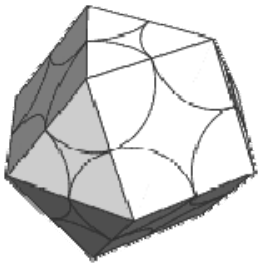
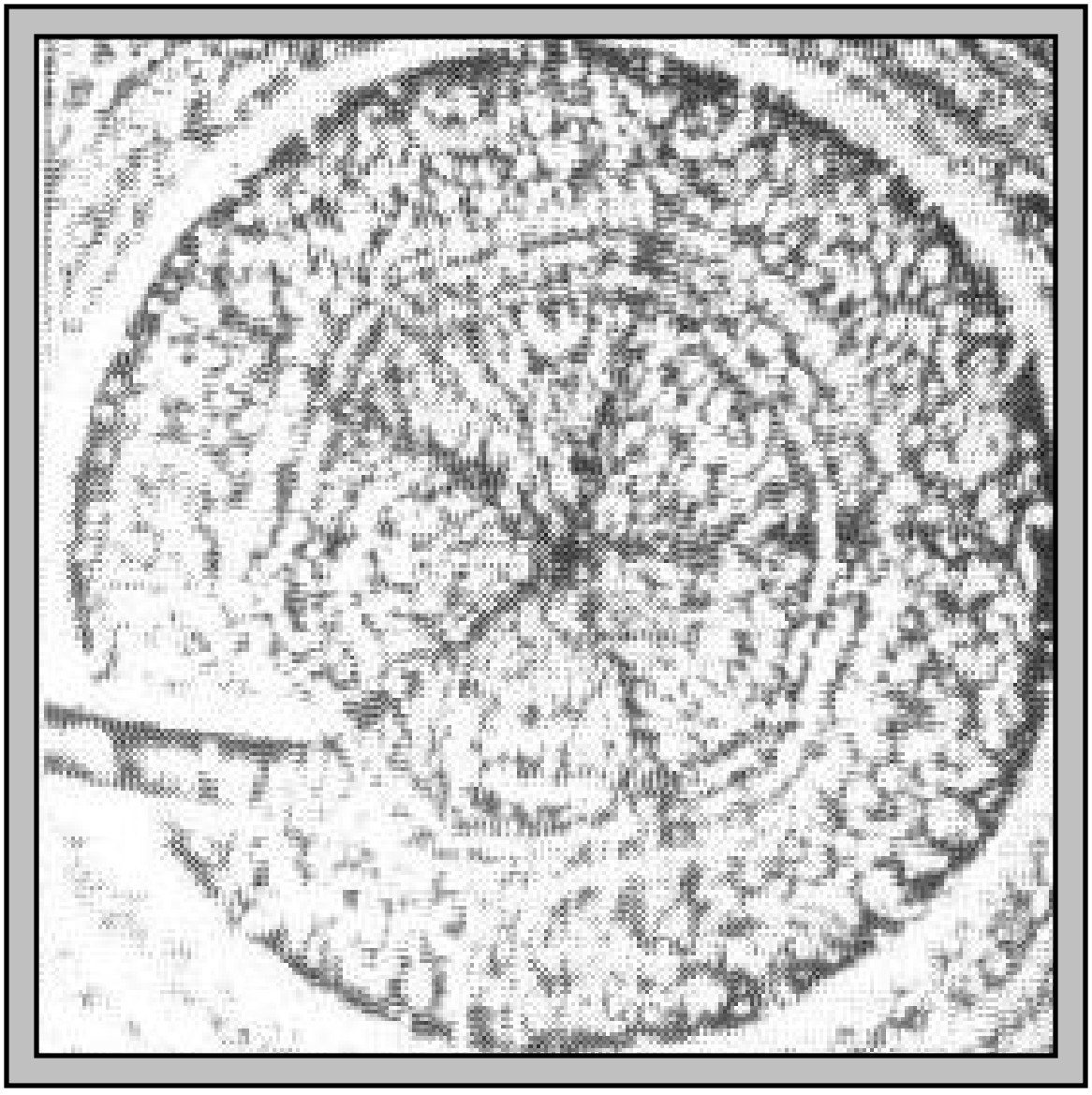


The Geometrical Basis of Information and Nature

By Doğan G. Gökçe



The Geometrical Basis of Information and Nature

By Doğan Gökçe

2007

"Dimensions"

Wall Hanging – Unknown Artist, Panama City, Florida 2007

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A Larger Truth - The Remaining Bits

Preface

Life is indeed mysterious. Largely, the degree of this mystery is defined by us individually and is influenced by a person's background and the circumstances of his or her life. The magnitude of curiosity expressed as a general trait widely varies from person to person. However, curiosity is the essence of what makes us human.

Just look at how our civilization has evolved on planet earth. Propelled by the quest to "know," in the figurative blink of an eye with the greater cosmic time scale in mind, we have gone from primitive hunter-gatherers who dealt with basic survival questions on an hourly basis to the society we enjoy today. So much has been accomplished from those harsh beginnings and has been propelled forward by our benefactor and defining characteristic, curiosity.

Sometimes in this "modern" era, it is very easy to grow complacent, for so many questions have been answered, and we have been separated from many of the problems which used to burden us every waking day in times past. In a direct and strange way, the more primitive life replete with its numerous difficulties spawned by necessity a natural inquiry among people to establish a better way or understanding. After thousands of years of introspection, through the trials of many environments and cultures, we arrive at the present day with many unpleasant aspects of nature largely tamed. In short, the modern life we live presently fundamentally owes its genesis to the human spirit of curiosity applied unceasingly toward the improvement of our lives. For better or worse, the current "survival mode" of world culture provides a less dramatic backdrop and incentive for such *questioning*.

Currently, the main lines of collective inquiry center in the biotech/computer realm with the digital computer spurring on new ways of reviewing, compiling, and synthesizing data in all fields. The scientific, social, and medical advances that surround us sometimes can have the effect of subtly lulling a person into a less mysterious world view where most of the populace is satisfied with their level of understanding and comfort. This is dangerous territory, and I ask the reader to follow me on a journey that delivers more meaningful mystery and some surprising results.

The world that many take for granted has "obvious" underpinnings that have yet to be adequately explored and "questioned." By better understanding "the everyday themes" that surround and flow through our lives as a part of living, we can hope to gain clues to how greater nature, i.e. the universe, operates. By paying attention to how we "get along" as observers integrally linked to what we observe, then we come closer to physical truths about ourselves and nature. As surely as the "laws" of the universe gave rise to us, then our physical consciousness should embody tenets of the cosmos.

Metaphorically speaking, the action of ordinary, garden wind chimes encompasses the essence of the representation of nature offered in the following pages. Why, you might ask, is this so? This is, after all, a fair inquiry for the curious. It is my sincerest hope that you, the reader, will gain an understanding of our lives that is in step with the metaphor offered. This knowledge has many avenues, and I chose to pursue the road that could be labeled as natural philosophy or physics. From *The American Heritage College Dictionary* a wind chime is defined as:

"An arrangement of small suspended pieces, as of glass, metal, or ceramic, hung loosely together so that they tinkle *(make sounds)* pleasingly when blown by the wind."

Let's see where the wind takes us...

The Geometrical Basis of Information and Nature

By Doğan Gökçe

Foundations

The Concept of "Void"

Consider a cubic space measuring 30 cm. per side. This is a space that can easily contain a human brain. How can the organ that defines and supports the complexity and nuance of humanity fit into such a modest box? Although nothing startling has been revealed that is not readily acknowledged at some level day to day, it is nonetheless instructive to elaborate a bit on the nature of any space:

The upper left portion of Figure 1 depicts a cubic 27,000 cc. volume that is large enough to accommodate any human brain. In the middle of the cube, a plane is shown bisecting the volume. This plane, restricted to 30 cm. in length per side, becomes an area section cut of the cubic space. In order to further examine its properties, the section cut is then rotated into the plane of the page and enlarged in the upper right of the figure. Since this area is an orthogonal slice of the original volume (a cube), it is indeed a square.

To begin this investigation, the 30 cm. per side square needs to be subdivided into equal sub parts. In order to obtain four sub squares, the original square is bisected with two lines - one vertical and one horizontal. This leaves two squares along each side of the original square for a total of four squares. Subdividing those four squares each into four more squares yields a total of 16 squares covering the original area. Four squares now exist along the length of one side of the original square. *(Please note that for clarity in the figure, only the lower left quadrant is shown in regression. In other words, the other three quadrants do not show further subdivision past four squares even though they are regressing - being subdivided - at the same rate as the lower left quadrant.)*

