of iteration or when a particular Fractal iteration persists for several length scales and then suddenly changes. What is the scale of the Golden Section? Draw a line and divide it so that 2 segments b and a are in the same ratio to each other as the longer segment is to the Whole line. The proportion a/b is equal to the irrational number 1.618.



This proportion can also be found in a series of numbers beginning with 1 where each number is the sum of the two preceding it. 1,2,3, 5, 8, 13, 21... The ratio of each number

to its predecessor approximates the Golden Mean. This series is the Fibonacci Numbers. The ratio of the lung lengths are classical Fibonacci for ten generations. Time is self-similar yet random. It is Chaotically changing scales in its iteration. Is Time evolving and shifting like a turbulent stream? Is Time a Strange Attractor? Strange Attractors have self-similarity. Why History seems to repeat and yet never repeat itself exactly? The intermixing of Fractals unfolding at different scales gives richness to natural forms and to Time. They evolve in Fractal measures and are richer by the concept of Random Fractals. A variety of generators can be used which can be chosen at random at each scale. Random Fractals have intricacy of detail but Unpredictability characteristic of Real Systems combining an iterative scaling with a random element of choice, coastlines, mountains and planets can be generated.

398. Fractal pictures represent Processes which are simplified idealizations of Reality. They exaggerate certain aspects to make them clearer. No Real structure can be magnified repeatedly an Infinite number of Times and still look the same. In Nature, after only a few iterations a new order takes over.

The evolution of Complex Systems can't be followed in casual detail because such Systems are holistic. Everything effects everything else. To understand them you have to see into their complexity. Fractal Geometry gives a picture of the qualities of change. Bohm contends that Light and Energy and Matter all over the Universe are composed of moving interference patterns which bear the mark of all other Waves of Light and Energy and Matter that they have ever been in contact with. Directly or indirectly each part or instance of Energy and Matter encodes an image of the Whole. Holograms describe the deep construction of Matter and movement of Energy. Mandlebrot's Fractals describe the shapes Matter takes and the orderly and Chaotic Processes that transforms those shapes. Each part of the phenomenon in the physical World represents a Microcosm of the Whole Like Holograms Fractals are a new image of Wholeness. Fractals will reveal more about Chaos hidden in regularity and about the ways in which Stability and Order can be born out of underlying Turbulence and chance revealing more about the movements of Wholeness. A Hologram is made by shining Laser Light of a single Wavelength through a half silvered mirror. Half the Laser Beam is directed onto a photographic plate. The other half is bounced off an object and then onto the plate. The two halves meet at the plate and interfere with each other. The interference pattern is recorded on the plate and looks like a fine grained picture of the Wave pattern created by pebbles thrown into a pond.

When later a Laser Beam is directed through the plate, an image of the object photographed unfolds from the Wave pattern and projects 3 Dimensionally in Space.

One can walk around this “object” and see it from a different perspective just like a Real object. The Whole object has been recorded in the interference pattern. Cutting a piece from the Hologram and sending the Laser Beam through the fragment also produces the Whole object but not as sharp.

This holistic effect is analogous to the self-similarity of a Fractal, repeating the shape of the Whole at different scales.

399. Waves can be pictured as a combination of Sine Waves. A Sine Wave is characterized by its Frequency or number of vibrations each second. A Wave can be considered to be the addition of Sine Waves at different Frequencies. Waves of different Frequency travel at different Speeds. The Sine Waves begin to overtake each other, break up and disperse. Chaos or Dispersion is because Waves are independent of each other and in a Linear way. The Non-Linear Wave or Soliton has Stability that binds individual Sine Waves together. The feedback occurrence at the bottom of the container causes the reverse of Turbulence, The Sine Waves couple. Non-Linear iterations at critical values produce spontaneous self-organizing forms instead of Chaos.
400. KDV equation is concerned with what happens when 2 Solitons collide i.e., they stay intact. The memory in the Non-Linear couplings is where the Wave remembers its former Order similar to what happens in intermittency. A central assumption of

Statistical Mechanics is the Principle of Equipartition or democracy of Energy. The internal structure of a metal is a Stable pattern known as a Lattice of Atoms. When Energy is added to the Atoms as Heat, the Atoms vibrate in a collective way producing many notes associated with a characteristic Energy according to the Principle of Equipartition. If all the Heat Energy were given to a particular note, a particular vibration within the Lattice, then soon the Energy would spread out and distribute itself to all the other notes of the Lattice.

401. Adding a Non-Linear term so that the different modes of a Lattice could interact so that Energy could pass from one note to another, Fermi, Pasta and Ulam found that this additional term dominated the Whole System and transformed it from a linear Lattice into an arena for Solitons. i.e., Equipartition of Energy does not apply. This concentration of Energy doesn't depend on the strength of the Non-Linear Interaction. Even a very weak coupling of feedback will cause the System to branch, A Poincare Recurrence is where the System would again and again return to the State it was in when it first received the burst of Energy. The Soliton is one of Energy which moves through the Lattice in a coherent Wave. Thus giant Waves can be considered to be a self focusing or surfacing of the ocean's memory in form of a Soliton. Russel's Soliton represents a delicate balance of Non-Linearity in the Realm of Dispersion. But a candle flame stands for the balance of Non-Linear reactions in the Realm of Diffusion. For a flame to persist a new source of Energy must flow into it as rapidly as Heat, Light and Energy flow out.

Wax melts, sucked up the wick by Capillary Action, vaporizes and enters the heart of the flame. Oxygen diffuses into the flame at the correct rate. The Soliton is the balance between inward and outward diffusion of Energy.

402. Soliton tunnels through Magnetic Fields. In a Superconducting metal, Magnetic transparency is turned off. At the critical temperature the point at which the metal becomes a Superconductor, itself a Soliton, the Magnetic Field is unable to enter. If the Magnetic Field is made stronger and bigger there comes a point in the Field where Soliton-like vortices of Magnetism are created that penetrate or tunnel into the Superconductor. One Soliton passes through another.

Soliton vortices are found in Superfluids. Fluids can flow without creating Turbulence. What forms, are not vortices of Magnetic flux but long thin cylinders or Strings of rotating Superfluid creating a curious texture in the Superfluid State. Soliton vortices or Strings formed after the Big Bang acted as Quantum objects around which Matter gathered into Galaxies and Star Clusters.

Self induced transparency shows what can happen when Light and Matter engage in Non Linear Interactions. When crystals, diamonds, etc. are transparent to Light other solids reflect Light and absorb Light. In absorbing Systems any Light that manages to penetrate into the solid is absorbed by the Atoms, then the absorbed Energy leaks away in the form

of Atomic Vibrations or Heat. Forcing Light through opaque substances is to heat its surface. When a Laser is Forced through a solid intense Light source the solid becomes transparent. The Light Pulse passes through unabsorbed.

With a Laser burst the Atoms in the Lattice are pumped to an excitable State and Interact Non-Linearly with the Light and the two fuse to form a Whole System, a Soliton Wave Front operating collectively. The Wave is not exactly Light nor exactly Atomic excitation but a complex Non-Linear combination of both-- a Polarization. When Solitons collide and Interact they look like the results of collisions of Elementary Particle experiments. The solution to one Soliton Equation involves Kinks and Antikinks. When two Kinks Solitons collide they repel as two Antikinks, A Kink and Antikink attract. They are similar or identical to oppositely Charged Elementary Particles. Applying the Soliton to Quantum Theory produces a Vacuum Bubble Instanton. This is a Quantum Non-Linear object.

403. When Quantum Energy descends to its lowest scale where the Potential Energy is at a minimum and no way of lowering it, this valley is at rest and is the Ground State. But when you are adjacent to a valley that has a lower level than yours, you have to climb. Quantum Field Theory pictures Elementary Particles as excitations that arise out of the Ground State or Vacuum State of the Universe. When a little Energy is added to the Ground State or Vacuum State, Elementary Particles are formed. When Energy leaves

the Ground State it returns to the bottom of the valley. If there were another Universe outside the Ground State with another Vacuum State it is a Potential Universe of lower Energy. In an absolute sense the Universe is Unstable because its Energy remains high relative to the Ground State of the other Universes.

Quantum Theory allows the tunneling across to the other Universe. Solitons can tunnel from the exterior to the interior of Plasma Solitons formed out of the Vacuum. They can tunnel from one Vacuum to the next. The Vacuum Bubble Instantons come about if the Vacuum State of our Universe, like Superheated water, is Stable until a single Nucleation occurs to begin the boiling in a violent outburst of Elementary Particles. A Soliton Bubble could tunnel across from one Ground State to another. The surface of the Bubble belongs to one Universe but the interior belongs to another Universe containing the lower Vacuum of another Universe. Such a Bubble would travel outward at the Speed of Light.

Single Instantons can be produced from the Interaction of extremely high Energy Laser pulses created with the size of a single Elementary Particle, after one second the Instanton would have expanded 300,000 kilometers containing a stream of Elementary Particles like dropping a speck of dirt into to Superheated water-the Universe would boil.

Prigogine's felt that because of Friction and exchanges of Energy with outside World that structures may arise.

404. Equilibrium is the State of maximum Entropy where Molecules are paralyzed or move around at random. Take 2 boxes connected by an opening and put nitrogen in one side and hydrogen in the other. The 2 will mix so that will be no difference in the concentrations of the System which has gone to Equilibrium and maximum Entropy. If you heat the two boxes to slightly different temperatures the gasses will mix but not uniformly. The flow of heat has produced more hydrogen in one side and more nitrogen in the other or a near to Equilibrium State or Order in which the System losses heat as fast as it gains it. This is a Point Attractor. It has no sense of Time since the System keeps returning to the Attractor.

In far from Equilibrium conditions. where there is a great deal of Energy input from outside there is Order out of Chaos. There is the passive Chaos of Equilibrium and maximum Entropy where the elements are so mixed that there is no organization. This is Thermal Chaos. The second Chaos is active, hot energetic, a far from Equilibrium Turbulent Chaos where Systems just don't break down but new Systems emerge. A pipe pouring into a basin first produces a dimple as it enters. At the surface of the oil basin opening, more oil pouring through produces increasing Turbulence and fluctuations.

These fluctuations increase randomly following a route to total Chaos until they reach a bifurcation point. At this critical juncture one of the fluctuations becomes amplified and represents a pattern of whirlpools. Forms and Order has sprung from Chaos. The

whirlpools remain Stable as long as the flow from the pipe is kept up. Even if the flow increases or decreases a little, the stability of the whirlpool pattern remains. Too much change in either direction causes new Chaos and new Order.

The Bernard Instability is where convection cells dissolve into Chaos or the way Bernard Cells turn into Chaos to Order. If a pan is heated so that the lower portion becomes hotter than the upper portion, heat travels from lower to higher regions. The flow is regular and smooth or near Equilibrium. As the heating continues the difference of temperature grows between them. There is a far from Equilibrium State and Gravity begins to pull more strongly on the layer which is cooler and more dense. Whorls and eddies appear throughout the liquid until the System verges on Complete Disorder. The critical bifurcation point is reached when heat can't disperse fast enough without the aid of large scale convection currents. At this point the system shifts out of the Chaotic State and the disordered whorls transform into a Lattice of hexagonal currents or Bernard Cells.

Turn the heat up and the Bernard Cells dissolve into Chaos. In chemistry, the relation between Order and Chaos is complex successive orders of ordered oscillatory followed by regimes of Chaotic behavior. Stengers and Prigogine--The Bernard Cells are produced by millions of Molecules suddenly moving coherently. The Whole atmosphere might be a sea of seething Bernard Cells. A far from Equilibrium Chaos contains Self Organization if the concentration of one of the reagents is increased to a critical point the

reaction undergoes a transformation in which chemical concentration begins to fluctuate regularly like a chemical clock.

405. Each Molecule is informed about the overall System. The idea of communication and information is tied up to the way random behavior leads to complex coupling of feedback and spontaneous Order. Instances of Disequilibrium and Self Organization are dissipative structures. In order to evolve vortices, slime molds use up Energy and Matter- open Systems taking in Energy from the outside and producing Entropy - waste, randomized Energy which they dissipate into the surrounding environment. Dissipative Structures are Systems capable of maintaining their identity by remaining open to the flux and flow of the environment in which they find themselves. Solitons like the Wave of Translation and the candle flame are Dissipative Structures arising from far from Equilibrium flux riding upon it. In the Non-Linear range, far from Equilibrium gives rise to structure and brings Order out of Chaos. Matter has radical new properties in the arena of the far from Equilibrium enabling Self Organization.
406. A Dissipative Structure constructs itself out of Chaotic Space or organizing Space and gives a direction to Time. Bifurcation, Amplification and Coupling lead to both sides of the mirror.

The Bifurcation Points constitute a map of the Irreversibility of Time. Time is Irreversible but Recapitulant and Time's movement is immeasurable. Each decision made at a branch point involves an Amplification of something small. Causality operates at every instant and branching takes place Unpredictably.

The mixture of necessity and change constitutes the History of the System. The idea of Bifurcation Sensitivity is explaining the phenomenon of Chirality or Handedness.