Mathematically, this regression of squares can be described by the following simple relations where n equals the number of sub squares found along an edge of the original square of area A:

$$\textit{Total number of sub squares that comprise area } (A) = n^2$$

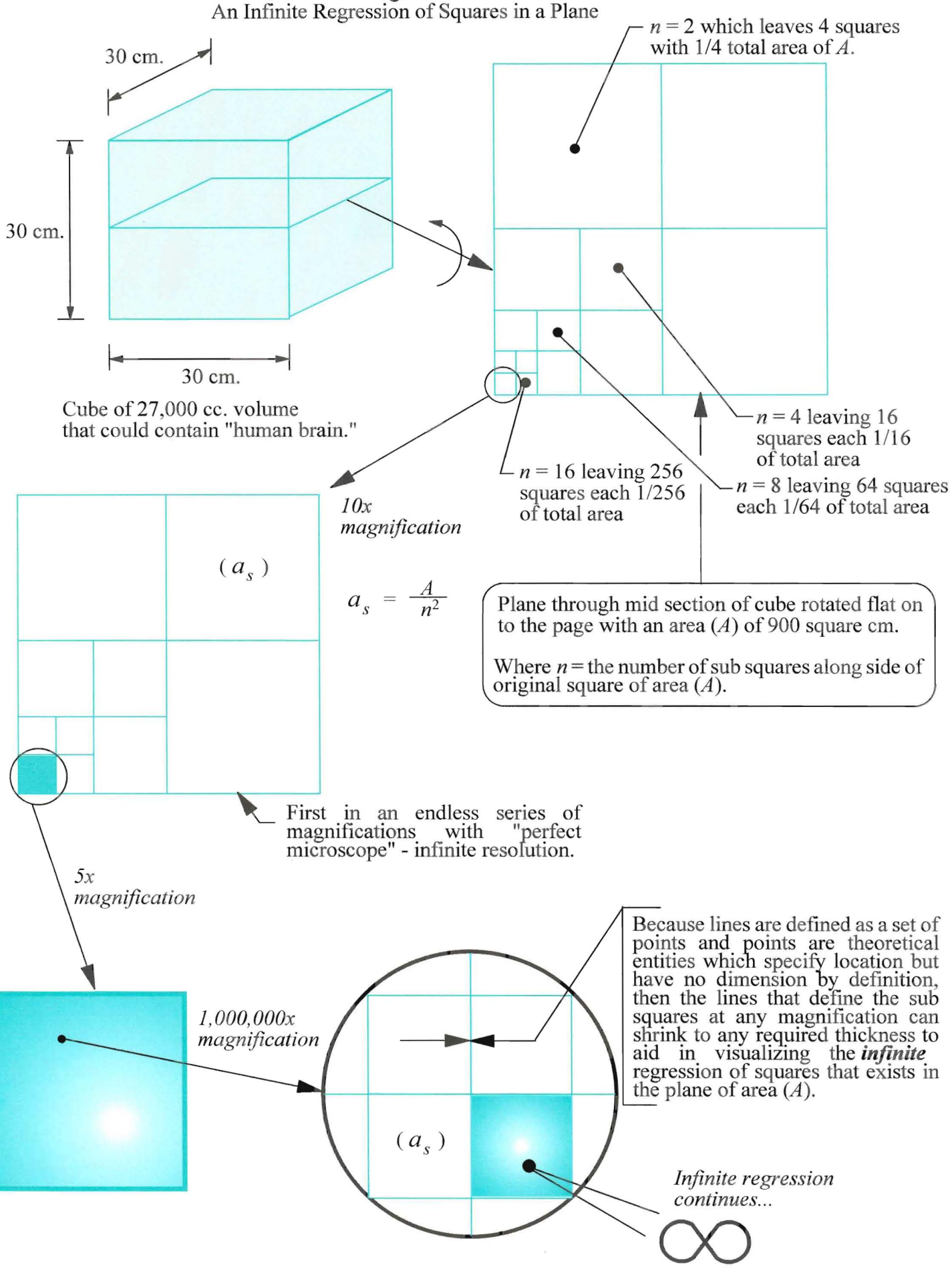
$$\textit{Area of each sub square } (a_s) = \frac{A}{n^2}$$

$$\textit{Where } n = (2^i),\ i = 1,2,3,4,5,6,7\ldots \textit{ etc. } (\textit{all integers})$$

Once the method of regression has been established, this exercise requires a theoretical instrument called a "perfect microscope" to aid in the exploration of the "unassuming" square. Please keep in mind that the perfect microscope does not lose resolution or clarity as its magnifying power increases toward very, very, large numbers approaching infinity. In other words, one can visualize getting closer and closer to the sub squares incrementally through the lens of the mind's eye, even if the actual mechanical aspects of this microscope, a flawless lens set coupled with a near infinite resolving capability, are left as exercises for a society with abilities far in advance of the present.

After two magnifications of the lower left quadrant of the original square in the figure with

Figure 1
An Infinite Regression of Squares in a Plane



this device, one of 10x and one of 5x for a total of 50x magnification, a sub square is shown containing an exceptionally high number of sub squares itself. They are depicted as a mesh pattern because they cannot yet be resolved with unaided vision. Employing the perfect microscope again to visualize this fine mesh of sub squares seen at 50x, one more magnification of a 1,000,000 times achieves a 50,000,000x total magnification of the corner which represents 1/256 of area *A*.

Even at this level of examination, another fine mesh of sub squares within the larger grid is seen. What is the magnitude of *n* at this magnification? How many squares are along the sides of the original parent square at these higher resolutions? The short answer is as many as one desires. For example:

$$\textit{If}\ \ i = 1000\,,\ \ \textit{then the third equation above yields}:$$

$$n = (2^{1000}) = 1.0715 \times 10^{301}\ \ \textit{sub squares per side}\,.$$

Viewing this number for more impact and taking it out of scientific notation gives:

10,715,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 sub squares per side of the original square.

As enormous as the above number seems, it is small relative to what could be generated with ever increasing values of *i*. In fact, *i* has no upper bound since its definition includes all positive integers. Therefore, so long as there is enough paper to hold all the ensuing zeros associated with larger and larger numbers, it is possible to increase the number of sub squares in the original square of area *A* to an infinite extent.

At extremely high values of *n*,

$$a_s\ ,\ \textit{the area of each sub square}\ ,\ \textit{approaches zero quickly but never reaches it}:$$

$$a_s = \frac{A}{n^2} \to 0 \quad as\ n \to \infty$$

Once again, so long as enough paper or computer memory is available, one can specify values for sub square areas at large values of *n*. Armed and ready to add an endless supply of zeros after the decimal point, it is possible to characterize these very, very, small areas with no lower boundary:

.0000000000000000000000000000000000000000000000000000000000000000000000000 0000000000000000000000000000000000000000000000000000000000000000000000000 0000000000000000000000000000000000000000000000000000000000000000000000000 000000...(insert as many zeros as necessary as *n* increases)...00000000000000000001 square cm.

These ultimately small areas quickly shrink and define perimeters that would total less than the Planck length of quantum mechanics,

$$1.6 \times 10^{-35} \textit{ meters},$$

where general relativity's smooth, spacetime "fabric" becomes distorted by quantum "weirdness" or "foam." Foam here is a visual metaphor coined by the American physicist John Wheeler to describe the quantum activity of space (the vacuum) at Planck length "resolution."

As a collection of four, equal length lines in the same plane connected at their ends at 90 degrees to each other forming a closed figure, a square is specified by lines, but ultimately, all geometric figures are arrangements of points - the absolute geometric abstraction. A point is defined as: a *dimensionless geometric object* having no properties except location.

Since these sub squares are delimited by lines which are composed of points that are dimensionless by definition, then in the regression of squares contained within the parent square of area A, there is no real lower bound to ever smaller squares. No bound exists because the lines that define the downward grid can become as "thin" as required to match the incremental magnification increases of the "perfect microscope" employed in this exercise. *Therefore, there exists an infinite number of sub squares within the original square.*

Symbolically in mathematics, as the total number of sub squares approaches infinity, the limit of the summation of the sub square areas (a_s) equals the area (A) of the parent square:

$$\lim_{k \to \infty} \sum a_s = A$$

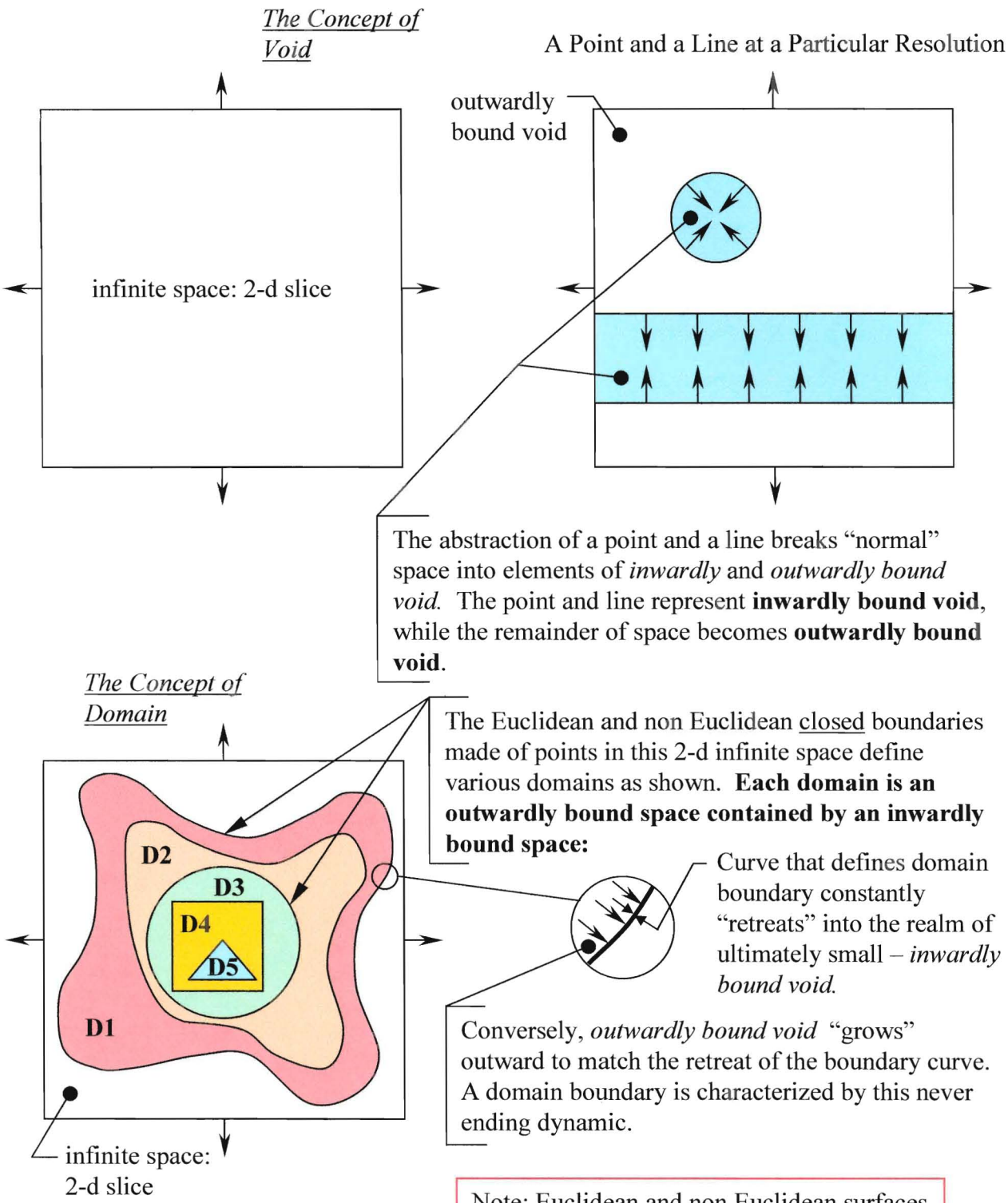
Where k is the total number of sub squares : n^2

However, the concept of a limit, in general, is a mathematical device which masks the spectacular nature of what is really happening here. The formalization of the limit does not mean that there is less than an infinite amount of sub squares possible in the area, A. The limit recognizes the infinity, but makes it tractable by definition. In a sense, the dynamic nature of the lines delimiting the sub squares is made static by the limit.