We live in an Asymmetrical World where patterns manifest themselves in one direction more than another. The World of Atomic Particles is not Symmetrical nor is the Macro World. Electrons come Spinning out of the Nucleus counterclockwise or left handed. Real life Molecules are left handed. In far from Equilibrium States very small effects become magnified. The extremely small Gravity difference across a few cms. of liquid would normally be negligible. In the Bernard Instability the far from Equilibrium Turbulence magnifies the Gravitational effect and results in the hexagonal Bernard pattern. Konepudi states that the same phenomena appears with the Spin of the Electron. In the disequilibrium of Chaos new Molecules are born in a Dissipative System and they quickly magnify or amplify the very small Energy difference in Spin projecting SubAtomic left handedness up to the level of the Organic Molecule. If we start with Particles which have the same velocities and have collisions they will end up with random velocities. But the reverse is not true. The World is temporarily organized. There is always an Arrow of Time. The Big Bang Theory of Relativity gives the

Universe an Irreversible History. In Quantum Physics Irreversibility is also present.

Unifying Dynamics and Thermodynamics, Microscopic and Macroscopic Reversibility and Irreversibility and Being and Becoming, Prigogine's System is a form of Symmetry Breaking. Complex Systems break the Symmetry that would allow Time to go backward as well as forward. Complex Systems give direction to Time. Any Interaction takes place in the larger System and the System as a Whole is constantly changing, bifurcating, iterating. So the System and all its parts have a direction in Time.

Time becomes an expression of the System's Holistic Interaction and this Interaction extends outward. Every complex System is a changing part of a greater Whole, a nesting of larger and larger Wholes leading to the most complex dynamical System, the System that encompasses Order and Chaos, the Universe. Once a Complex System appears it becomes separated from Reversible Time by an Infinite Entropy Barrier. Processes that run in the reversed direction become Infinitely improbable.

407. Symmetry Breaking of Time occurs at all levels of Nature. There is both one Time and Infinite Times. Time is the Arrow that couples all Systems together and a multitude of Arrows constitute the Bifurcations and changes of each individual System. Each of us

has our own autonomous Irreversible Arrow but that Arrow is intertwined with the Irreversible Arrow of the Universe.

408. Prigogine revises the Big Bang. The Universe starts with a burst of Entropy Chaos leaving Matter in an organized State. The Matter is slowly dissipated. Obviously in this dissipation Cosmological structure, Entropy has positive and negative powers but the total remains positive.

A System can never be sealed in a box. The outside leaks in though a breach in the chain of decimals, the missing information. "Nature" is always Entropic, Turbulent and Irreversible. Irreversibility does away with the separation between large scale and small scale Universe. Nature is not built from the bottom up. It is built by feedback among all the levels. Each level of description is implied by another and implies the other. No level can claim preeminence. The Laws of Nature, Physics, are not all given at the outset or logically implied. They evolve like species, as things get more complex, Bifurcations and amplifications occur and new Laws emerge.

Grand Unification eliminates the need for the Second Law of Thermodynamics, the Law of Increasing Entropy. The Universe isn't an Identity. All Particles don't melt down into one. If you have Identity you don't have an Arrow of Time. Prigogine's Uncertainty Principal says that beyond a certain threshold of complexity, Systems go in unpredictable

directions. They have their Initial Conditions and cannot be reversed or recovered. The Entropy Barrier is the inability to go backwards in Time. Prigogine rejects Reductionism. Time is in all Dimensions of Reality. Chaos creates Spontaneous Order.

The root of the Universe is either Chaos or Order of an Infinite Degree of Chaos. Chaos is a form of Order with the Quantum as the fundamental level of Reality. The solution to any problem in Quantum Theory is given in terms of Linear combinations of different solutions--Combinations of different outcomes. The solutions given by Linear Theory like Quantum Theory are equally good from a mathematical point of view. Solutions are added together in various ways to form more solutions. But in any actual Quantum experience there must be a definite outcome producing Quantum Strangeness or the collapse of the Wave Function to produce definite solutions.

409. Bohr believed that the fecundity of the Cosmic Order is an Infinite complexity of movement. The Order of the Whole is implicit in the motion of each part. Schrodinger's Cat Paradox can be solved by the addition of Non Linearities and Phase Locking. By introducing Non-Linearity into Quantum Theory, Schrodinger's equation can be solved by splitting it into 2 parts. The first part of the equation describes a Classical Electron. The second part is the Electron Potential in which Electrons or other Quantum Particles are sensitive to their environment. The Quantum Potential of Bohm's equations are a

mathematical Transformation of Schrodinger's Equation. They give the same numerical results as conventional Quantum Theory. There is a difference however. The Quantum Potential that dictates the way an Electron moves is Non-Linear and determined in a complicated way by all Matter and all Atoms and Elementary Particles that surround the Electron in question. The Quantum Potential controls the movement of an Electron inside an Atom or as it travels within the experimental apparatus because of its sensitivity of Quantum Potential the Electron is constantly pushed into Bifurcation points along its path where it can be flowing in one direction or another resulting in Indeterminism and Unpredictability of an individual Quantum like an Electron, Quantum Chaos but ultimately the movement is totally determined by a Potential of endless complexity such that attempts at prediction are futile. The Quantum Potential is an Infinite sensitive feedback with the Whole. Since all Molecules in an experimental apparatus surrounding the Quantum System are in a constant State of thermal motion, the Electron's Quantum Potential continues to fluctuate in an extremely subtle way.

This fluctuation of the Whole Information Field gives rise to the probabilistic results of Quantum Processes or Quantum Chaos. The Wave Functions collapse and are an information collapse making the Quantum World consistent with the Classical World. There does not have to be any division between Non-Linear large scale phenomenon and Quantum Linearity, between Determinism and Indeterminism. Order stretches from the

Electron to the Galaxy. Nonlinear Quantum Potential explains Quantum Wholeness if you correlate 2 Quantum Particles and send them in different directions. Whatever is done to one of them is felt by the other and it reacts accordingly even with the separation in Space. The Particles are coupled together with all other Particles by their Non-Linear Quantum Potentials. The coupling includes the Particles in the measuring apparatus. The Whole System moves together and what is done to one Particle is instantaneously registered by a change in the Whole System thus affecting the other Particle. Bohm's causal interpretation of the Quantum Potential is part of the implicate order or a feedback from which Quantum Processes emerge and where everything affects everything else. The universal ground of feedback exists before there are things to form feedback relationships. Each part or object enfolds the movement of the Whole because it is rooted in the Infinite Non-Linear feedback ground. Quantum events blend with the large scale Non-Linear feedback we saw in sensitive Chaotic Systems, bacterial Symbiosis in the Belousov-Zhabotinsky Reaction, and other appearances of Order out of Chaos.

410. In the coordination of Electrons a Superconducting Phase Locking occurs when many different or individual oscillators shift from Collective Chaos to beating together or resonating in harmony.

Phase locking explains how Quantum Level Systems come together to create Classical Scale Systems. The Michelson-Morley experiment showed that the Speed of Light

measures the same no Matter what direction the observer is or how the Light sources moves. Lorenz suggested that the Speed of Light is not constant but experimental effects conspire to make the actual change in the Speed unobservable. Clocks and rulers are made out of Atoms and these Atoms are held together by Electromagnetic Interactions so that when any material body moves it must readjust its internal structure. This readjustment makes clocks run slower and measuring rods contract. These small adjustments in the measuring apparatus mask the changing velocity of Light that the apparatus is trying to measure. Einstein pointed out that Time and Space aren't Absolute so there could be no meaning to Lorenz's arguments that clocks run slow and measuring rods contract. But lengths and Times of different Systems run at different rates relative to one another.

411. Bohm combines Lorenz's approach with Einstein's Relativity Theory to produce material frames. Observers, including labs and other collective structures define their own local Time and Space. The Time within a material frame is generated out of the Phase Locking of Matter within the frame but without absolute background of Space and Time against which these clocks and distances can be measured. Time is a measure of the amount of Process that takes place, the ticks of the frame's internal clocks. When clocks run slow with respect to each other it is because their material frames are Phase Locked differently from each other.

Quantum Phase Locking could provide a bridge joining Classical Non Linear Reality and Linear, Quantum Reality. The answer lies in the Transformation that occurs when random individual behavior becomes collective behavior.

Through Phase Locking Molecules are built up whose properties lie midway between the Quantum and the Classical. Such Molecules have on the one hand certain definite properties and on the other they are still involved in Quantum Processes. Some Molecules are sensitive to the input of a single Quantum Particle.

412. Penrose suggests that when large numbers of Quantum objects are coupled together, Spinors, or the smallest of all Elementary Particles, each of which take on one of 2 possible values. By adding these objects together according to the rules of Quantum Theory you end up with a large network of Spinors. When 2 networks of Spinors are brought together they will see each other in spatial terms as if oriented at a particular angle one to the other until they derive a 3D Space or transform from the Quantum World to Classical Space.

The Properties of Space are not inherent, not given, but emerging in the large scale out of the cooperative Interaction of Quantum Systems. Quantum Systems may lock together to create not only Space but Time and other Macroscopic structures. It is therefore

unnecessary to draw a line between the Linear and Quantum World and the Non-Linearities of our large scale World. As Quantum Systems grow they will develop Non-Linearities and structures. The Classical level structure that evolves becomes relatively Stable and therefore as in the case of our solar system relatively insensitive to individual Quantum fluctuations. But other large scale Systems Phase Lock in a way that leaves them sensitive and close to a Chaotic Region. In such cases the Classical structure or collective System is responsive to individual Quantum fluctuations so that it behaves Chaotically Unpredictably under the influence of the Strange Attractor.

When one makes measurements one amplifies a single Quantum Process resulting in the change of some large scale variable such as a dial on a meter. The result is Unpredictable. The tension between individual Quantum Chaos and collective Quantum Order is able to create and drive increasingly complex scales of structures.

Prigogine solves Schrodinger's Equation or cat problem in Chaos and the evolving Arrow of Time. Bohm solves it by finding signs of an Infinite Holistic Order which suggests that the solution lies in Phase Locking Feedback. It is the ancient tension between the individual and collective Certainty and Uncertainty, Chaos and Order.

413. In SubAtomic Matter Hydrogen consists of a single Nucleus that contains a positive Electrical Charge called a Proton surrounded by a single SubAtomic Particle called the Electron with negative Charge and are held together by the Electrical Force of Attraction

between them. The question is how do they arrange themselves inside the Atom? Because the Force pulling on the Electron would cause it to accelerate and radiate away its Energy; the Electron would fall into the Nucleus and the Atom would shrink. So it exists as an Electron Cloud not a Particle made of separate Electrons, each occupying a different position in a separate World or Universe. When no one tries to locate it the separate Universes overlay creating a single Stable World.

In our World the Electron is a cloud in Space and gives the Atom its shape, Stable with defined Energy. A change in the shape of the cloud produces a different Energy. When the Electron is observed it appears as a point or Particle with no spread in Space. The Atom has no longer a precise Energy. The disparity between the observation of the Energy of the Atom, the precise determination of the location of an Electron, is the principle of Indeterminism or Heisenberg's Uncertainty Principle (UP).

414. Heisenberg's UP is the inability to predict the future based on the past or present. The Energy of the Electron at the moment of each jump is Indeterminate and Unpredictable. Each position corresponds to a unique Electronic Energy State. When the lowest Energy or Ground State pattern emerge the Electron is in the lowest Energy State but without a unique location. Bohr's interpretation of the Momentum position paradox is that large objects follow Newton's Laws. Atomic sized objects are disturbed by any attempt to observe them. Eventually a large scale device had to observe the small scale device,

Electron or Atom. All the large scale objects could do was disturb the small scale object with Unpredictable results or these disturbances were called Quantum Jumps. The only thing one could say about tiny objects is to describe what can be observed of them.

The Wave of all possibilities undergoes a sudden change the instant anything physical is observed or the collapse of the Wave Function. The observer is responsible for the collapse of the Wave Function. The collapse means that the probability has changed from less than certainty to certainty or the observer effect. The System Quantum leaps into one of the possible States.

The System takes on a physical value. In the Parallel Universe the observer is part of what he chooses to measure. No collapse of the Wave takes place. The observer is part of the Wave. The Whole evolves in Time in a correlated and consistent manner. The Whole system evolves into a myriad of splitting and merging Parallel Universes. If a Quantum System evolves to any one of a Set of possible States according to Quantum Physics it evolves to all possible recognitions of those System States. The observer becomes part of the System he observes. In the Copenhagen Interpretation all one can do is assign a statistical weight to each State according to the relative height of the peak of the Wave representing that State. The Wave with the highest peak spread over the most Space has the most probability for a Real occurrence. The other possibilities exist but are collapsed.

However, Schrodinger's Wave Equation does not describe this collapse but does provide the Time evolution of the Wave.

Bohr stated that Atomic Electrons would not radiate Energy when they were in certain constrained types of circular motion or Bohr orbits. De Broglie said there was a Wave carrying the Electron in one of its undulations wherever a Bohr orbit existed. Erwin Schrodinger developed the mathematical representation of the Wave and believed it was Electromagnetic in character like radio and television Waves but it has never been observed. Born said the Wave was a probability and not a Real Wave describing the probable location of an object in Space but never its actual location. The Wave and Particle being the same thing. It changes into a Particle undergoing Quantum jumps upon observation.

415. The Universe is not everything it once was. It is everything and not everything at the same Time. Infinity is reduced to a point, a single equation, a Space that contains all possibilities including other Universes or SuperSpace. Occam's Razor does not apply but it does apply rather than Causality. Instead of predicting behavior based on the past we base it on that whatever takes place must be consistent with itself.

416. To locate a Subnuclear object you would need Gamma Rays which have smaller Wavelengths. The shorter the Wavelength required the more Energies needed. The Energy of a Photon is inversely proportional to its Wavelength. Since both Relativity Theory and Quantum Theory predict other Universes they can be resolved.
417. Whenever it is possible to find a Set of equations that produce the same physically observable phenomena in spite of observational differences where seen from different view points we have an Invariant Relationship.
418. The Invariance found by Einstein was similar to the simple Right Triangle Invariance found in Geometry, If Time is a Dimension of Space and you can construct right triangles with one adjacent side corresponding to Time and the other to Space there can be a SpaceTime Invariance similar to the Invariance found for the Right Triangles inscribed in a semicircle where Time is an Imaginary or new Dimension of Space. Time is relative. It depends on the relative Speeds of the Time observers or on how you construct your SpaceTime triangle as long as the Imaginary or Time side of a SpaceTime triangle is longer than the Real side the hypotenuse will be Imaginary or Time like side.

Particles that live longer in Imaginary Space than in Real Space, or travel more in Time than in Space-- Particles that always travel slower than Light Speed spending their Existence in longer Imaginary Space (Real Time) and shorter Real Space are called Braydyons or slow moving Particles.

$$a^2 + b^2 = c^2$$

Imaginary leg = a = i3 Real leg a length, b=3

$$(i3 \times 3) + (3 \times 3) = -9 + 9 = 0$$

Hypotenuse has length c=0

Zero Time Particles are Light Particles- the Photon. Zero Time Particles make Photons exist on the borderline between solid tangible and the real potential simultaneously, spending equal amounts of Time in Space and in Imaginary Space and travel at the Speed of Light. Zero Time meaning Zero Imaginary Space and Zero Real Space. or when the Real leg is longer than its Imaginary leg. This is not a triangle with Zero-Time hypotenuse. It is not an Imaginary Space interval or a Time. It will be a Real Space interval -1

$$a^2 + b^2 = c^2 \quad a=i3, b=5$$

$$(i3 + i3) + (5 \times 5) = -9 + 25 = 16 =$$

4x4 C=4. The hypotenuse

Imaginary Space meant movement in Time without movement in Real Space or standing still and moving in Real Time. Real Space hypotenuse means movement in Real Space without movement in Real Time or movement in Imaginary Time. This person is observed by a stationary observer to move in both Space and Time i.e., is Real Space and Imaginary Space by how wrist watch travels only in Imaginary Time which is the

same as Real Space. It is seen by himself as movement in Space alone traveling faster than the Speed of Light. A Particle already existing with a Speed greater than Light is not disallowed by Relativity Theory. No Particle can be accelerated past the Speed of Light because of the Infinite amount of Energy needed. There are Tachyon Particles.

Tachyons are Particles that move in Imaginary Time as seen by themselves just as Photons are Particles that move in Zero Time and Bradyons move in Real Time.

Moving a Bradyon in Real Space (Imaginary Time) by simply going to get a cup of coffee and returning to your chair. You have moved your body, a Bradyon, in Imaginary Space (Real Time) and in Real Space (Imaginary Time). Going backward and forward from chair to kitchen and back in Imaginary Time. But this is not so easy in Real Time.

Tachyons do not experience Real Time. They can move backward and forward in their Imaginary Time Dimension as easily as Bradyons go back and forth in our Dimensions, We would experience Tachyons in Real Time.

419. If there is a Gravity Field there must be a difference in Time Curvature since our Gravity points downward the Curvature at our feet is slightly greater than at our head. The higher we go the less Time Curvature. The farther down we go the greater Time Curvature and the slower clocks tick. Up, Time Speeds up and going down, Time slows down. Curvature leads to Singularities where all physical quantities take on Infinite values.

Using Quantum Physics there would be no Singularities at the basic level of Existence.

This fact has to do with the connection of Momentum. (Momentum is a measure of

Matter in motion- a large hunk of Matter moving slowly has large Momentum because of its Mass. A small bit of Matter moving quickly has a large Momentum because of its Speed. In Quantum Physics, Momentum is a primary quality. An object can have a well defined Mass or Speed. It is called the UP Principle when you try to squeeze an object into a Space that is too small i.e., locate it. It will resist the squeeze by making its Momentum more and more uncertain leading to a possession of a large but undefined Momentum to release it from Confinement. In an Atom of Hydrogen with a single Nucleus and a single Electron, the Nucleus exerts a confining Electrical pull on the Electron in its vicinity. Without Quantum Action that Electron would vanish into the Nucleus pulled by the Electrical Force. The closer it gets to the Nucleus the greater is its Uncertainty in Momentum and it quickly moves away. It takes on the appearance of a spherical cloud surrounding the Nucleus. The Electron splits into multiple copies of itself. No copy actually being under the Force that holds it but all copies dealing with Confinement by forming a ghostly cloud. The most probable radial separation for the Electron from the Nucleus Cloud turns out to be just the right distance to counterbalance the Force of Confinement against the Force of Uncertainty. Any closer and the UP would cause the Electron to flee away, any farther and the Electrical Force would pull it closer. “Quantumally” speaking the Electron evades the Nucleus. Classically the Electrical Force grabs the Electron and tends to confine it to a region that would be singular-- or a region of Infinite Curvature and Zero radial separation. But the cloud exists and no such Singularity does.

420. The Dirac Equation is a mathematical expression to explain the behavior of Electrons moving near the Speed of Light. Dirac thinks all Particles move at the Speed of Light following jagged paths through Space. This jitterbugging motion gives the illusion that Matter is moving slower than Light. Every SubAtomic Particle is capable of existing below the threshold of any perception and that an Infinite number of Particles exist at that level. When certain Energies are created one of these Particles can manifest out of nothing leaving behind a Hole. This Hole has properties and appears as the AntiParticles of the Particles that manifest.

Square roots are related to i numbers. The square root of a number (4) is another number (2) that you multiply by itself 2×2 to get the original number (4). The square root of 1 is 1, Square it and you get 1, Take the square root and you get 1, $1 \times 1 = 1$ or $1^2 = 1$.

Negative numbers have square roots. The square root of a number multiplied by itself gives -1. The symbol for the Imaginary number is i , $i \times i = -1$

All numbers multiplied by i are Imaginary $i5 (i5^2) = -25$

Minkowski noticed that if you insert i as a multiplier of the Time symbol in Einstein's equations and you measure all Speeds in relationship to the Speed of Light you can reproduce all of Einstein's relationships and give them a visual Geometric sense.

Thus Time as we know it becomes an Imaginary Dimension of Space. Using i Space and Real Space all of the Einsteinian Relationships can be drawn in the form of triangles.

The Time leg of the triangle was an Imaginary Space Dimension and the Space leg of the triangle would be a Real Space Dimension.

If one holds a pointer, by orienting it so that it points straight up the holder of the pointer is looking at one Dimensional possibility up-down. By holding it so that the pointer points perpendicular to the north wall it makes another Dimensionality north-south. By holding it so it points along the diagonal you take into account more than one of the prescribed Dimensions-up-down, north-south. By swinging the pointer possibilities are continually changing as quickly as the direction of the pointer changes. Putting another observer in the room nearly identical to the first observer and he mimics the movements of the original observer. The parallel observer is observer -2. Each Time Observer-1 points in a direction $|a\rangle$ Observer -2 attempts to point in the same direction but misses the mark and points in a direction $\langle b|$. The direction $|a\rangle$ is called a "ket" and the direction $\langle b|$ is called a "bra" or taken together they make the word bracket and the association of b and a , $\langle b|a\rangle$. This is a fleeting association. This is an association of possibilities a and b . If observer 1 and observer 2 repeat then a pattern emerges where observer 1 points to a and observer 2 points to n . Next, observer 1 points to b and observer 2 points to a or $\langle a|b\rangle \langle b|a\rangle$ and the association is a Reality. It comes into Existence. It is beyond Time. It is a double flow from a past a to a future b and from a future b to a past a . Observer 1 moves the pointer from the past to the present moment in

Time while observer 2 moves the pointer from the future to the present. The double association of a & b is the probability of association of a&b. If a then b when seen from the normal perspective of Time running from past to present--Observer's one's point of view or it can be viewed as the logic Statement if b then a when viewed from the Time-reversed perspective, Observer 2. A meaningful connection can be made between two possibilities. If a & b are identical the probability becomes a certainty and the possibility becomes an actuality. It come into Existence. Existence is the result of a double flow of information. One from the past and one from the future. A thing is said to exist in a State, a given, that it had existed in State b by the product of $\langle alb \rangle \langle bla \rangle$. The product contains 2 factors multiplied together if a then b & if b then a.

421. A Fractal is a shape made of parts similar to the Whole in some way. Or it is a Set for which the Hausdorf-Besicovitch Dimension exceeds the Topological or surface Dimension.

The Fractal Dimensions are Sets of points embedded in Space. The Set of points that make up a line in ordinary Euclidean Space has the Topological Dimension $D_t=1$ and the Hausdorf-Besicovitch Dimension $D=1$. The Euclidean Dimension of Space is $E=3$. (Chaos Theory weakness is that it deals in only 3D. Infinitism (Lewis) deals in 3D+ up to Infinity, i.e., $4 \frac{1}{2}$, $5 \frac{1}{2}$, $8 \frac{3}{4}$ Dimensions, etc. Since $D=D_t$ for the line it is not Fractal. The Set of points that form a surface in $E=3$ Space has the Topological

Dimension $DT=2$, and $D=2$. An ordinary surface is not Fractal independently of how complicated it is. Finally, a ball or sphere has $D=3$, & $D_t=3$. The concept of a distance between points in Space is central to the definition of the Hausdorff-Besicovitch Dimension and therefore of the Fractal Dimensions D . $D=1$ for lines $D=2$ for plane and surfaces $D=3$ for spheres and other Finite volumes, There are Sets for which the Hausdorff-Besicovitch Dimension is noninteger and said to be Fractal.

422. Kaluza-Klein theorization in 5 Dimensions is an act of compactification that produces an Electromagnetic Field in the 5th Dimension (Witten, Alvarez). Chiral Theories possible only in even Dimensions, i.e., 10 but upon compactification Chirality is destroyed in all Dimensions. Exchange Force Particles is the splitting and joining of Strings but at a distance it is the work of a Quantized Force Field. The exchange of Quantum Numbers involve Vector Bosons.
423. Only Vector Bosons are involved in the Forces of Nature because Topologically speaking One Dimensional objects behave like Superstrings. Force then is at short distances, and is seen as Strings that split and join and at larger distances it is the exchange of Vector Bosons the Elementary Particles of a Gauge Field, that turn local Symmetries into Global ones.

424. Closed and Open Strings trace out World surface in SpaceTime. Closed Strings trace out World Tube or cylinder in SpaceTime. Quantum fluctuations cause Superstring or World Tube to fluctuate. Quantum fluctuations change Geometry of World Surface but the Topology of the surface is unchanged. It is Topologically equivalent to a cylinder.
425. A Time Slice through the World Tube appears as a loop being born and disappearing again. Superstring Loops are being created and annihilated out of the SpaceTime around them. The exchange of Closed Loops looks like a Spin 2 Vector Boson or Graviton. Gravitons are continually being born and dying, disappearing into Quantum Vacuum of SpaceTime. Closed loops are a part of the Vacuum. Space and Superstrings must be taken together. Elementary Particles and Quantum Space are unified. Gravity is equal to the other Forces leading to the creation of the Geometry of SpaceTime out of Superstrings. Strings should create their own SpaceTime rather than moving in background Space. The linkage here could be Chaos analysis to connect Real World with Superstring World. In Point Particles Theories, the summation of Feynman Diagrams blows up to Infinity as the distances involved become smaller. In String Theory these distances are never reached or large Energies are absorbed by the vibrations and rotations of the Strings. Other Infinities are solved by the Gravitational Closed Loop. Green and Schwartz's Theory based on $SO(32)$ Symmetry satisfies Chirality, Grand Unified Symmetries, Relativistic Covariance and Quantization nature of Force connection between Gravity, Space and the Quantum Theory.

426. Weak Interaction involves Unification exchange of Intermediate Vector Boson, large Mass with a short range. Hadrons are made out of Quarks. Electromagnetism is unified with Strong Force so Physics in the 1970's did not need Strings, vibrations, Spinning twisting extra-Dimensional extended objects. Particles are characterized by Electrical Charge, Spin and IsoSpin (in abstract Space called IsoSpace or Internal Space i.e., both a physical and mathematical entity.)
427. Partners to the Proton are called Hyperons and Strangeness covered them as a way of characterizing them as Particles. Z mirror reflection of Hyperons is Proton or a mirror in IsoSpace can reflect a Neutron into a Proton and a mirror in Strangeness Space can reflect a Proton into Hyperon. Quantum Chromodynamics directs that 6 Quarks Interacting via the Gluon Force are simply Quarks exchanging Gluons between each other. The Strong Interaction between Hadrons is the Gluon Interaction between Quarks. Quark Interaction leaves out Leptons thus leaving out Lighter Particles-- the Electron, Muon, Tau and their Neutrinos. 6 Leptons were Lighter partners of the Quarks but not unified. There still are Four Forces--Gluons, Electromagnetic and Weak Forces.
428. Local Symmetry is freedom of choice at each point in Space when Symmetry choice at one point is identical to that at every other point it is Global Symmetry. A Field which carries information about certain conventions such as North and South on a compass needle is a Gauge Field. $SU(2) \times U(1)$ is the Symmetry Gauge Field $SU(2) \times U(1)$. The

Symmetry Gauge Field that embraces the Weak Nuclear Force and EM is $(SU(3) \times SU(2)) \times U(1)$. The Electroweak Force contains 4 Massless Vector Bosons carrying the Force, 2 Gauge Particles that have Charge and 2 that do not. One of these Particles resembles the Photon. The resulting Asymmetry of the World is simply the Symmetric Breaking of these Fields at higher to lower Energies.