Exploring the implications of embracing the infinities generated by geometric abstractions will be part of the focus of this inquiry. Abstractions of lines and points are really inwardly bound, dynamic entities which can shrink to any size no matter how incredibly small. *Points and all constructs made by them will be characterized as being elements of "void" in this discussion.* **Void** being an abstraction that is unquantifiable, but absolutely necessary in any geometrical construction. Void is, in fact, inwardly or outwardly bounded space. See top of Figure 2.

With this realization in mind, the box that was developed earlier in the narrative that could contain a human brain is a three dimensional analogue to the two dimensional square that has been examined: instead of an infinite regression of squares within a perimeter, one has a volume that bounds an infinite regression of sub volumes or cubes. With this knowledge, the rather smallish volume that "encapsulates" humanity's means of consciousness is seen quite differently - it is indeed limitless with this perspective.

Figure 2
The Concept of Void and Domain



Note: Euclidean and non Euclidean surfaces that form closed volumes in 3-d space create domains in 3-d space.

Regression into the very small or expansion into the very large, requires "bounding" of infinite space: that is to say, space is made meaningful by defining geometric elements constructed of points *(inwardly bound void)* which have no dimension. Specifying a geometric entity or form (a square or cube in this case) determines a **relative** spot or resolution in this continuum. Any specific resolution of space will be labeled a domain and will be referred to as such in future sections. See lower portion of Figure 2.

The external space (outwardly bound void) that surrounds the box which could encapsulate a human brain is infinitely expansive until hard data about the size and "shape" of the universe is revealed which somehow limits its extent. For now, space, both inner and outer, is an infinity construct which is navigated using *elements of void* to aid in a search for meaning.

Embedded Uncertainty and the Randomness of Discrete Events

According to Charles Darwin, the dynamic of the biosphere figuratively floats on the unpredictable ocean of randomness. Evolution and natural selection are predicated on the appearance of random genetic mutations which enhance a living organism's survival potential. Some mutations are not as successful as others and cause severe hardships or early death to the life form expressing them. The chance mutations that succeed are those that over time are beneficial to the organism in its present environment. Thus, the unanticipated, "instant," random occurrence of genetic mutation is thought to drive the creation and adaptation of life on Earth.

Evolution then, can be viewed as occurring in a series of jumps or steps with each step being a successful mutation. Just one beneficial mutation can catapult the affected, "lucky" organism into an immediate state of "better fitness" over its competitors or its environment. Isn't it curious that a process so dramatic and vital to the fabric of life expresses itself in a *random, incremental way?*

Similarly, the elementary "particles" which constitute the standard model of physics today are currently envisioned as being best understood as probability waves instead of physical objects. For example, quantum mechanics can describe where an electron will *most likely* be based on Max Born's interpretation of the Schrödinger wave equation:

$$-\frac{\hbar^2}{2m}\nabla^2\Psi + U(x,y,z)\Psi(x,y,z) = E\Psi(x,y,z)$$

where Ψ *is the wave function of Schrödinger ,*

$\hbar = \frac{h}{2\pi}$ *with* h *= Planck 's constant ,*

$U(x,y,z)$ *is the potential energy , and*

E *represents a system energy eigenvalue .*

The electron, according to Born, can still be considered a specific entity. However, the value of Schrödinger's wave function at a specific point can be used to determine the *probability* of finding the electron at that location. With this interpretation, a normalized wave function that satisfies Schrödinger's equation is termed a probability amplitude. Each probability amplitude corresponds to a **discrete** system energy and is called an eigenvalue.

A probability amplitude generally takes the form of a complex function in which case its

product with its complex conjugate, i.e. (a + bi) (a - bi), gives the *real* physical probability of finding the electron in a particular location:

$$P = \Psi^*(x,y,z)\,\Psi(x,y,z)\,dx\,dy\,dz$$

P is the probability that the electron can be found within the infinitesimal volume element (*dx* by *dy* by *dz*) about the position (*x*, *y*, *z*). The asterisk indicates complex conjugation.

Locations of individual subatomic particles are strictly *probable* locations as given by the relations above. It has been previously discussed that randomness finds itself imbedded in a fundamental process of life (natural selection), and now probability is found central to the science of the particles that make life possible in the first place. More recently, different applications of randomness have surfaced in the characterization of the microworld.

"Quantum field theory, our description of the fundamental forces in nature, was originally formulated in continuous space-time, where it leads to embarrassing infinities which have to be eliminated by a process called renormalization. A simple but rigorous formulation can be obtained by replacing continuous space-time by a ***discrete** set of points on a lattice*. This clarifies the essentials of quantum fields using concepts such as universality of critical phenomena and the renormalization group."[1]

While there are several methods of analysis that have been applied in particular to the problem of the strongly interacting lattice gauge model, **Monte Carlo** techniques currently reign supreme in the field. *A Monte Carlo calculation explicitly employs random variables.* Using digital computers and numerical procedures that produce random variables having any given distribution, researchers can write computer programs which simulate the transport of particles or photons on a lattice. A Monte Carlo simulation can be fashioned if one knows or puts forth the probability distribution which controls each step of the process. *At vastly different resolutions in the substance of life and existence, elemental, distinct, chance events are apparently a thread of choice and a significant theme.*

"As we study the universe as a whole, we realize that the 'microcosm' and the 'macrocosm' are, increasingly, the same subject. ...More and more, the universe appears to be as it is because it must be that way; its evolution was written in its beginnings - in its cosmic DNA, if you will. There is a clear order to the evolution of the universe, moving from simplicity and symmetry to greater complexity and structure. As time passes, simple components coalesce into more sophisticated building blocks spawning a richer, more diverse, environment. **Accidents and chance**, in fact, are essential in developing the overall richness of the universe. ...Though individual events happen as a matter of chance, there is an overall inevitability to the development of sophisticated complex systems."[2]

One of the most vivid, tactile introductions to the "stewardship" of randomness can be found in the exercise of generating the Sierpinski Triangle. The Sierpinski Triangle is a pattern which emerges by means of a simple algorithm conducted within the area of an equilateral triangle of any dimension. Most interestingly, tossing a die will determine the "moves" made during the process of pattern generation. Please refer to Figure 3 for the discussion and instructions which follow.

First, draw an equilateral triangle an a sheet of paper and label the vertex points (1,2), (3,4),

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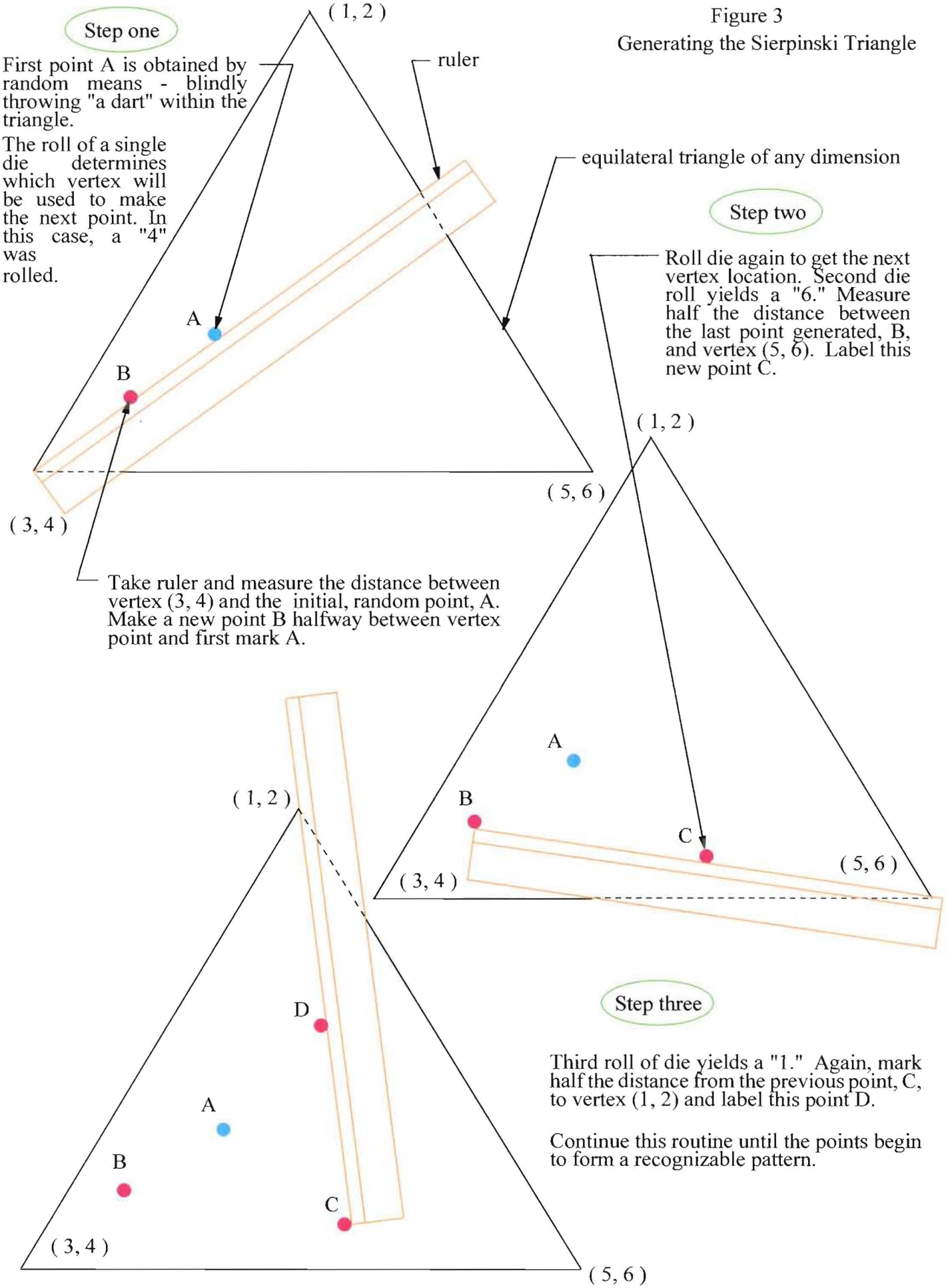
[1]Jan Smit, *Introduction to Quantum Fields on a Lattice*, Preface.