429. Real Particles break Symmetry of an underlying Law in their lowest Energy States. The Broken Symmetry of the Ground or Vacuum State becomes evident. 2 Gauge Field Vector Bosons were discovered in 1982. Carlo Rubbia verified the W and the Z or W + W and Z⁰ (Neutral Vector Boson).
430. Since Protons, Neutrons and Hadrons are composed of Quarks, the Strong Force becomes the Gauge Force. The Force between the Quarks, the Gluon Force is unified with the Electroweak leaving a single Force, a Gauge Force carried by the Massless Vector Bosons or SU(3) = Gluon Force with $(SU(3) \times U(1))$ the Electroweak Force or $(SU(3) \times (SU(2) \times U(1)))$ and the Standard Model is six Quarks and six Leptons with a Universal Force. When SU(5) breaks to $SU(3) \times SU(2) \times U(1)$ then the Gluon Force breaks SU(3) from Electroweak and then $SU(2) \times U(1)$. However the lack of detection of Proton Decay eliminated the creation of new Massive form paving the way for Unification but changing the Symmetry group to SU(10) didn't help.

431. When Fermions and Bosons could be reflected one into the other and vice-versa, this created Supersymmetry and paved the way to link up the remaining Force of Gravity. It is the local Field that reflects Fermions into Bosons and vice-versa and is the Spin 2 Vector Boson or Gravitons or the Gravitational Field. Gravity becomes a Gauge Field or Super Gravity unites the Weak and Strong Forces and Supersymmetry produces Squarks, Winos, Gluons, Photinos, etc., in their respective mirror States. All this is accomplished in Super Space. The TOE Theory (Theory of Everything) and Superstring Theory incorporating GUT (Grand Unification) and SUSY (Super Symmetry) utilize Topology and Geometry to eliminate Infinities and other anomalies (Michael Green and John Schwarz, 1980).
432. String Theory requires Existence of Gravity whereas Point Particle Theory requires that it does not exist.
433. To create a Superstring correct equations are needed to describe the way a String vibrates. Then ensure the equations conform to Relativity Theory. Then Quantize the equations of a Relativistic String. Ensure Strings are Supersymmetric and relate to the Symmetry Groups of the Elementary Particles and give the Wave Function. Then the

Second Quantification creates a Quantum Field out of the Wave Function solutions producing a Quantum Field Theory. String had to be 10^{-33} cms. to accord with Quantized Gravity Tension of 10^{39} tons. Complete the Relativistic values for the Strings and then replace this description with Quantum operation describing the Wave Function of the String. Use Chirality of the basic Handedness of Nature --Left and Right handed in the final step in Quantification. Any theory dealing with the Weak Interaction of the Electroweak must deal in Handedness or Chirality. The theory has to be Supersymmetric, Quantum consistent, Relativistic and retain Chirality. Compactification of the higher Dimensions leads to improper results of Chirality. Point Particle Theories require 11 Dimensions and compacted to 4 thus producing Chirality. Closed Loop Superstrings produce Fermions and Bosons circling around in opposite directions leaving them equal in importance and the Quantum Numbers were equal to Quantum Particles or Gravitons.

434. Action Sum of Time One and Time $2xPvdt=$ is an integral summing up of the Momentum P and Velocity V of a Particle between some Initial and Final Time computed via the Least Action Principle step. The Action must manifestly be Covariant, i.e., that going from one coordinate system to another its underlying physical form must remain the same. A String is a 2 Dimensional entity including Time or a 1 Dimensional line that enters the 4th Dimension of a line or swept out not as a World Line but World Surface. Relativity demands the surface be minimized because of the Least Action Principle or

the Minimum Surface Principle.

435. Relativistic Symmetry dictates that the basic Action Principle must be Covariant essentially unchanged by Transformation among its coordinates. This Relativistic principle is that Strings correspond to minimal surfaces in SpaceTime, i.e., Massless and moves at the Speed of Light but because the String vibrates and rotates it can have a Mass at a series of Energy levels. Since via $E = MC^2$ these Energy levels have associated Masses. Steps three and four.
436. Gauge Theory was still to be explained, i.e., the way Elementary Particles Interact. Kaluza-Klein Theories had proposed that there were 5 Dimensions, i.e., curling up of 5th Dimension produced 4 Dimensions. The EM Field $SO(32)$ produces the Symmetry necessary to free theory from anomalies containing Gravity and Gauge Fields of Nature. Gauge Fields and Gravity act together to eliminate anomalies. $SO(32)$ Theory (TOE) is free of ghosts, Tachyons, Infinities and anomalies in general. It was Chiral, Supersymmetric and accounted for Forces of Nature. Symmetry pattern of Elementary Point Particles Theories worked if they used Symmetries $SO(32)$ or $E_8 \times E_9$, using open ended Superstrings. Strings are free to break because all sorts of Interactions permit joining, looping and circles. No new Forces are needed by way of explaining Interactions. By adding together all of the possibilities, one can calculate the size of the

Interaction between Strings. Each String has a Quantum Number identifying it as a String. Split Strings' Quantum Numbers change. From a distance Strings look like points and Quantum Numbers are being exchanged between Particles.

437. Heterotic Strings. Two Waves of Quantum numbers can travel around a Closed Loop at once in opposite direction without mixing. Therefore they can be separate, creating a String in both 10D and 26D or the combination of 2 or more different Dimensions. The Boson Field requires 16 extra coordinates when the 10 Dimensional Fields are compressed. The 16 Bosonic Dimensions can account for the Gluon and Electron with Gauge Field. Interactions are hidden in the Strings as it moves in 10D Space. A Heterotic String combines a 10D Fermionic Field moving right to a 26D Field, moving left, 16 of which are a Bosonic Field generating the Electroweak and Gluons or 4D moving to the right including 6 quasi D's then moving to the left-- 22 extra D's.
438. Two points that lie close to each other as long as they don't touch, or different numbers can be assigned to them and one of them is further away from an end point of a line than the other; then there is always a third point that can be found between them. Between any 2 numbers there can always be found a third number greater than the smaller of the two and less than the larger. Another point can always be found in between the points for a point takes up no Space itself. Or 2 points represented by a different number cannot be

the same point. Therefore there is an Infinity of points on a line since you can always find a point between any two points.

439. Infinity can be generated from 2 provided the 2 is a feedback loop, a self-consistent reference, a self-reference totally consistent with itself. Infinity being one more than now. There is always an inbetweeness and therefore Infinity is Real. Reflection--Parallel Realities are Infinite reflections of any one Reality. Self-reference--a self-consistent referral generates from Parallel Universes, a single Universe. In between any 2 Universes there will always be a third result present.
440. Imaginary Time Particles do not experience Time the way we do. We experience Real Time which in Relativity is the same as Imaginary Space since Imaginary Space is Real Time, Imaginary Time must be experienced in Real Space. A Tachyon can move in Imaginary Time just as Braydons move in Real Space.
441. An object moving at a constant velocity is the line representing the movement of the object going from the top to the bottom of a page and corresponds to the object moving through Time but going nowhere in Space--an object at rest. If the line making the object is drawn diagonally across the page, the object is moving Linearly through both Space and Time. This is an object traveling with constant velocity. But drawing a curved line

442.

on the paper, the Geodesic, the line corresponding to an object undergoing acceleration and acceleration is equal to Gravity and the Curvature of the line is equivalent to acceleration; then Curvature is equivalent to Gravity according to Relativity Theory. Gravity is Curvature of Space in both Space and Time. Gravity can be related to a Time Warp, a distortion in the movement of Time as one moves from a higher to a lower room in a building. Measuring the difference in Time between 2 locations is called the Gravitational Red Shift.

443. Spinning Black Holes have two Event Horizons--outer and inner. The outer is the same for a Non-Spinning Black Hole. The inner is a reversal of the outer thus avoiding Singularity. In the Singularity in Negative Space, Gravity reverses and becomes repellent instead of attractive and negative Space ejects Matter. Kerr's equation solves the rotating Black Hole and indicated the Existence of an Infinite number of Parallel Universes all connected with the Spin of the Hole. A Singularity is when Space shrinks to a Zero radius with Infinite Curvature. Our Universe may contain an Infinite number of Singularities at the smallest Quantum level of SpaceTime Matter. SpaceTime is continually fluctuating creating momentary Bubbles of Matter which quickly vanish into Nothingness.

444. Hawking believes there was no Singular behavior at the Time of the Big Bang. Although an Infinite number of Bangs occurred they followed the Laws of Quantum Physics

without the presence of an observer and appeared in Parallel Universes. Equilibrium between the Forces of the UP and the Forces of Attraction existing between all Particles of Matter (Gravitino-Weak-Electromagnetic-Strong) were all one Force. Weak Forces are responsible for a certain type of Particle emission such as the Decay of a Neutron into a Proton, an Electron and an Anti-Neutrino. Strong Forces hold the Nuclear Particles inside the Nucleus to each other. The Big Bang had a similar structure like that of an Atom or like a Black Hole Structure. Atoms exist with unique Energies called Energy States. Their Structure follows the Laws of Quantum Physics or unique Quantum States analogous to the Quantum State that exists in the Hydrogen Atom. There is a State of lowest Energy--a Ground State.

445. All possible futures act on the present. With an Infinite number of Parallel Universes one big continuum stretching from the Infinite past or 15 billion years ago to the Infinite future the effects of observations propagate in both directions through Time to the past and the futures. If the future communicates with the present and the present communicates with the past Time is not fixed.
446. Electrons are point sized Particles possessing Spin, and may be Black Holes leading to Parallel Universes.

447. There is the possibility that our Universe is a Black Hole. The factors that define a Black Hole are M, Mass, R, Radius, D Density. The radius of a Black Hole is directly proportional to its Mass ($R \propto M$). The Density of a Black Hole is $D = M/V$.
448. The volume of a Black Hole is proportional to the radius of the Black Hole to the power of $(V \propto R^3)$. The Density of a Black Hole is inversely proportional to its Mass raised to the second power, $(D \propto M^{-2})$ meaning if a Black Hole has a lot of Mass it doesn't appear very dense. Our Universe is not very dense being made up mostly of Space. But there is a lot of Mass in it and therefore could be a Black Hole being Massive but not dense.
449. Chaos means bizarre form of Order. Time's Arrow is equivalent to the Second Law of Thermodynamics. Deterministic Chaos is predictable Randomness. Dynamical Chaos arises in the simplest equation based on probabilities. Newton's Deterministic cause and effect is based on Initial Conditions. No difference between past, present and future (also Einstein). Poincare's Theorem is that given a long enough period of Time any isolated System will return to its Initial State in an unlimited amount of Time and it will do so indefinitely. (The Theory of the Eternal Recurrence). The Universe will repeat many Times 10^{10} years (the age of the Universe).
450. Heisenberg's Uncertainty Principle (UP) has implications for Time. There is a limitation to the accuracy with which we can measure Energy in a given unit of Time.

(Refer to the experiment on the solution of the EPR Paradox, that there is a faster than Light connection between distant regions of SpaceTime. (1982, Alain, Aspect Institute D'Optique Theorique at Applique in Paris). It is shown that Action can take place at great distances without Deterministic connections but only Quantum connections where two Quantum Particles in widely separated part of the Universe constitutes a single physical entity.

451. Irreversibility of Wave Function collapse implies an Arrow of Time. In Quantum Theory Time stands still under continuous observation but since only in idealized Universe could we either have Discontinuous or Continuous observation Quantum Theory is either wrong or incomplete. Parallel Universe also helps explain the collapse of the Wave Function presenting an Infinite number of Universes that the Wave Function has to choose from and upon moment of observation only one parallel Universe is chosen.
452. CPT Theorem is the mathematical form of the Microscopic Laws of Physics. There is a Symmetry of these Laws which remain Invariant or unchanged in any Process where Particles are swapped with AntiParticles. The Process being exchanged with its mirror image and the direction of Time being reversed (Luders & Pauli, 1955). Symmetry is tested by the combined sequence of these abstract operations. C-Charge Conjugation, whereby Matter is converted to AntiMatter. P, Parity inversion-converting spatial coordinates into their mirror images. T, Time reversal which reverses the direction of Time, CPT Theorem predicts equal but opposite events in a mirror image World and how

Symmetry may be broken to give an Arrow of Time. The only exception in Microscopic Physics is the long-lived Kaon (K^0). Kaons form a negative Pion, a Positron and a Neutrino. Yet 1 in 1,000 million Decay into positive Pion, an Electron and Antineutrino CPT is violated and the Process is Irreversible.

(What is the relationship of Entropy to Microscopic World? Is there a relationship?)

453. Heisenberg's Principle states that there is a limitation to the accuracy with which we can measure Energy within a given interval of Time. A precise measurement of Atomic Energy in a particular Quantum State can only be performed at the expense of considerable Uncertainty over the Time it spends in that State violating the Conservation of Energy Laws.
454. The shorter the interval of Time considered the more Uncertainty there will be in the Energy and Energy may be borrowed at no cost from nowhere (Virtual Particles).
455. Even Vacuum States contain random Quantum fluctuations or Quantized Energy.
456. Renormalization methods cancel out Infinities just like the Sum of Histories method does using mathematical Infinities to cancel out other Infinities.
457. Prigogine & Glansderf--local Equilibrium or approximation makes Systems far from Equilibrium look and behave locally as a patch work of Equilibrium Systems or like curved SpaceTime in General Relativity consisting of local regions of flat SpaceTime stitched together (Cohomology).