[2]George Smoot and Keay Davidson, *Wrinkles in Time*, p. 296.

Figure 3
Generating the Sierpinski Triangle



and (5,6) as shown in the figure. The numbers on each vertex will be used to match die rolls with six possibilities as outcomes.

To obtain the first point in the pattern, randomly make a point with a pencil within the area of the triangle. This point will be labeled A. Now, roll the die to obtain a number. In this example, a "4" was rolled. Using a ruler measure the distance between vertex (3,4) and point A. Note: vertex (3,4) is used because the die roll yielded the value of "4" which matches one of the numbers within the parentheses at vertex (3,4). Make a new point B halfway between vertex point (3,4) and the first mark A.

Roll the die again to get the next vertex location. Assume the second roll yields a "6." Once again, take the ruler and measure half the distance between the last point generated, B, and the vertex (5,6). Label this new point C.

Throw the die a third time, and in this example the die shows a "1." Following the rules set forth above, mark half the distance from the previously generated point C to vertex (1,2) and label this point D. Continue this routine until the points begin to form a recognizable pattern. This process can be a time consuming exercise, but it does not take too many points to see the incredible result shown in Figure 4.

The Sierpinski Triangle exhibits characteristics mentioned and discussed previously. It embodies the concept of infinity by displaying an infinite recursion of triangles within the outer perimeter. Additionally, the resulting pattern reflects a hierarchical structure with intersecting lines (inwardly bound void) creating nested domains out of outwardly bound void. Compelling and revealing are the first two words that come to mind when pondering the fact that the roll of a die produces such an intricate structure.

A Universal, Invariant Reference Frame

This fundamental "feature" of awareness and physicality is so intertwined in everyday experience that most feel no reason to note its overwhelming presence, and that very neglect is perhaps part of its sublime nature. An understanding of this perspective illuminates the very consistent way that the "stuff" of the universe moves.

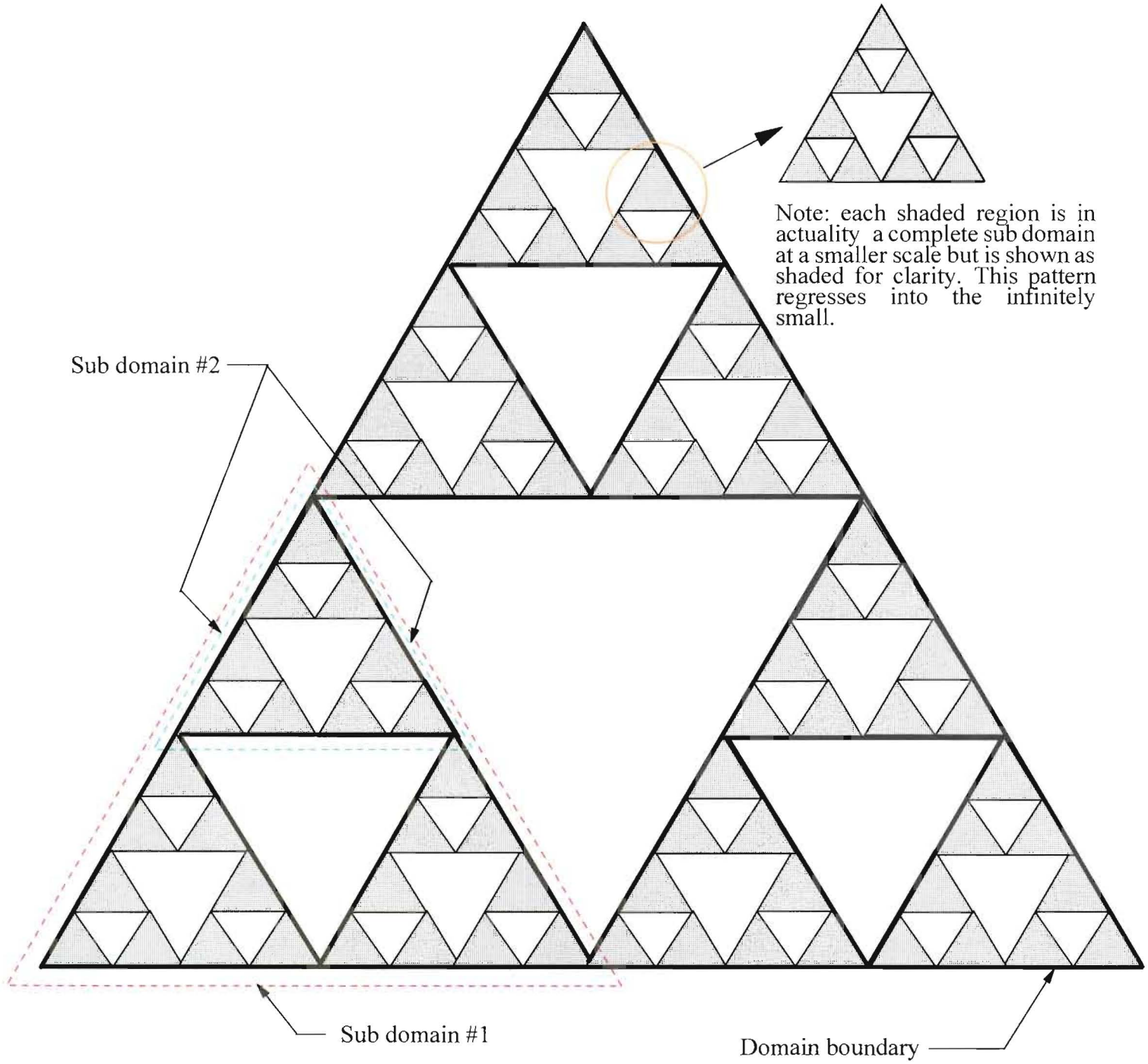
As an introduction to this notion, imagine watching a favorite movie on either a VCR or a DVD player. Now, with the screen displaying the middle of a compelling scene, hit the fast forward or reverse key. It doesn't matter what the scene entails, mobsters discussing a hit, a couple enjoying a sunset, entertainers in concert, dialogue of any kind, chase scenes or battles galore, the overwhelming impression one gets of the image in fast forward or reverse is the "jerkiness" of the action.

People, animals, machines and most everything that moves do so with an exaggerated "inflection" of movement. Inflection of movement occurs when a body in motion stops moving relative to the observer (the movie fan) for any instant of time and then begins moving again. A "body" moving in this context encompasses both the displacement of an inanimate object and the movement of any feature of a life form.

At normal speeds, this stopping and starting is done at a rate most are accustomed to and thus, no real attention is given to it. Viewing things in fast forward or reverse accentuates this very pervasive characteristic of the "on the go" observable universe - namely, that movement tends to be discrete rather than continuous when any observing (movie watching) is going on. Another way of looking at this phenomenon is to say that movement in loose terms is more digital than analog.

It's time to discuss this concept in more detail because it provides an avenue to a new

Figure 4
The Sierpinski Triangle



This is the amazing pattern that emerges in time with many throws of the dice. *It is infinitely recursive and displays the characteristic of nested domains.* Most importantly, it was generated by totally random means - the tossing of a die.

paradigm or way of thought that will be quite powerful. The primary idea is quite simple: *from a particular perspective, all basic constituents of matter and light are only seen moving between stopping points of zero velocity located at their "mass" centers.*

The photon, and any other possible zero rest mass particle, will be envisioned as being an ultimately small spheroid object in this discussion. Thus, its "center of mass" location will reference a generic point which is set at the geometric center of its "spheroid body." This point is more aptly described as a center of relativistic mass and a reference frame in this discussion, consistent with the center of rest mass found in "mass bearing" particles. Mass bearing particles/objects will be idealized as ultimately small spheroids as well with their mass centers coincident with their geometric centers.

These elemental "objects" may move in very contorted and complicated paths between stopping points with vast time lapsing between instances of zero relative velocity, but a fundamental characteristic of the primary components of matter and light is that their *center of mass* will have zero velocity *at least once*, if only for an instant, relative to another basic object's center of mass (a "universal observer") in time. The resulting lapse point in observed movement will be called a **node**. See upper portion of Figure 5. For a table of elemental objects used in discussion see below.

Table of Elemental Objects

(Family 1) Matter Objects	**(Family 2) Matter Objects**	**(Family 3) Matter Objects**
Electron	Muon	Tau
Electron - neutrino	Muon - neutrino	Tau - neutrino
Up - quark	Charm - quark	Top - quark
Down - quark	Strange - quark	Bottom - quark

Force "Carrying" Objects (Bosons)	photon, gluon, weak gauge boson, graviton
Generational Objects	hadrons, atomic nuclei, atoms

Note: Each object above has an antimatter counterpart.