458. Steady States are when far from Equilibrium becomes Unstable. At the crisis point the Bifurcation point of the System leaves the Steady State and evolves into some other State. Beyond the crisis point one has highly organized behavior in Time and Space. These States are no longer associated with minimal internal Entropy production. Thermodynamic Systems pushed to a stable State a little ways from Equilibrium will minimize the production of Entropy. Far from Equilibrium there will be more choice available. Although Global Entropy increases orderly behavior still exists.

Thus the Arrow of Time does not necessarily mean Degeneration into Randomness. A System can only be held away from Equilibrium if it is Prigogine & Glansdorf Local Equilibrium. Approximation makes Systems far from Equilibrium also behave locally as a patchwork of Equilibrium Systems or like curved SpaceTime in General Relativity consisting of Local Regions of flat SpaceTime stitched together (Cohomology). Steady States when far from Equilibrium become Unstable. At the crisis point, the Bifurcation Point, the System leaves the Steady State and evolves into some other State. Beyond the crisis point one can have highly organized behavior in Time and Space and these States are no longer associated with minimal internal Entropy production. Thermodynamic Systems pushed to a stable State a little away from Equilibrium will minimize the production of Entropy. Far from Equilibrium there will be more choices available. Although Global Entropy increases, orderly behavior still exists.

A System can only be held away from Equilibrium if it is open to its environment. The Entropy produced by the System is then exported to the surroundings thereby permitting the maintenance or organization while allowing an overall increase in the Entropy of the System and the environment. There is only the possibility of a Thermodynamic crisis occurring not its inevitability. Far from Equilibrium there is in general no Thermodynamic potential, no single Attractor, which can act as the target for the Arrow of Time, i.e., Irreversibility, i.e., lack of Universality.

At the point of crisis, there can arise so much choice at point of Bifurcation, choice of Stable States that very Unpredictable dynamical behavior occurs such as Limit Cycles, i.e., Deterministic Chaos or where a whole succession of further crisis points appear beyond the primary one.

Dissipative structures which result from the exchange of Matter and Energy between Systems and environment together form the production of Entropy (dissipation) by the System and the mutually dependent Processes are called Self-Organization.

Spontaneous creation of Matter is not forbidden by Thermodynamics. Irreversible non-Equilibrium Thermodynamics creates spontaneous self-organization leading to the structures of our Universe. Deterministic Chaos is when precise Laws lead to apparent random behavior which is actually minutely organized. Time Asymmetric Differential

and Partial Differential Equations give birth to both order and Chaos via Non-Linearity in Space, in Time, in SpaceTime, via Non-Linearity providing that Time is Continuous and not discrete moments or Discontinuous.

459. Unlike Limit Cycles and Fixed Point Attractors, the Strange Attractor or Chaotic Attractor depends on its Initial Conditions and it is a Fractal Object. Regardless of how much a Strange Attractor is magnified it contains the same structure of the Attractor, i.e., showing a motif within a motif and is a self-similarity motif mirrored at every scale length or is Invariant under scaling. The form of the pattern is the same no Matter on what scale the object is viewed. Koch Curve successively reduced triangles have a Dimension between one-Dimensional Euclidean line and 2 Dimensional plane or 1.2818 Fractal Dimensions. Fractals of Nature's clouds, etc. are similar because the large-scale features of their growth can be generated by repeatedly iterating a simple mathematical rule. A System restricted to a Finite region, the Strange Attractor, can generate unlimited opportunity and is Unpredictable Dissipative Chaos and is nested in the Strange Attractor.

The Strange Attractor has a trajectory that alters constantly with the passage of Time leading to a completely different motion on the Attractor--a different path through the Fractals' Infinite patterns within patterns.

460. Non-prediction is amplified exponentially as Time passes. However, Deterministic Chaos results from Non-Linear Dynamical Equations or is generated within a System as distinguished from Stochastic Fluctuations in the external environment. Such Stochastic Processes can generate random Chaotic behavior not trapped by a Strange Attractor.
461. The minimum number of Non-Linear Differentiated Equations needed for a Strange Attractor is 3 coupled equations. Strange Attractors for Chaos can be generated from oscillating State rules by periodic Limit Cycles or from Time Independent Steady States of Fixed Point Attractors. Ruelle Takens path is where Chaos requires a System to be driven through 3 or more Limit Cycle Bifurcations on its way to Chaos or a quasi-periodic route.
462. From Limit Cycles, 2 more ways are possible leading to Subharmonic Cascades and Intermittency. Subharmonic (Feigenbaum) Cascade or Period Doubling until it Bifurcates an Infinite number of times so the period is Infinite and the clock never repeats. It enters the Strange Attractor where it will never trail the same path twice (Chaos) or the Limit Period Doubling. For any system in inanimate Nature in which Chaos emerges from Period Doubling sequence similar numerical scaling features are present the Cascade is universal. The higher the Fractal Dimension the more random the Deterministic Chaos. Continuous causes produce Discontinuous effects. In Phase Space making a diagram of a single billiard ball moving in a box we must state its position or

3 coordinates x , y and z , left, right, up, down, backwards and forwards, i.e., 3D Phase Space is the Real World and velocity by 3 components along 3 mutually perpendicular directions or 6 coordinates for 2 ball, 12 coordinates for 3, 18 coordinates for 4. For N balls there will be $6N$, position plus Velocity coordinates. The $6N$ Dimensions make up the Phase Space of N Balls and can be described by a single point on the n -D Dimensional Phase Space. Or a representation of 1,000,000 Molecules by a single point in 6 million Dimensional Phase Space is more descriptive than a representation of 1,000,000 points in 3D Space. As the balls bounce they trace out a trajectory or path in Phase Space. The latter being described by the traditional Differential and Integral Calculus of Loops and Eternal Returns with no Arrow of Time. Ergodic Systems are of the former variety with any given Molecule the Phase Space is able to explore any position in that Phase Space given enough Time, i.e., random motion instead of Deterministic Classical Newtonian Motion.

The only constraint on the System is its total Energy, which remains constant in isolated Systems. If the System is left to itself in the actual State of motion it will pass through every Phase or place which is consistent with the Equation of Energy. Classical patterns like the pendulum and cycles are integrable and Ergodic Systems and are not Birkhoff, Hopf, Von Neumann, Halmos, Khinchine, Kolmogorov, Anosov, Arnold and Sinai-- where in Ergodic Systems simple and complex behavior appear at the same Time. Some of the Ergodic systems run into Chaos enough to Equilibrium. In Ergodic Phase Space

no Matter how much we know about the Initial conditions of a point at its inception after a certain length of Time, 2 points diverge from each other exponentially. Therefore prediction is impossible for the State of any given point or system in Phase Space in the Future and only Probability Mechanics is an effective predictor and can be formulated for end results.

463. K-Flows are the limit of total Unpredictability and even an Infinite number of prior measurements cannot predict the outcome of the next one unless the prior measurements were of Infinite accuracy. These flows are intrinsically random mimicking Stochastic Noise Systems. The properties of K-Flows apply to 2 or more objects but over a short period of Time the local effects of friction, etc. would have to be absent to witness this Unpredictability. KAM Theorem--Complex Systems can display simple Timeless behavior in parts of Phase Space and complex random behavior in other parts giving rise to an Arrow of Time Irreversibility, Reversibility and Equilibrium at the same Time. The exception being at the Macroscopic level with large bodies of Molecules where all regularity of periodic behavior is drowned out. Ergodicity, Instability and Irreversibility reign supreme. Thus in Particle Physics Chaos and Equilibrium reign side by side explaining the anomalies in Particle Physics.

464. Thermodynamics Process divides into 2 parts in a given system called Sub-Dynamics. The long-range and the short-range. The short-range depends on the Initial conditions.

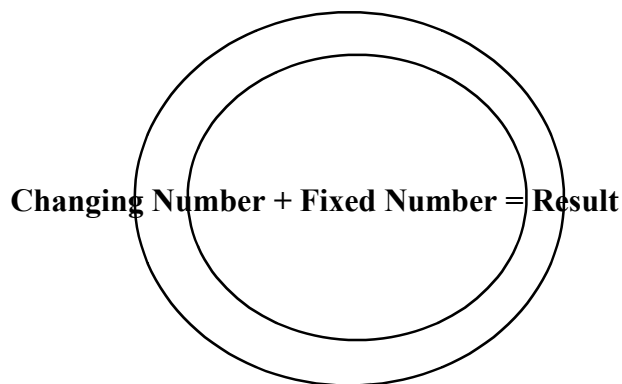
The long-range breaks off the short-range at some point and heads for Irreversible Equilibrium. Equilibrium under the Arrow of Time obeys the Microscopic Kinetics in General Time-Asymmetric Kinetic Equation.

465. Solving Linear Equations is a Matter of plugging in quantities and calculating the equation's terms to a result. Nonlinear Equations must be solved by iterating, or recycling the end result of the equation to see whether Processing the equation pushes that end value toward a Stable number, periodically returning number, or a number that fluctuates randomly. This suggests that the cause and effect Processes of Nature described by Nonlinear Equations themselves involve some kind of dynamic recycling that leads to Stability, Periodicity, or Chaos. If you solve a Linear Equation with one starting value and then solve it again with a closely related starting value, the end results of the two calculations will remain close to each other. If you plug similar values into a Non-Linear Equation, the results of the two calculations might be close or they might be far apart. A Linear Equation will behave the same way almost no matter what values are plugged into it. A Non-Linear Equation is sensitive to its starting conditions. With a Linear Equation, when you've solved for one value, you have a good idea of how the equation will behave when you solve for any value. With a Non-Linear Equation there is no such assurance.

466. Before Chaos Theory, unable to solve Non-Linear Equations, scientists Linearized them. Linearizing means throwing away awkward terms in the Non-Linear Equation (the terms that involve feedback) and using instead a series of approximations to model the Process at hand, i.e., Perturbation Theory.
467. Mandelbrot discovered that by using Nonlinear Equations, the feedback of iteration that produces a Fractal can bend straight lines into curves and swirls and make self-similarity at different scales variously deformed and Unpredictable or statistically self-similar. The Mandelbrot Set is an example of a Non-Linear Fractal, though it exists in a purely mathematical Realm it creates a coastline of Infinite self-similar intricacy.
468. A third type of Fractal introduces a random element to the iteration. By randomly changing the size and shape and size of the triangles as they are iterated inside of triangles, the irregularity of Nature can be imitated. But whether the Fractal is Classical (Linear), Non-Linear, or random, the complex way it fills Space establishes it as an object between Dimensions.
469. Simply put, the Fractal Dimension indicates the degree of detail or crinkliness in the object, how much it occupies the Space between the Euclidean Dimensions. The rugged

Coastline of Britain is a line crumpled up enough to partially fill a plane, similar to the Koch Island curve 1.25 to 1.2618 or a quarter of the way between a line and a plane. For example: if you have a piece of paper as a plane in 2 Dimensions and then wad it up. The resulting object is neither a plane nor a sphere, but something folded in between the Second and Third Dimension. As calculated by Fractal geometry, this wad of paper has a Fractal Dimension of about 2.5.

470. A simple way to view the operation of an iterative equation is by starting with one of the numbers on the complex plane and put its number in the fixed number slot of the equation. In the changing number slot put 0. Now calculate the equation. Take the result and slip it into the changing number slot. Repeat the whole operation again or recalculate or iterate the equation. Does it hover around a fixed value, does it spiral towards Infinity quickly or does it go upward by a slower expansion?



Starting with the value of a point (or pixel) and applying the equation to it, iterate the equation perhaps 1,000 times. If the result remains Stable color the pixel black. If the number heads at one Speed or another to Infinity, paint it a different color, assigning colors for each rate of movement the Fractal explorer decides. Moving on to the next pixel and do the same thing until all the pixels on the screen have been colored. When all the pixels or points representing complex numbers have been iterated by the equation a pattern emerges. One pattern is a Stable point pattern on the complex plane or the Mandelbrot Set. which is usually black surrounded by a boundary of detail that include miniature, lightly distorted replicas of the Stable shape with layer upon layer of self-similar forms. The Boundary Area of the Set is Infinitely complex and therefore Fractal because you can bring out finer and finer detail by zooming in on the Set's Boundary or magnifying it.

On the Real number line we routinely imagine that between the numbers 1 and 2 are other numbers 1.5, for example, or 1.6. Between those numbers are still more numbers, 1.53 and 1.54, etc. The same is true for numbers on the complex plane. These numbers between numbers allows us to use the computer like a microscope diving into increasingly deeper detail. In addition, different styles of iterative equations can act as prisms to display varying facets of the behavior of the complex numbers around the Set. This region is a mathematical Strange Attractor, it is self-similar at many scales, is

Infinitely detailed, and attracts points (numbers) to certain recurrent behavior giving Clues to the behavior of Non-Linear (Chaotic) Dynamics of Real systems.

471. Hubbard's Theorem The Mandelbrot Set leads to a Holistic Theorem, i.e., that all mini-Mandelbrot figures folded into the Boundary are mathematically connected.
472. A Chaotic System constantly mixes things up, creating new directions in which the System can go. These moments of possibility are called Bifurcation Points by Chaologists. At some Bifurcation Points just the right concentration of a chemical or flux of heat or timing of an Electrical impulse can amplify through the System's feedback. The phases or frequencies of the feedback become locked together and a structure emerges.
473. Especially long-lasting forms of Phase-Locked feedback are called Solitons. Soliton Waves are created when a Wave's nature tendency to disperse is exactly compensated for by some critical factor, i.e., the intensity of the Light pulse and the size of the optic fiber. The Soliton is in a semi-permanent Phase Locking State. The Phases of the Elements in a Soliton Wave are so synchronized that two Soliton Waves that collide at angles or from opposite directions will pass through each other, emerging on the other side as if no collision whatsoever had taken place. The Soliton, like other self-organized structures,

breed and thrive in the dynamic World that flourishes on the sharp and delicate edge of dissolution.

474. Change one part of a System and the Whole is changed. Non-Linear Systems and many Dynamical Systems and all Chaotic Systems are extremely sensitive to small changes, because the feedback among their inextricable parts can amplify small changes into large results.
475. There are two different types of feedback. Negative feedback is the type that keep things in check. Positive feedback pushes a System to explode or spiral out of control. It is where new forms come into being and there is a structure making Dimension to positive feedback.
476. Positive feedback can cause complex and even Chaotic behavior inside Orderly Systems to unfold and that negative feedback can grow inside an otherwise Chaotic System, suddenly organizing it and making it Stable (a Soliton like Action). Feedback then is the key element in transitions from Chaos to Order and from Order to Chaos.
477. The Julia Set is actually a mathematical construct in a thicket of numbers called the Complex Number Plane. To find the Fractal outline of the Julia Set all the pixels are like points marked at the intersections of the lines on a graph paper. The computer tests each

point (number) in the area of the complex plane by applying an iterative equation to it and recording how fast the value expands. If the value remains Stable it gets assigned a color (black); if the value soars quickly to Infinity it gets another color; if it lifts upward at slower rates it gets a different color for each rate. The best behaved pixels or points or colors are the most Stable points, expanding at approximately the same rate in the Julia Set.

478. When a special kind of plot, known as a Phase-Space Plot, is made at intervals, instead of mapping out the neatly circular patterns characteristic of a regular, periodic rhythm, the pattern takes on the characteristics of a Strange Attractor. Strange Attractors are Fractal patterns made by a Dynamical System exhibiting Chaos.
479. Kolmogorov's Theorem. The orderly movement of a planet in orbit can be depicted as a line that winds around the surface of a Torus, repeating the same path but shifted slightly with each circuit. But to measure this System as it breaks down, disintegrates, comes apart or fluctuates Unpredictably and Transforms themselves takes a Chaotic Analysis. The K. Theorem showed that there was Chaos occurring in some orbits as a result of Friction and Resonance Set up by the combined effects of the motions of other nearby objects. The mathematics of the Kolmogorov's Theorem can be plotted out as a Torus by cutting it open and providing you with a visual picture of the Chaos that occurs when you take into account several contending motions.

480. The Vague Attractor is the Kolmogorov Attractor (VAK). The VAK Torus shows that the Chaotic orbits exhibit some regular motion indicated by arrows winding around the Torus. Orbits of regular Systems are attracted to smooth shaped Tori and make abstract portraits of their Orderly behavior. The Movements of Chaotic Systems are attracted to Strange shapes but they have an overall predictable form, but it is a form made of Unpredictable details. By using equations to follow one or more of the variables of a Chaotic System as it changes and moves you can plot the Strange Attractor that portrays the System's activity. To create these Strange Attractors the equations are calculated to an output and then the output becomes the input as the equation is calculated again and mimics the kind of accelerating, amplifying feedback that goes on in Real Chaotic Systems.
481. The Rosseler Strange Attractor can be found in volcanic eruptions and the plot of the Belousov-Zhabotinski chemical reaction. The Chaotic bonding of the Chemical Reagents self-organize to create highly structured spiral-like forms. The Rosseler Attractor plots the transition from Order to Chaos and the transition from Chaos to Order.
482. The Ueda Strange Attractor. This is a Chaotic Torus where it is continually folding in on itself. The Ueda Attractor shows up when plots are made of the equations that model Dynamical Systems such as the oscillation of an Electromagnetic Field within a ring-shaped cavity. Magnifying a small-scale portion inside a Strange Attractor reveals

shapes similar to those seen on a larger scale. Because of the self-similar way they fill Space, Strange Attractors are Fractal. They are fingerprints of the Chaotic Dynamical Systems they plot. The Ueda Attractor resembles the symbol of the Yin/Yang (Symbol for change).

483. Lorentz Strange Attractor. Lorentz has several variables describing the movement of a Weather System. Very small differences in the Initial data would make very large differences in a long range forecast, By iterating equations of the model he ended up with the Butterfly Wing plot which is a Fractal portrait of the Unpredictability he had found in the Weather. The repeated folding of the system onto itself or the continuous Interaction of variables such as temperature and pressure is represented by the fold between the two eyes of the Attractor. The recurring shapes that circle around the eyeholes indicate that the Weather is Unpredictable but self-similar; high and low-pressure gradients, temperature variations, and other factors exist on every scale, from global weather patterns to local variations between the front and back yards of your house. Strange Attractors like this depict a System whose behavior never repeats itself and is always Unpredictable and yet always resembles itself and Infinitely recognizable. Strange Attractors then are portraits of Order in Chaos.

484. Period Doubling Attractor As some value is increased another value decreases. Then it period doubles and period doubles again into Chaos.

485. Newton's Method Fractal Mathematics is a shortcut for finding roots of Polynomial Equations (an equation with several terms) Starting with a guess at a root's value, plug in the guess into the method's formula and iterate it, watching as each iterative loop of the method changes the guess so that it gets closer and closer, converging toward some fixed number which is one of the polynomial's roots.

If the starting guess happened to be a value that lies on the Boundary Region between roots, then Newton's method turns into Chaos. By plotting the different starting guesses and coloring them according to whether iterating them makes the result converge toward one of the roots, fly off into Infinity, or lie in the Boundary Area; one can obtain a Fractal Picture.

486. Geometry of Physics and Astronomy Combined. Equations such $E=MC^2$ will operate in a Newtonian Universe as $E=MC^2$. However, when accelerated the formulae tend to operate under Fractional-Fractal mathematics, i.e., Einstein's Relativistic SpaceTime configurations when the operative accelerator is moving away from the Geodesic effects operate in a free fall or a Quantum Field Equation. With further departure or acceleration from the Quantum Geodesic i.e., the expanding or contracting paths tend to operate in either Newtonian Classical modes or they operate in some combinatorial of all these modes—Newtonian-Classical, Relativistic-Quantum and the Fractional-Fractal Infinite. (Lewis, "Fractometry" or Interface Mechanics).

THE METAPHYSICIAN PART 4- CHAPTER 44

SETTING THE COSMOLOGICAL RECORD STRAIGHT.

THE SPEED OF DARKNESS EQUATIONS

THE STRUCTURAL POLTERGEISTS OF THE UNIVERSE(S)

GRAVITY'S DARK SIDE

INTERFACE MECHANICS

(BOUNDARY MECHANICS: TRANSITIONAL MECHANICS)

GRAND UNIFICATION-DEUNIFICATION

$${}_F E_f = \& \neq {}_F M_f {}_F C_f^{2f} !$$

(LOCAL---SyM - Gravity, G, Interaction not completed)

$$qp_F E_f = \& \neq qp_F M_f qp_F C_f = \& \neq < \pm qp_F G_f > !$$

(GENERAL--aSyM - Gravity Interaction completed before Disengagement)

SUMMARY

On the eve of the acceptance of E-8 Symmetry, i.e., complete Symmetry as the final pathway leading to the destination of Unification for the Field Forces, the Electro-Weak, the Electromagnetic and the Gravitational; I thought it would be prudent to put forward an alternative approach to the problem that has dogged Cosmology for the past one hundred and ten years. It is not surprising that mistakes were made because Reductionism was relied upon even up to and including E-8 Theory. We still, in the first decade of this Century, are plagued by the addiction to Symmetry in a universe that is structurally and ontologically speaking (in the Philosophy of Science's use of those terms) predominately Asymmetrical in its construction.

In the domain of the Philosophy of Science there is a need to tie up the loose ends that have been unraveling with respect to the revolutions in Quantum Mechanics, Lattice Mechanics (E-8), Interface Mechanics (Fractal-Fractional Mechanics) and attempts to link up those theories with the Theory of Relativity via the God Particle (Higgs) Gravitational Unification pursuit.

Equations such as $E=MC^2$ will operate in a Newtonian Universe as $E=MC^2$. However, when acceleration enters the picture the formulae tend to operate under Fractional-Fractal Mathematics. Einstein's Relativistic SpaceTime configurations, when the operative accelerator is moving away from the Geodesic effects of Tensor considerations, operate in free-fall Quantum Field Equations. With a further departure (de-acceleration) or acceleration from the Quantum Geodesic, i.e., the expanding or contracting paths tend to operate in either Newtonian Classical modes or they function in some combinatorial plasma of the best of these modes—Newtonian-Classical, Relativistic-Quantum and the Fractional-Fractal Infinite that hereafter will be known as Fractometry or Interface Mechanics.

With the inevitable fall of C (Charge Conjugation-Symmetry) P (Parity – Left-Right Polarized Orientations, Chirality – A- Chirality Symmetry) and T (Time Symmetry Perturbations) or CPT violations, with the inevitable demise of Light Speeds as the ultimate arbiter of velocity (i.e., that Light is the ultimate vectorized speed obtainable by material bodies in a vacuum) with the fall of Euclidean and Non Euclidean 3-D Integer Structures and with the less than complete Super Symmetry, Superstring, Manifold-Torus Theories; all of those breakdowns of Reductionism indicate that the pathway to Unification leads only to “DeUnification”. The search for Perfect Symmetry and ultimately the Reductionist Program itself is doomed to failure without the incorporation of the Asymmetric properties of the universe.

One of most remarkable Discontinuities (Asymmetries) in the universe is the Speed of Darkness (S.O.D.) Discontinuity that occurs not only in deep space but throughout the visible “accelerative-deaccelerative” universe at large. It is important to note that Darkness (Darkons—not to be completely absorbed under Advanced Thermodynamic Dark – Hot- Cold - Energy Theory) outnumber Lightons (Photons) by almost 60% to 80% in the visible spectrums of the Universe. Eighty percent of the Universe is not illuminated. It is that way because Darkons have a greater influence or range of importance than do the Lightons or Photonic permeable structures in the ontological fabric of the universe. What then are the structures, velocities and angles of secular orientation of the Darkons (D)?

Taking a closer look at Darkons, we find that when Light comes into contact with D, Light becomes Realigned. That is to say, that Light does not bend in a Gravitational Field, nor does it curve progressively (Parallax configurations) or retroactively but it goes through a process of Realignment in Darkness. This Realignment of Light by Gravitational Forces is the “Velcrolization” of Gravity’s main components—the Gravitons. Contraction and expansion are merely expressions of a cosmic concave-convex polarization Realignments and depends upon the “accelerative” or “deaccelerative” features of Pure Lightness and the medium of Darkness into which that Light source swims. It will be the “deaccelerative” properties of Darkness that will produce an unstable Unification.

Light then does not bend in Gravitational Fields but instead Darkness contracts “convexly” and expands “concavely” within a certain Parallax nexus zone. More succinctly expressed, Darkons overrule Photons when they interact in Photonic Fields. Gravity is the equivalent of Polarized Darkness and the interaction with the Photonic Fields of Action takes place via the medium of sub-nano connective tissues between the super-microscopic, microscopic, macroscopic and super macroscopic worlds by the Discontinuous use of Fractal-Fractionalized Basin Boundaries in deep space. Different degrees of darkness permeates the trans-natural viscosity of the transitional Barrier Boundaries between the false vacuum (aligned) dichotomies of physical phenomenon. This perspective explains how stability can be generated between the interaction of the instabilities of quantum micro and sub-micro world down to and below the Planck considerations (now known as the Lewis Level) and the classically stable macro physical world of Epistemological (Observational) Empiricism.

In Particle Physics for instance, the Gluons or “Gluonic” activity necessitates the realization that the Gluonic Forces cannot be rent asunder because of the inflexible Velcro quilt like adhesive structure, despite the homing synchronization tendencies of Gluons that are perfectly aligned (Infrared Slavery). Only when the “Grappleonic” like hooks of the Gluons become misaligned can they be severed each from their fractalized-fractionalized mates. The “Grappleons” of Gluons are like the tendrils of the Grappleons (secular orientations). Gravitons (Grappleons) will provide the alignments necessary for Unification-DeUnification. It should now be apparent when important and significant Discontinuities in Nature have been described, we can readily see that Classical Physics applies to the reality of the senses and macro world of molecules. Quantum Physics applies to the microscopic world of the atoms (and of course the super macroscopic world of the cosmos) and of the nucleus. Infinitism and Chaos applies to the subatomic, sub-nano, nuclear and sub-nuclear world as well as the Super-macro world of astronomical distances, spaces, events and lie for the most part within the confines of Darkness. Therefore the macro world of basic reality is Existential, Psychological, Classical, Chiralized and Symmetrized. The micro world of the atom and molecules is Symmetrized, Phenomenological and “Quantumized”. The super-microscopic world of the nucleus is positively Quantumized, Negatively Quantumized and “Infinitized”. The super-macro world is negatively Quantumized, “A-Symmetrized”, Infinitized and A-Chiralized. The following conjectured equations are based on the first 313 Axioms of Symmetry and the 182 Axioms of Asymmetry and these equations (as Keats almost said over two centuries ago). These Equations are all “Ye” can know on Earth and that is all “Ye” need to know!