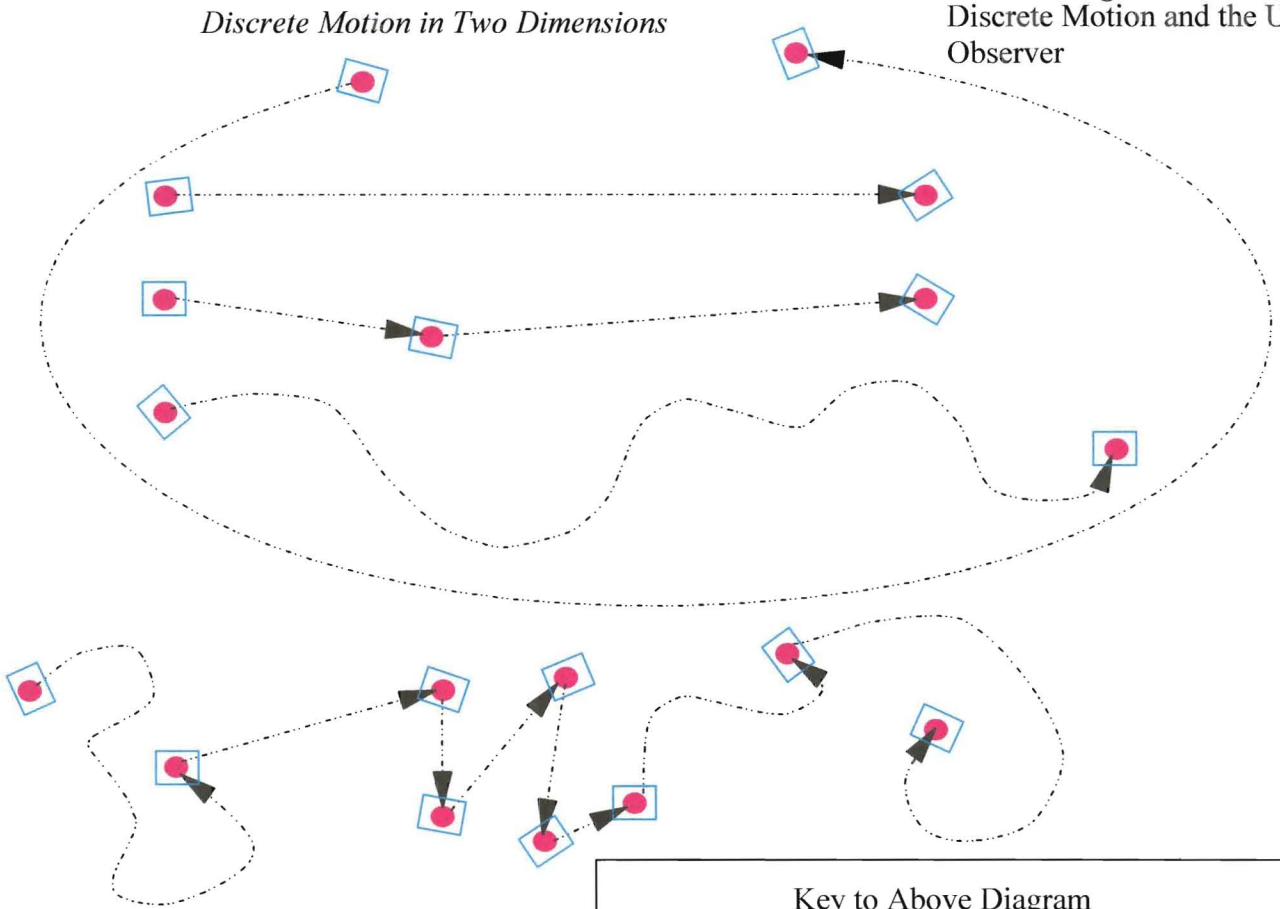
The phrase *universal observer* refers to a reference frame located at the center of mass of any elemental object from which something is being measured. The sum total of observations made from the reference frames of all the universal observers is the *universal perspective*. See lower portion of Figure 5. For example, from a reference frame of the center of mass on either of two elemental bodies moving towards one another, a colliding system, an observer will note that an incoming object's center of mass stops for an instant of time during the collision. See Figure 6.

During a collision, a relatively large force acts on each elemental body for a relatively short period of time. The basic idea of a "collision" is that the motion of the colliding entities (or at least of one of them) changes rather suddenly and that we can make a relatively clean separation of events that are "before the collision" from those that "are post the collision."[3]

Collisions involving the primary components of light and matter will be modeled as both

[3]David Halliday and Robert Resnick, *Physics: Parts 1 & 2*, p. 187.

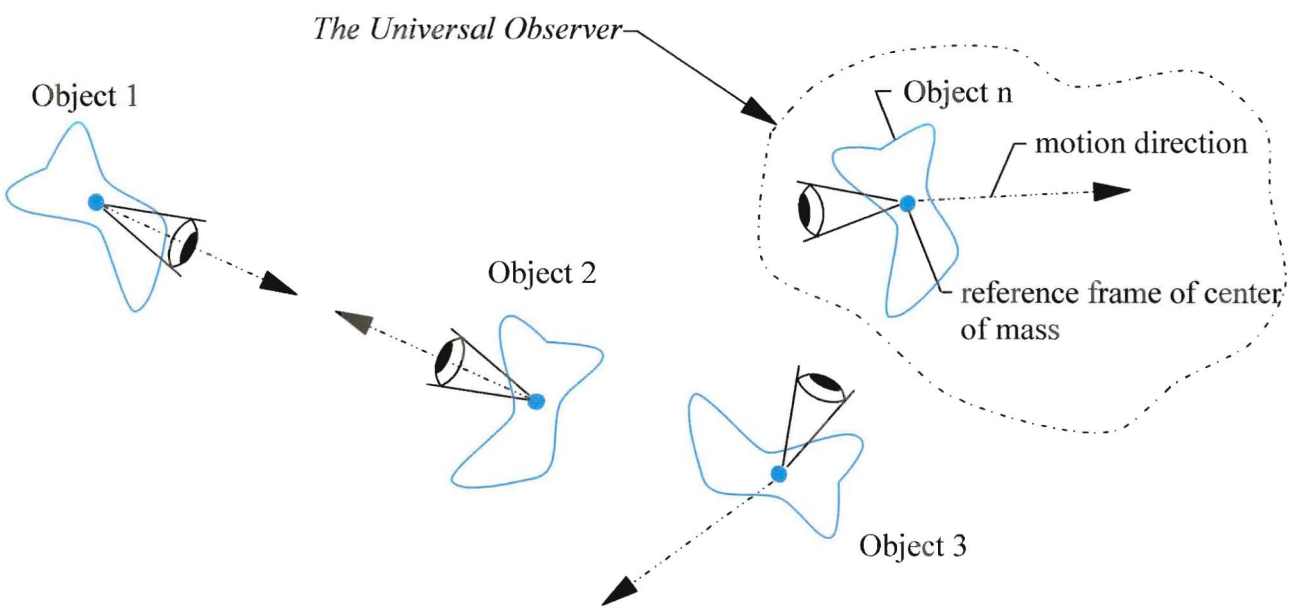
Figure 5
Discrete Motion and the Universal Observer



Note: Discrete motion in 3D is identical to above with objects, motion paths, rotations, and nodes existing out of the plane of the diagram.

Key to Above Diagram

- object in motion (translation + rotation)
- node (lapse point): location at center of mass, total velocity = 0 relative to a universal observer
- motion path and direction over arbitrary time interval