THE FIRST TWO SPEED OF DARKNESS EQUATIONS

$${}_F E_f = \& \neq {}_F M_f {}_F C_f^{2f} !$$

(LOCAL---SyM - Gravity, G, Interaction not completed)

$$qp_F E_f = \& \neq qp_F M_f qp_F C_f^{2f \rightarrow F^\infty f} = \& \neq \langle \pm qp_F G_f \rangle^{2f \rightarrow F^\infty f} !$$

(GENERAL--aSyM - Gravity Interaction completed before Disengagement)

THE STANDARD EQUATION OF STATE FOR THE UNIVERSE

IN THE 20TH CENTURY WAS:

$$\begin{aligned}
 S = S_d \sqrt{g} [1/G^R \\
 + 1/g F^2 + \square/\square \\
 + (D) \delta^2 + v(\delta) \\
 + \square \square] \\
 R
 \end{aligned}$$

Where $1/G^R$ represents Gravity

And

$1/g F^2$ represents the other three Interactions.

THE NEW STANDARD EQUATION OF STATE FOR THE 21ST CENTURY IS:

The first Expansion of the Four Dimensional Formula F (where F = Fractionalized Processes and f = Fractalized Processes) is ${}_{FF}E =$ and does not $\neq {}_{FF}M_{FF}C^2$, where of course ${}_{FF}E$ = the Fractionalized Fractal Energy during the initial stages of Energy Expansion or Contraction (acceleration-de-acceleration) and is in a direct relationship to $(:)$ ${}_{FF}T1$ (Fractionalized Fractal Time Past) ${}_{FF}T2$ (Fractionalized Fractal Time Present) ${}_{FF}T3$ (Fractionalized Fractal Time Future). Where ${}_{FF}D1$ (Fractionalized Fractal Distance “transversed” Past) ${}_{FF}D2$ (Fractionalized Fractal Distance transversed in the Present) ${}_{FF}D3$ (Fractionalized Fractal Distance transversed in the Future) in conjunction with the ${}_{FF}I/m$ (Fractionalized Fractal Interaction Modification) ${}_{FF}W_{FF}S_{FF}S_{FF}(+,-)G$ (the Fractionalized Fractal Electromagnetic, the Fractionalized Fractal Weak, the Fractionalized Fractal Strong, the Fractionalized Fractal Superweak and The Fractionalized Fractal Gravity + or minus Forces ((Anti-Gravity and Gravity)) where m’s (modified) Interactions across the ST_{FF} Gap Fractionalized Fractal Spacetime Coordinates are equal to (=) & not equal to \neq the Interaction Modification producing Fractionalized Fractal Mass ${}_{FF}M$ in its direct relationship to those same parameters of Fractionalized Fractal Time and Fractionalized Fractal Light Speed (Fractionalized Fractal Light or Photon-Wave Speed in a vacuum) squared through the range of a hyper-cube up to and including Infinity where the exponent

is raised through the range along a Discontinuous course (Chaotic) or along a well defined well placed Continuum by the squaring procedure and through $_{FF}X$ (any number real or irrational, the totality of Reality's integers) – starting in the range of a Hyper-Cube in Four Dimensions and raised to the $_{FF}X$ Power (Fractionalized Fractal Infinite) together with the relationships of $_{FF}T$ and $_{FF}D$ and Distance Function expressed on the right hand side of the equation together with the Interaction Modification (not to be confused with the Cosmological Constant) of $_{FF}W_{FF}S_{FF}W_{FF}S_{FF} +$ or $- G$ across the $_{FF}ST$ Gap (Fractionalized Fractal SpaceTime coordinates) yielding the approximations for the $_{FF}T1$ and $_{FF}T3$ (the Fractionalized Fractal Time Past and Future components of the Classical (Newtonian) the Relativistic and Quantum (Post-Quantum-Lattice, i.e, Interface Mechanics) Time Present Interactions $_{FF}T2$. (qp equals the Quantum- Planck components that are rotated positively and negatively along the continuum of a $_{FF}$ Infinity in Four + to Infinite Dimensions. (Notice that the Process of Asymmetry Symbol representing the Asymmetrical Quantities of the Universe is not specifically analyzed in these introductory Equations. However, the Symbol for Asymmetry is -- aSyM and has been inserted above. The Symbol for Symmetry is SyM). Now we begin the Age of INTERFACE MECHANICS that side steps PERFECT SYMMETRY in order to supplement QUANTUM MECHANICS, CLASSICAL MECHANICS AND RELATIVISTIC MECHANICS in the arena of the dark side o Gravity by the Unification of Gravity with the other main Forces of the Universe eventually leading to Grand Unification-DeUnification.

APPENDIX I

THE COMPLETE SET OF THE EIGHT-FOLD-WAY SPEED OF DARKNESS
EQUATIONS AXIOMS # 487-494

1.
$${}_F E_f = \& \neq {}_F M_f {}_F C_f^{2f} !$$

 (LOCAL---SyM - Gravity, G, Interaction not completed)

2.
$$qp_F E_f = \& \neq qp_F M_f qp_F C_f^{2f \rightarrow F^\infty f} = \& \neq \langle \pm qp_F G_f \rangle !$$

 (GENERAL--aSyM - Gravity Interaction completed before Disengagement)

3.
$${}_T E_f = \& \neq {}_T M_f {}_T C_f^{2f} !$$



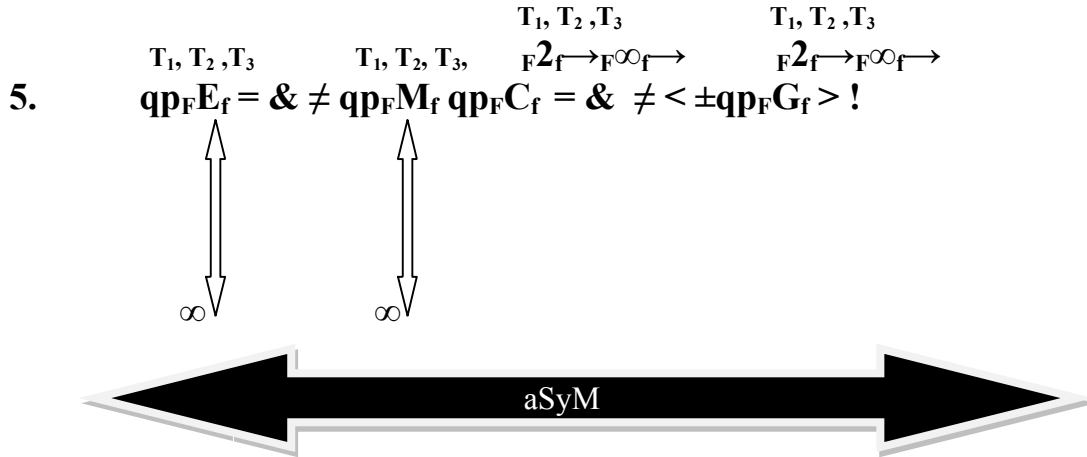
4.
$$qp_T E_f = \& \neq qp_T M_f qp_T C_f^{2f \rightarrow F^\infty f} = \& \neq \langle \pm qp_T G_f \rangle !$$

(GENERAL--aSyM - Gravity Interaction completed before Disengagement)

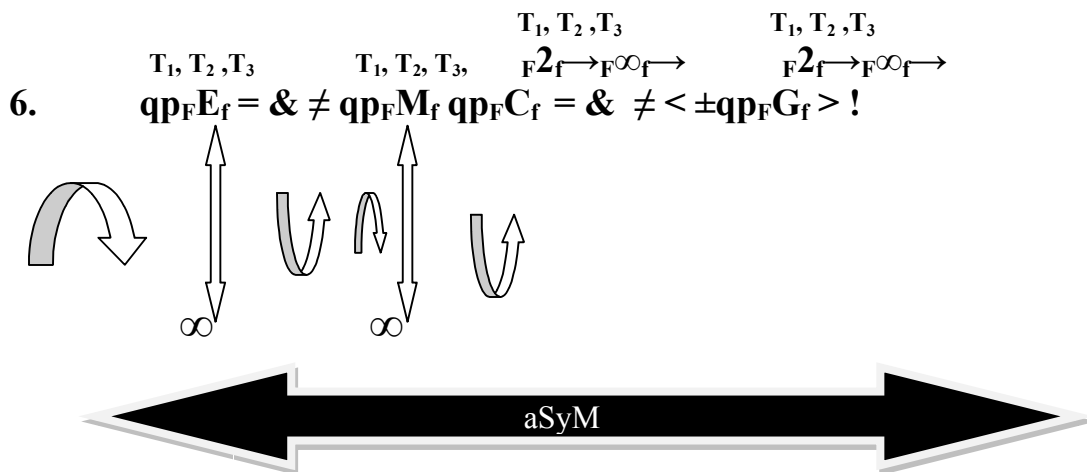


APPENDIX I CONTINUED

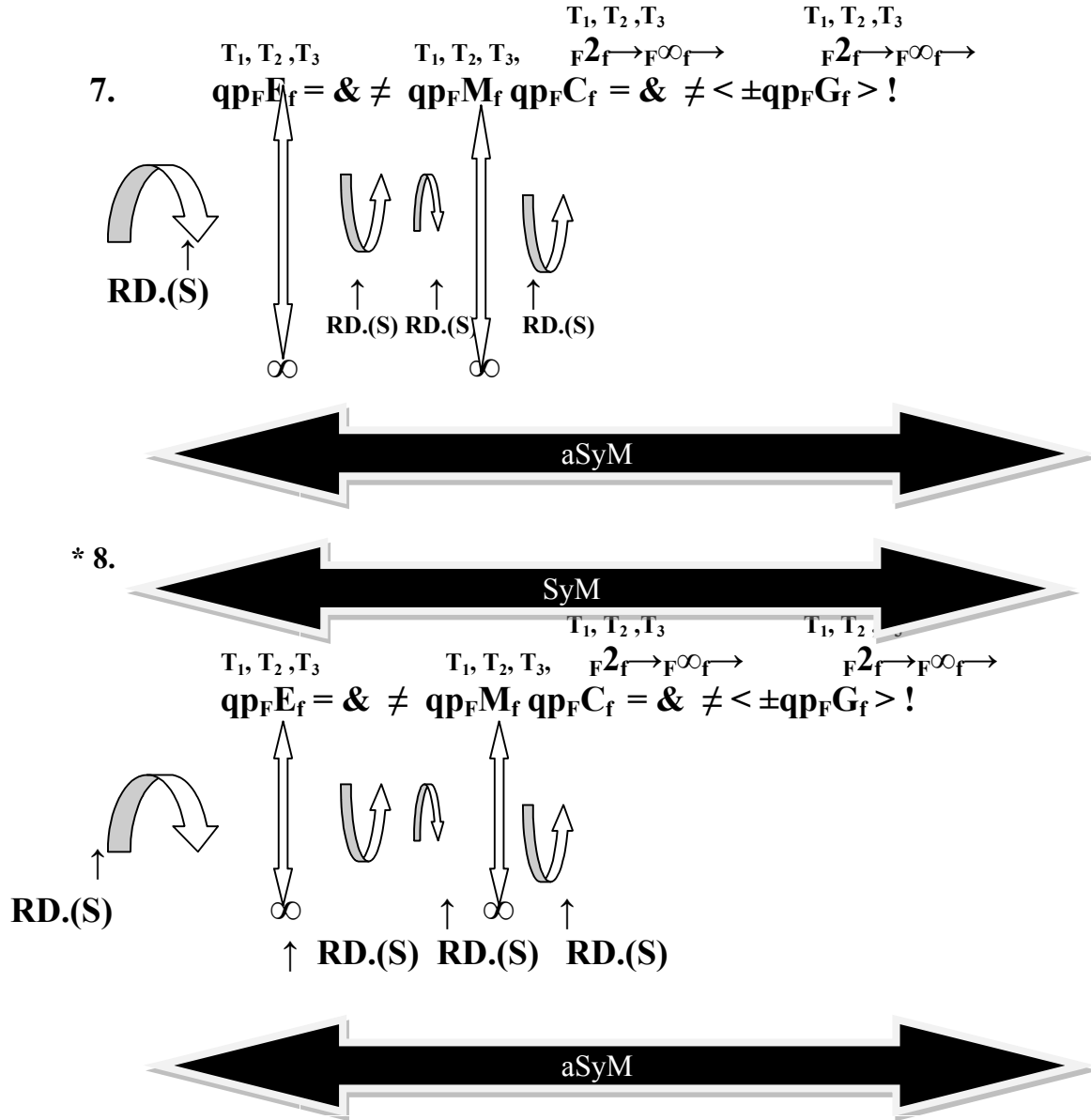
THE COMPLETE SET OF THE EIGHT-FOLD-WAY SPEED OF DARKNESS EQUATIONS



(GENERAL--aSyM - Gravity Interaction completed before Disengagement)



APPENDIX I CONTINUED
THE COMPLETE SET OF THE EIGHT-FOLD-WAY SPEED OF DARKNESS
EQUATIONS

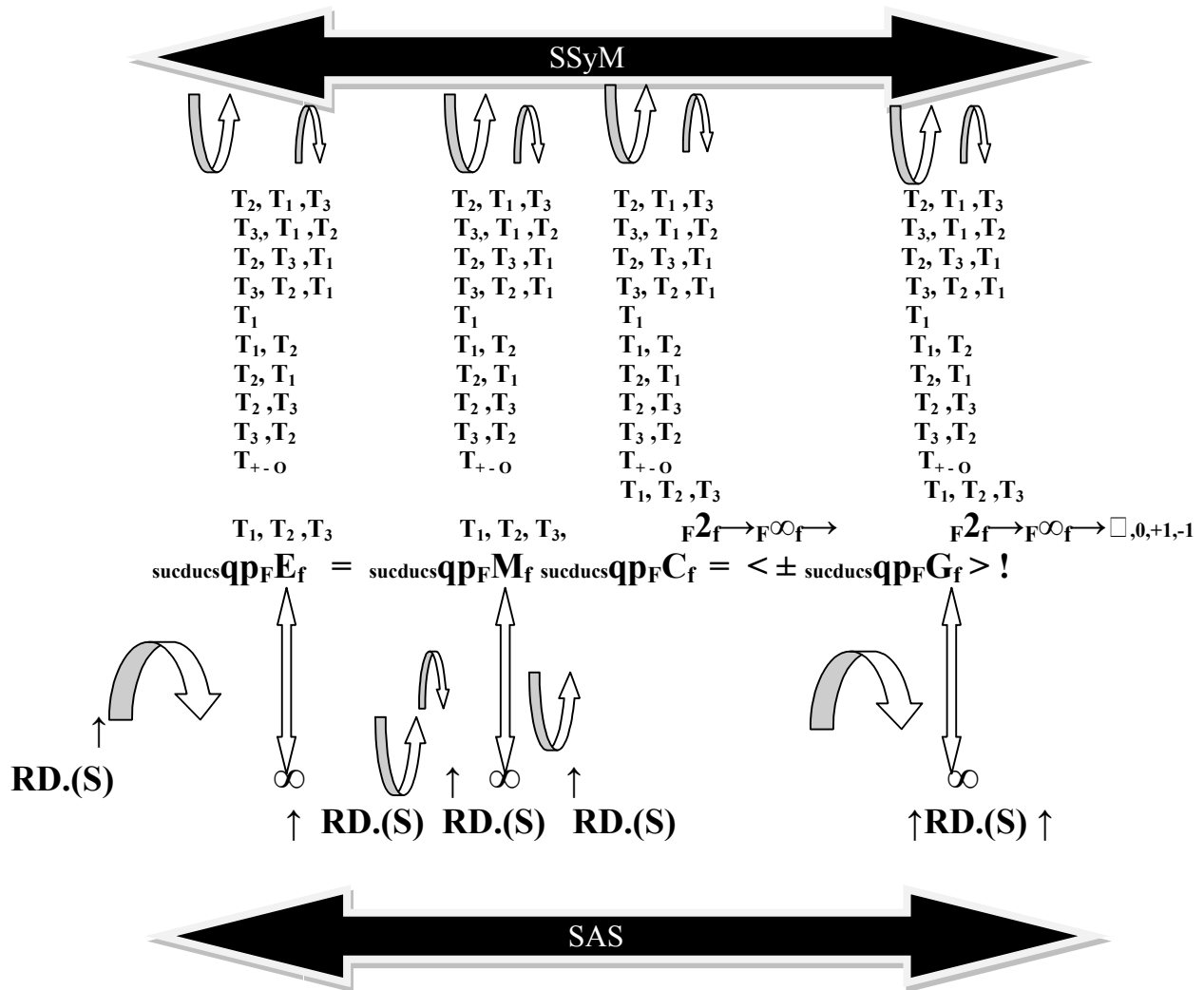


*The Variant Non-Translational T_1, T_2, T_3 Rotational Processes as well as the Variant Non-Translational Processes of Noether's Conservation Laws of Spin, Momentum, Energy, Mass, Photonic-Particle Processes of Conservation or lack thereof, etc., are not included in these equations but are naturally discussed in Advanced Interface Mechanics, i.e., Equation Number 9 which simply has Rotational Arrows above the Time

Vectors and actually is applicable only to the Asymmetric Components. Equations 10- 16 incorporates the Rotary action on the Time₁, T₂ and T₃ , Fractal Processes, Fractional Processes on Mass, Energy, Light, q Processes, p Processes and the Releqs. These Equations lie deep in the Heart of Darkness and are known as the Secondary Eight-Fold-Way Speed of Darkness Equations

GRAND UNIFICATION DE-UNIFICATION EQUATION OF STATE AXIOM NO. 495

* 9.





Q. E. D.

***Equation 9, The Super Symmetric-Super Asymmetric Equation Of State (Matrix Equation), is governing in a Flat, Open and Closed Universe(s). One may think that everything but the “kitchen sink” has been inserted in the Equation because it will often be referred to in the future as “The Kitchen Sink Equation”. However, in order for Grand Unification-DeUnification you need everything including the kitchen sink. The Equation is, now that the “does not equal” symbol has been deleted, much more stable and traditional. The succduc in the Equation are the historically based stable universal constants and the changing (dynamic) historically based universal constants. \square , 0,+1,-1 represents the traditional Omega configurations. RD.(S) = Rotational Dimensions (Dark) (Space). One important final note: all the so-called Constants of the Universe can be coupled with or decoupled from each other or remain isolated for short or long periods of time. They accomplish this feat both Symmetrically and Asymmetrically. The 10th Speed of Darkness Equation is The Darkon Equation of State.**

**APPENDIX II BOUNDARY CONDITIONS FOR THE GRAND UNIFICATION-DE-
UNIFICATION OF GRAVITY**

**GRAVITATIONAL-ELECTROMAGNETIC ---→NEWTONIAN-RELATIVISTIC-ENTROPIC-
DETERMINISTIC-PROBABILISTIC--MOLECULE-0-PHOTONIC>(Based on Light Propagation for its
Existence)-SYMMETRIC-STATIC-(Non-Rotational)-NON-TACHYONIC-ANTI-TACHYONIC-NON-
VIRTUALIZED – (No Exchange of Mediating Particles) ---STRONG FORCE---ATOM-00...>PHOTONIC-
ENTROPIC-DETERMINISTIC-SYMMETRIC-QUANTUMIZED-RELATIVISTIC-NON-ROTATIONAL-
NON-TACHYONIC-ANTI-TACHYONIC-NON-VIRTUALIZED-STRONG FORCE-QUANTUMIZED-
RELATIVISTIC-ELECTRON—NUCLEON-000...>-WEAK FORCE-SYMMETRIC-RADIOACTIVE
DECAY---NON-ENTROPIC-INDETERMINATE-QUANTUMIZED-RELATIVISTIC-ELECTRONS-
VIRTUALIZED- (Mediating Particle Exchange) – NON-TACHYONIC-ANTI-TACHYONIC-NON-
ROTATIONAL-PHOTONIC----(Anti-Electron, ((Positron)), -- WEAK, SUPER WEAK---PROTON-
NEUTRON-SYMMETRY—(Anti-Proton-Anti-Neutron)-SUPERWEAK---0000---QUARK-GLUON-
FLOWON) HOMING AND NON HOMING PLASMA---0000...>NON-ENTROPIC-
INDETERMINATE-SYMMETRIC—QUANTUMIZED-NON-STATIC-SEMI-ROTATIONAL-NON
TACHYONIC-VIRTUALIZED-PHOTONIC---CHROMODYNAMIC-UP—TOP---FRACTIONAL-
FRACTAL CHARGE-SPIN-POSITIVE CHARGE-NEGATIVE...<0000>----BOTTOM-DOWN-FRACTAL
FRACTIONAL CHARGE-SPIN NEGATIVE-POSITIVE---0000...>-CHARM-NON-ENTROPIC-
INDETERMINATE-SYMMETRIC-NON-SYMMETRIC-ASYMMETRIC---(Anti-Quark)---0000...>NON-
PHOTONIC-(Does not depend on Light Propagation for its Existence ((Darkons))-DYNAMIC-FULLY
ROTATIONAL-FULLY CHAOTIC-TACHYONIC-FULLY ANTI-TACHYONIC-FULLY INFINITIZED
(Incorporating the False and Real Vacuum) – VIRTUALIZED—MIRROR RESONANCES—
3+DIMENSIONAL---SUPER SYMMETRIC (With Asymmetric-Non-Symmetric Properties including CP
Violations and CPT Violations-Time, Space, Energy, Mass Distortions or Perturbations, Reverse
Asynchronous, Discontinuous Time Flow--)--DISCONTINUOUS FORCES OF INTERACTION----000000----
-SUPER MIRROR...>SUPER RESONANCES---SUPER CONDUCTING-SUPERSTRING---
SYMMETRIC-NON-SYMMETRIC, SUSY AND SAS, -ASYMMETRIC-NON-PHOTONIC---NON-
CONSERVATIONAL-NON-INVARIANT---NON-TRANSLATIONAL-
→000000000>.....>.....>.....><GRAPPLEONS-GRAVITONS<<VELCROLIZATION OF
GRAVITY>>(Gravitons, Inflatons-Deflatons-Negatons-Expandons and Contractons,
Flowons<>DARKONS....<<INFINITONS>>...>>∞**

APPENDIX III**SYMBOLS FOR FRACTOMETRY**

1. E = Energy
2. M = Mass
3. C = Light Speed (S.O.L.)
4. F = Fractionalization Processes
5. f = Fractalization Processes
6. q = Quantum Processes
7. p = Planck Range extended to Infinity or Lewis Level
8. ∞ = Infinity
9.  = Rotational Action
10.  = Reverse Rotational Action
11. D. = Dimension(s) Configuration(s)
12. S = Space Configuration(s)
13. R = Rotary Processes
14. G = Gravitational Processes
15. \pm = Gravitational-Anti-Gravitational Processes
16. G_g = Gravitons
17. G_p = Grappleons within the Quark-Gluon-Flowons (with respect to vectorized orientation considerations) Plasma also referred to as Negatons (Neutralized Bi-Products).
18. D_d = Darkons (The Darkness "Particles").
19. SyM = Symmetry Configuration(s)
20. aSyM = Asymmetrical Configuration(s) Alternative Conversions of Penrose's Twister Universe(s) and Conversions of Hawking's Thermodynamic Naked Singularities of White and Black Radiative Event Horizons into the Universe's Entrance-Exit Corridors.
21. S.O.D. = Speed of Darkness
22. L.O.S. = Loss of Speed
23. G.O.S. = Gain of Speed
24. B = Boundary Interface Conditions
25. B_r = Brownian Boundary Crossover Conditions
26. T_1 = Past Time
27. T_2 = Present Time
28. T_3 = Future Time

APPENDIX III CONTINUEDSYMBOLS FOR FRACTOMETRY

29. EM = Electromagnetic Processes
30. FF = Field Forces
31. A/M = Antimatter Processes
32. Releqs.= Relevant Universal Structural Equations
33. GUT = Grand Unification Theory
34. GUUT = Grand Unified-UnUnified Theory
35. T.O.N. = Theory of Nothing (Instability) or Theory of S.O.D.
36. SyMs = Symmetrics or Simplicity
37. aSyMs = Asymmetrics or Complexity (Advanced Chaos Theory).
38. Un-DeUn = Unification-DeUnification
39. I = Infinitism (Infinitons)
40. T_r = Transformatics
41. R_{tr} = Reverseamatics-Transformatics
42. L_m = Lattice Mechanics (E-8 Super Symmetry)
43. Q_m = Quantum Mechanics (Uncertainty, Complementarities, Indeterminancies, Statistical Probabilities, Stochastic Modular Manifold Topologies and Interconnectedness, Instantaneous Discontinuous/Continuous Action at a Distance).
44. I_m = Interface Mechanics
45. N_m = Newtonian Mechanics
46. T_m = Topology-Manifold Mechanics
47. I_M = Infinitism Mechanics
48. S_m = String-Super String Symmetry Mechanics
49. S_M = Symmetry-Super Symmetry Mechanics
50. aSym_m = Asymmetrical Mechanics
51. I_f = Inflationary Mechanics
52. D_f = Deflationary Mechanics
53. S_s = Steady State Mechanics
54. AU_m = Alternative Universe(s) Mechanics
55. UC_m = Universal Constant(s) Mechanics (Coupling and Decoupling of the Constants of the Universe.
56. FUC_m = Fluctuating Universal Constant(s) Mechanics
57. R_m = Relativistic Mechanics
58. P_m = Particle-Super Particle-Anti-Particle Mechanics
59. Ff_e = Fractional/Fractal Boundary-Interface Mechanics
60. Exp/Com_m = Expansion-Compression Mechanics
61. B_m = Boundary Mechanics

Lewis

62. **SUSY (Supersymmetry or Supersymmetric) SAS (SuperAsymmetry or SuperAsymmetric)**
63. **The succduc in Equation 9 are the historically stable universal constants and the changing (dynamic) universal constants. \square , 0,+1,-1 (Flat, Open, Closed) represents the traditional Omega parameters. AM (Antimatter), AE (AntiEnergy), AS (AntiSpace), AntiLight(D), AT(AntiTime), AC(AntiConstants) AU(AntiUniverse(s)). S.O.D. Equations 10-16, Super Asymmetric Axioms #496-502, not included here.**

APPENDIX III CONTINUED

**SYMBOLS FOR THE DIAGRAMMATICAL STRUCTURE OF THE PRIMARY
AND SECONDARY UNIVERSES**