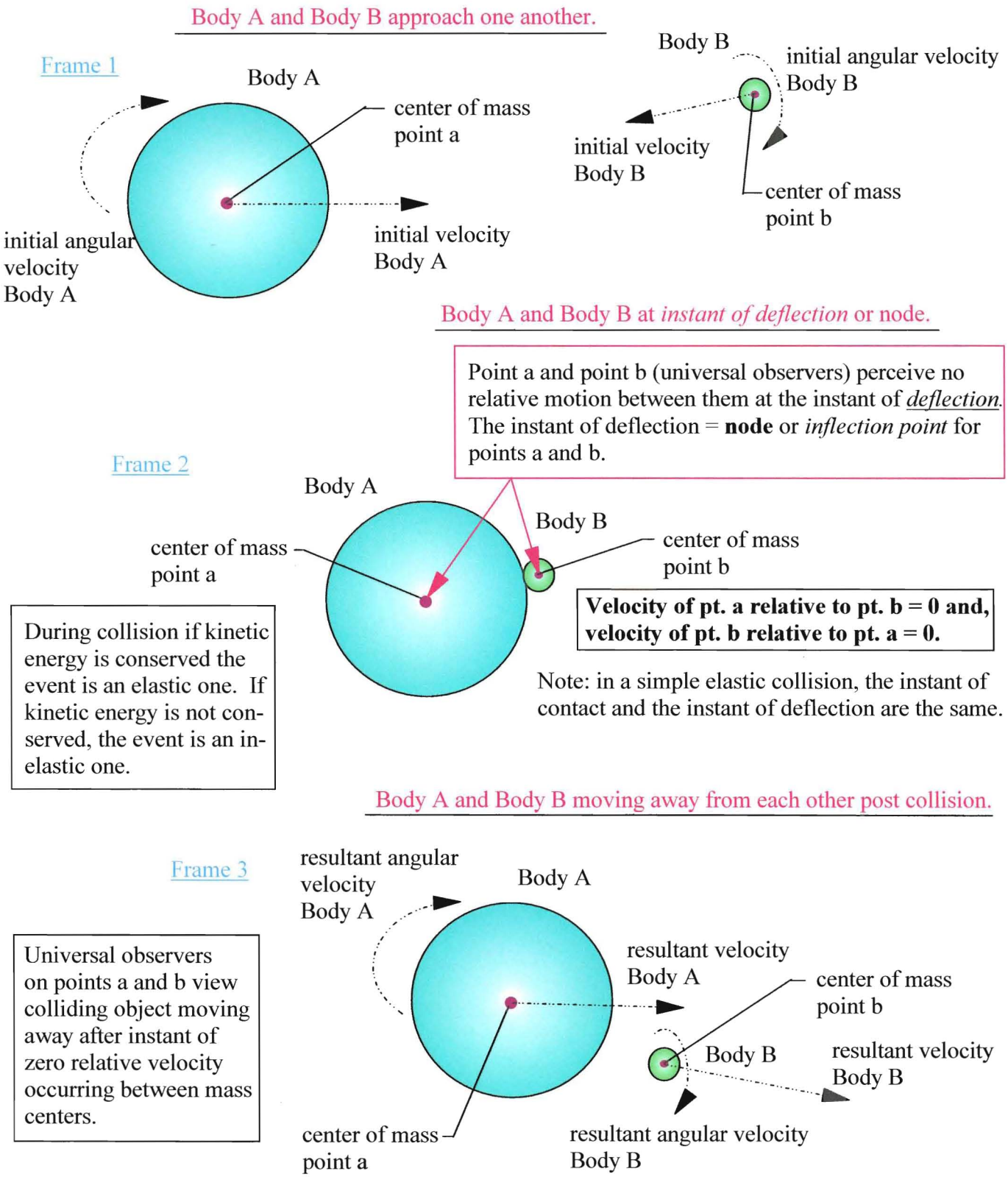


The Universal Perspective = total "shared" perspective of all universal observers = perspective Object 1 + perspective Object 2 + perspective Object 3 + ... + perspective Object n

Figure 6

Perspective (Reference Frame) of Universal Observer (Center of Mass) During a Collision Event

Sample elastic or inelastic collision for elemental objects:



elastic and inelastic ones. When kinetic energy is conserved in a collision it is labeled elastic. If on the other hand, kinetic energy is not conserved in the collision, it is termed inelastic. Elemental objects have been observed "interacting" both elastically and inelastically.

Thus, bearing in mind the standard model of the universe, a proper characterization of elemental object motion would be to say that from a "universal" perspective, all of the basic constituents of matter and light to this point in the evolution of the universe will have been "seen" to have stopped their motion for a brief moment of time by hypothetical life forms (the universal observers) "stationed"on the centers of mass of other colliding, elemental objects.

As a result of this collective viewpoint, all basic/elemental objects moving in the observable universe are only doing so *between or after* an instance of zero relative velocity occurring at their mass centers, that is to say, between nodes. Foundational objects in motion between nodes are said to be moving in a *discrete* way.

Object and body are appropriate generic nouns to use in describing moving rudimentary entities because they are the most simple carrying the least associative baggage. Because this fundamental assertion stipulates that all basic matter and light constituent movements are discrete occurrences existing between nodes or lapse points, the *Discreteness Paradigm* implies that there is no such thing as continuous motion of these elemental bodies from the universal perspective.

How can it be that the basic entities that comprise matter and light only move stopping and starting relative to the universal perspective? The ideas embodied by the standard model of the universe give credence and support to this declaration. In the late 1940's, George Gamow and his colleagues, Ralph Alpher and Robert Herman, proposed a "Big Bang" theory for the origin of the universe. Sir Edwin Hubble's prior discovery of the intergalactic red shift and the associated proportional recession of galactic clusters from one another aided in this conception. (Georges-Henri Lemaitre, a Belgian cleric and astrophysicist, pioneered the notion of a Big Bang in the early 1930's, but the Gamow, Alpher, and Herman model began a larger discussion of this idea among more scientists.) Essentially, Gamow hypothesized that the forming of all matter in the universe (nucleosynthesis) was the by product of an expanding universe that began at a finite time in the past in a state of enormous density and pressure. As part of this theory, Alpher and Herman predicted that a background radiation of 5 degrees Kelvin (K) would exist in space today as a fossil remnant of this process.

During the spring of 1964, a pair of radio astronomers, Arno A. Penzias and Robert W. Wilson of Bell Laboratories, discovered a sizable amount of microwave noise at 7.35 centimeters in wavelength that had no source direction and emanated from all points in the sky. (As will be discussed later, 7.35 centimeters corresponds to an "equivalent temperature" of 3.5 degrees K.) This radiation in time became known as the cosmic microwave radiation background, and thus, gave strong support to the Big Bang theory.

Later, Roger Penrose at Oxford and Stephen Hawking of Cambridge University collaborated to describe the "foggy" first instant of the Big Bang in the late 1960's. Using general relativity and the properties of space-time versus analyzing individual particles led them to conclude that a singularity was required.[4] On January 13, 1990, data from the Cosmic Background Explorer project satellite (COBE) confirmed that the spectrum of the cosmic microwave background radiation matched perfectly (within 1%) that of a "black body" spectrum.

The fact that the cosmic microwave background radiation correlates with that of a

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[4]John C. Mather and John Boslough, *The Very First Light*, p. 146.

black body spectrum is important to the Discreteness Paradigm outlined above because black body radiation is characteristic of a system (early universe) in *thermal equilibrium*. Any system in thermal equilibrium has characteristics which are derived from the discrete motions of objects.

Back in the 1890's, scientists discovered that the properties of radiation in a state of thermal equilibrium with matter vary solely with temperature. A universal formula emerged which relates the amount of energy per unit volume in such radiation (within a given range of wavelengths) to a wavelength and a temperature. This same equation also yields the amount of radiation emitted per second and per square centimeter at any wavelength from any "totally absorbing" surface. Thus, radiation of this type is labeled as black body radiation. At a given temperature, a black body will radiate the surrounding space with a characteristic energy density in each wavelength range.[5]

In other words, at a particular temperature, the black body will produce a distinctive radiation density which peaks at a specific wavelength. For example, the 7.35 centimeter wavelength of the cosmic background radiation measured in 1964 is the wavelength at which the peak energy density occurs when a black body is heated to 3.5 degrees K. 3.5 degrees K therefore becomes the black body equivalent temperature. (Note: more modern measurements of the cosmic background radiation yield an equivalent temperature of 2.7 degrees K.) For more on black body radiation see Figure 7.

Max Planck derived the equation which correctly described the black body radiation phenomenon. In doing so, he postulated that the resulting energies of matter in equilibrium with radiation came in distinct, separate, noncontinuous packets or "quanta." This conclusion led to the quantum mechanics revolution that supplanted "classical" physics. The noncontinuous nature of the energy of black body radiation is counter intuitive but very consistent with the theme being presented.

Below, the Planck distribution[6] (This equation generates the curves seen at the bottom of Figure 7.) specifies the black body radiation per unit volume (*du*) as:

$$du = \frac{8\pi hc}{\lambda^5}\, d\lambda \Big/ \left[e^{\left(\frac{hc}{kT\lambda}\right)} - 1\right]$$

In a proximate range of wavelengths from λ *to* $(\lambda + d\lambda)$

Where T is the temperature , k is Boltzmann 's constant $(1.38 \times 10^{-16}\ erg/°K)$,

c is the speed of light $(299,729\ km/\text{sec})$, *e is the mathematical constant* 2.718,

and h is Planck 's constant $(6.625 \times 10^{-27} erg\ \text{sec})$.

Integrating both sides of this equation gives a total energy per unit volume (u) emanating from a black body:

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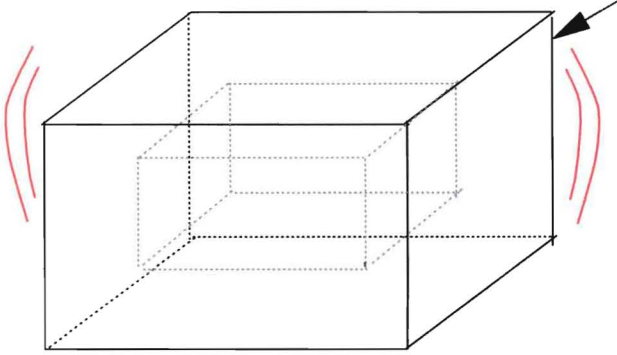
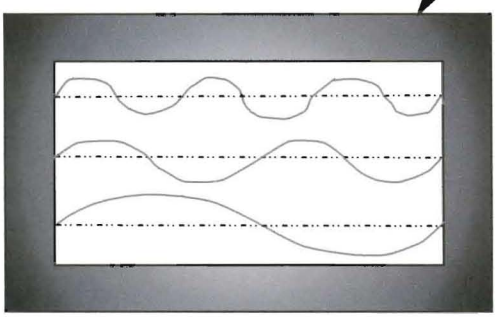
[5]Steven Weinberg, *The First Three Minutes*, p. 57, 58.

[6]*Ibid.*, p. 173, 174.

Figure 7
Black Body Radiation

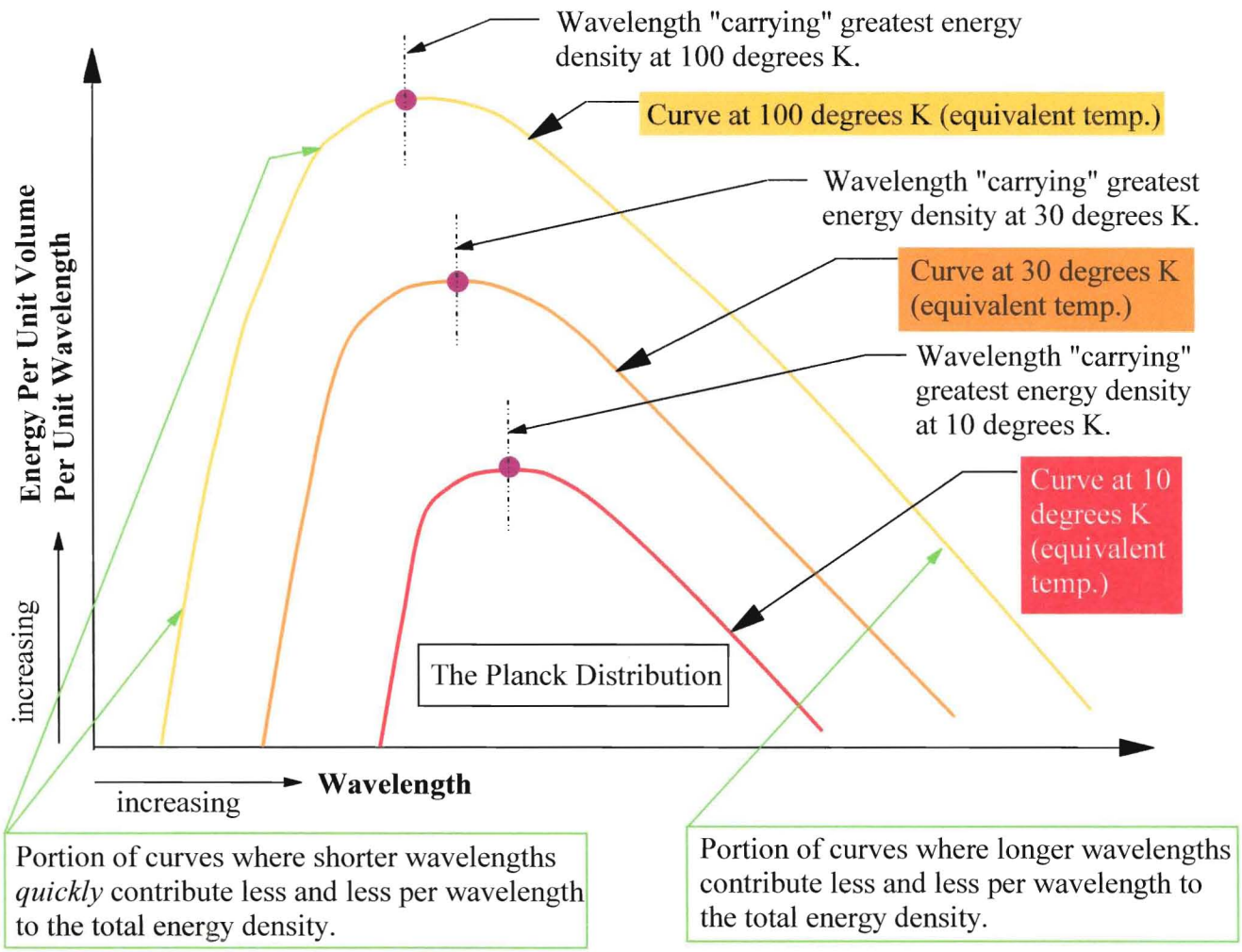


An idealized black body is an opaque box with a blackened cavity inside. The walls of the box emit electromagnetic radiation when heated due to electrons moving within them. Because the box is in thermal equilibrium, the temperature of the walls (equivalent temperature) will determine the radiation intensity at a given wavelength.



section cut through center of box

As a consequence of Maxwell's equations, the radiation waves in the box must have a whole number of crests and troughs and be complete wave cycles. This requirement eliminates the longer wavelengths that can't fit in the box from contributing to the energy density. Because an "infinite" number of shorter wavelengths is possible, to avoid infinite energy density coming from the box, *Planck hypothesized that the energy contribution from many of the shorter wavelengths lies dormant because their minimum, quantitized energy exceeds that required for equilibrium.* Energy in all wavelengths is quantitized with shorter wavelengths having more energy per "photon" than longer wavelengths.



$$u = \int_0^{\infty} \frac{8\pi hc}{\lambda^5}\, d\lambda \Big/ \left(e^{\left(\frac{hc}{kT\lambda}\right)} - 1\right)$$

Solving the standard integral yields ,

$$u = \frac{8\pi^5 (kT)^4}{15\,(hc)^3} = 7.56464 \times 10^{-15} \quad [T\ (^\circ K)]^4\ erg/cm^3$$

This is the Stefan - Boltzmann Law .

In use today, the term black body radiation means any radiation for which the energy distribution with wavelength correlates with the Planck equation. Irrespective of the origin of the radiation in question, it does not have to be actually given off by a black body in order to be labeled "black body radiation." It follows then that during the first million years after the Big Bang, when radiation and matter were existing in *thermal equilibrium*, the universe emitted black body radiation with a temperature equivalent to that of the material contents of the universe.[7]

In an early universe going from one state of almost perfect thermal equilibrium to another, the rates of scattering and absorption of individual particles were much faster than the rate of cosmic expansion. "Of course, 'equilibrium,' here does not mean that the particles are frozen - each one is continually being knocked about by its neighbors."[8] Put another way, *objects (material particles, and photons) in the early universe collided with each other with high frequency and experienced countless nodes.*

Now having some background, can the present understanding of the universe be described in terms of the discrete, noncontinuous movements of elemental objects? In the unknowable beginning, current thought describes an ultimately dense, "point like" state of matter and space (a singularity) as giving birth to the cosmos. An instability akin to an explosion forced a rapid expansion of the singularity, and from that acceleration, emanated all matter and space itself.

Most matter in the beginning moments of the universe was in the form of radiation. At high temperatures in the early universe, the few material particles in existence essentially behaved like photons with kinetic energies much larger than that of their masses. Therefore, the infant universe consisted almost exclusively of radiation (photons) in thermal equilibrium.[9] Because the pressures were so great and the universe so relatively small, each and every photon in the nascent universe collided enumerable times with the other photons and the small contingent of material particles in existence at any given instant. *Each collision served as a node for each photon and material particle involved, an instant of zero velocity relative to each other.*

Photons, the quantum particle manifestations of wavelike radiation, have no rest mass but do carry momentum. For the purposes of this presentation, photons are modeled "physically" as

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[7] *Ibid.*, p. 58.

[8] *Ibid.*, p. 55.

[9] *Ibid.*, p. 78.

spheroid bodies, and their relativistic centers of mass (refer to the discussion at the beginning of this heading) therefore reside at the center of their spheroid bodies. Thus, photon to photon scattering can be modeled as a series of node generating collisions. [Type C collisions - see Figure 8.]

As the temperature decreased and the universe expanded further, the photons through collisions with each other started producing material particles . Much of the material particle matter in the universe was created from the initial radiation in this way. Particle antiparticle pairs resulting from these collisions, such as the electron and the positron, proliferated. Every particle born from the radiation had the legacy of its "antimatter" twin.

From the perspective of each photon involved in an annihilation event, the "approaching" photon was seen to have a relative velocity of zero the instant before they collectively vanished and their energy state changed. The moment the photons disappeared, they ceased to exist, and therefore, one can say that their velocity was zero relative to each other at that particular time. Similarly, the particles of the newly created particle antiparticle pair witnessed each other speeding away from the point of annihilation after an instant of zero relative velocity occurring at their birth. [Type A collisions - see Figure 8.]

Because the statistical conditions of thermal equilibrium prevailed (black body radiation), the Stefan - Boltzmann Law derived previously will give an energy density in given space for a given temperature. The temperature at which a particular form of particle matter can be created out of the collision of photons is called the *threshold temperature*.

The higher the temperature, the greater the energy density of the space in question becomes. At higher energies and temperatures (i.e. earlier in the expanding universe) the more exotic particles, such as the quarks, formed first because of their greater "photonic" energy needs. As the universe cooled through expansion and the threshold temperature dropped to that required for each "particle species," the particle antiparticle pairs (electrons and positrons for example) of the other constituents of matter came into being through the now familiar mechanism of "light" collisions or nodes.

In time, the particles of antimatter and matter annihilated each other. [Type B collisions - see Figure 8.] Just prior to an particle antiparticle pair "destroying" one another, the particles "observed" each other for an instant with zero relative velocity before their energy state changed into that of photons. The resulting photons are born, traveling at light speed and scattering from the annihilation point (node) at the moment of their creation. The instantaneous energy state change which created these new photons became a node event for each photon because "they" did not exist before the material particle collision occurred and can be described as having zero relative velocity before "popping" into view.

Thankfully, owing to a very tiny imbalance of matter over antimatter, matter prevailed. Known as the Fitch and Cronin asymmetry, only one material particle of matter was left after 1,000,000,000 annihilations! Eventually ionized matter (atomic nuclei - helium, deuterium, and lithium) formed roughly 3 minutes after the Big Bang due to protons' and neutrons' "binding energy" being greater than that of the cosmic background radiation energy.[10] Although the universe was expanding quite rapidly during this time, from a reference frame of an individual photon, electron, or nucleus, the mean free time between encounters (nodes) was slight as each particle was scattered, absorbed, or reemitted many times as the universe cooled and expanded.[11] [Collision Types A, B, C, and D - see Figure 8.]

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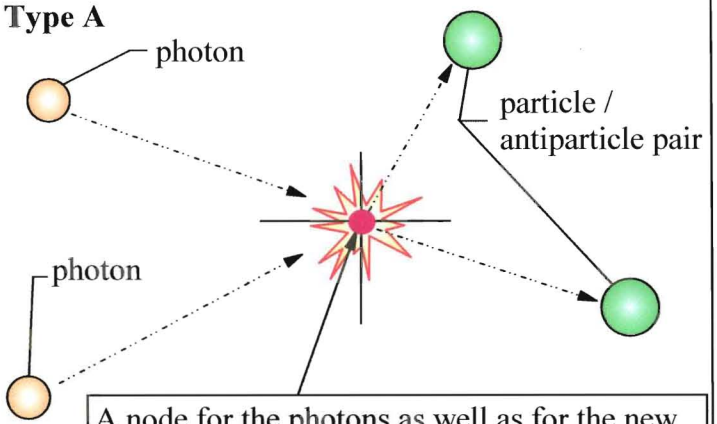
[10]Smoot and Davidson, chart found between p. 150 and 151.

[11]Weinberg, p. 55.

Figure 8

Elemental Object Collision Types

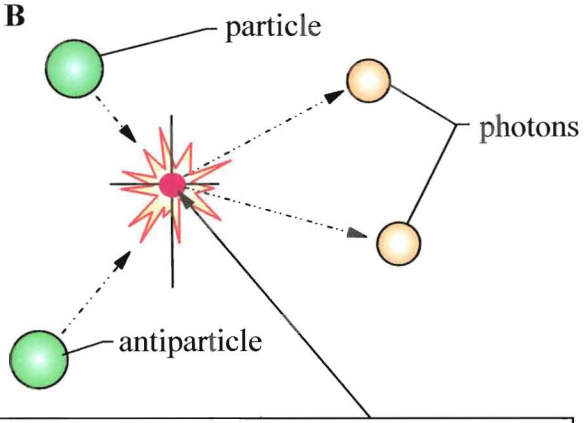
Type A



A node for the photons as well as for the new particles is created when the photons disappear and the particles appear and scatter (accelerate) from the point of creation.

Two photons collide to form a particle / antiparticle pair.

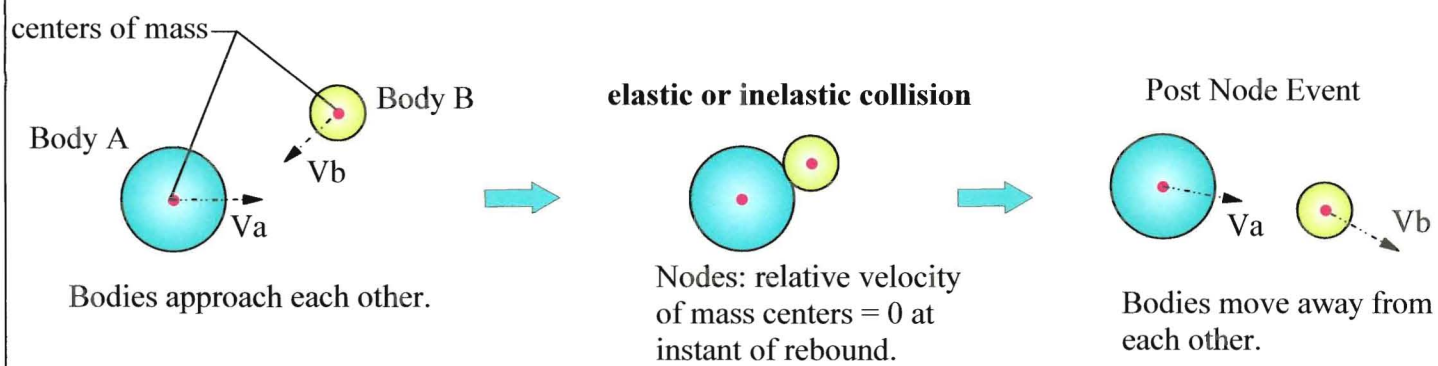
Type B



A node for the particle / antiparticle pair and the newly created photons is formed when the particles vanish and the photons emitted emerge from the point of annihilation.

Particle / antiparticle pair collide to form pure radiation.

Type C



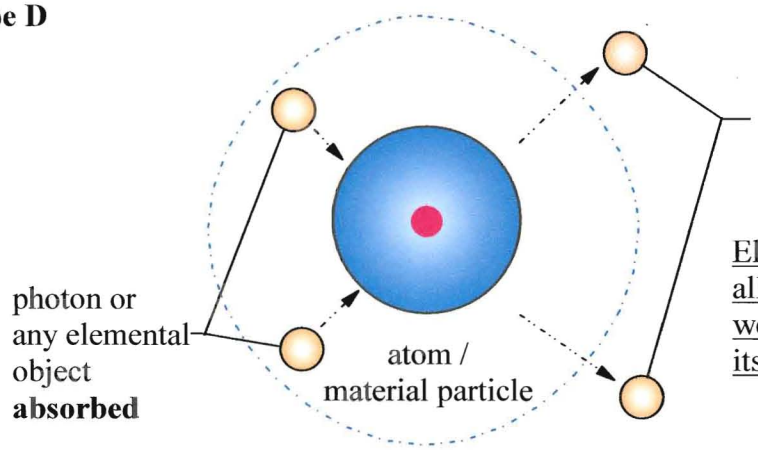
Bodies approach each other.

Nodes: relative velocity of mass centers = 0 at instant of rebound.

Bodies move away from each other.

Simple elastic or inelastic collision

Type D



<u>Elemental Object location becomes a node for all elemental objects absorbed or emitted as well as for the emitting / absorbing object itself.</u>

Elemental object absorption and emission from another elemental object

Note: Type D events are the mechanism behind nuclear fission, nuclear fusion, and nuclear radiation.

Phenomena such as photon absorption and emission by material particles or atoms as depicted in Figure 8, collision Type D, served as node events as well. Once a photon was absorbed, it effectively disappeared from further scrutiny and had zero velocity relative to the particle or atom "object" which absorbed it. The absorbing **body** "witnesses" the photon instantaneously disappearing into its "inner works," but the incoming photon's exact whereabouts are lost at that moment to the "body." What truly physically happens to a photon once it is absorbed is unknown. We can only say that it has vanished as an independent object and given its energy to the absorbing entity with the absorbing body's center of mass being the vanishing point where the relative velocities are zero. Emission of photons from material particles or atoms are also node events per the arguments put forth previously in describing photons originating from particle antiparticle pair annihilations.

Similarly, the emergence and absorption of all "virtual" gauge particles (not just the photon), are node events. [Collision Type D - see Figure 8.] These particles, also classified as bosons, are best visualized as being "tossed back and forth" between material particles. During their brief existence, they manifest a momentary imbalance between the particles "exchanging them." The strong, weak, electromagnetic, and gravitational forces are currently thought to arise as a result of this discrete mode of action.

Any quantum mechanical event portrayed in a Feynman Diagram is by necessity a discrete one with particle action depicted in spacetime that centers around creation or absorption points (nodes). A Feynman Diagram is a two dimensional drawing that greatly aides in the visualization process of quantum interactions. Named in honor of its creator, Richard Feynman, a Nobel Prize winner in physics who contributed much towards the understanding of the interaction of light and matter, these diagrams highlight the fact that node behavior is central to the quantum.

While the quantum vacuum produces non gauge virtual particles that exist on a very short time scale, these "phantoms" are not considered as *contributing* elemental objects in this model unless they interact in some way with non virtual basic objects. If and when virtual objects encounter elemental objects, the universal perspective "registers" those collisions as nodes, and the virtual objects become a "real" ones. As this paradigm develops, virtual particles will become less strange because their very "existence" will be shown to be totally expected and consistent with the "structure" and modality of what is presently called "the vacuum."

It is important to note again the *Discreteness Paradigm - that is, the notion that all elemental or foundational bodies in the universe are only seen by the universal perspective as moving between instances of zero relative velocity from the reference frame of their mass centers.* In the first moments of thermal equilibrium, when most matter was in the form of exceptionally high energy photons, the mean free time between collisions was unimaginably small.

Thus, within the dictates of thermal equilibrium at such advanced temperatures, one can rest assured that every photon in the universe had a great number of collision events or nodes with other photons and material particles. Similarly, all particle matter created in thermal equilibrium would have had many collisions (nodes) per particle.

In essence, thermal equilibrium (statistical mechanics) guarantees that all elemental objects that became the universe we live in today would have experienced at least one node (many, many more likely) in the first three to four minutes past the Big Bang. *Thanks to the busy, early moments of the standard model, all elemental matter, force, and generational objects that compose current substance danced discretely with each other from the start from the universal perspective.*

Approximately 300,000 years after the Big Bang and at 3000 degrees K equivalent temperature, the transition from a radiation dominated universe (where most of the energy was in the

form of radiation) to a matter dominated one in which most of the energy is found in the masses of nuclear particles occurred. The cosmic background radiation "decoupled," and electrons, largely free from the previous, intense, photon collision (node) environment, combined with nuclei to make stable, electrically neutral, atoms. 22 - 28% of these first atoms were helium with the remainder being hydrogen.[12] As the universe left the condition of thermal equilibrium, the legacy of this *node rich* environment will be detected by "Earthlings" 13.7 billion years later as the cosmic background radiation at 2.7 degrees K equivalent temperature.

After decoupling, but before 200 million years had past since the Big Bang, clusters of matter formed around primordial "space/time" ripples which became protogalaxies, stars, and quasars. Small variances in the intensity of the cosmic background radiation known as anisotropy were first detected by the COBE satellite and are now mapped in detail. These variances are thought to be evidence of the beginnings of these "ripples."

At 200 million years post the Big Bang, the first stars fused the primordial hydrogen into helium nuclei and synthesized heavier elements such as carbon, nitrogen, oxygen, and iron. All atomic nuclear processes: nuclear fusion and fission, as well as nuclear radiation, are represented as discrete Type D collision phenomena. Eventually after a series of supernova events combined with stellar wind dispersal, succeeding generations of stars, including our sun, evolved from the "enriched, well mixed remains." The time is now 10 billion years past the singularity.

As the sun coalesced, condensing from the interstellar debris, and ignited, it spun out of its own mass a nebular disk made of objects of various sizes. In time, the process of accretion produced the earth and the inner planets while dissipation created the outer gas giants. This was a particularly violent time in the new solar system as millions of collisions with nebular "planetismals" (bodies smaller than the planets themselves) rocked the inner planets. The severe scarring of the surface of the moon, Mars, and Mercury are left as reminders of this period in the Earth's history.

Chemical reactions forged atoms together in this environment to form molecules and their associated various states of solid, liquid, and gas. *The birth of molecules, compounds, and higher generational states of elemental object organization over the atom serve to modify the character of discrete movement but do not change its basic mode of action.* **Thus, *atoms* in all states (from being parts of solids on earth to being members of molecules in interstellar gas) represent the most complex form of *elemental* object considered in the narrative of this investigation.** Ultimately, mankind arises on Earth, bringing this account to the present day, 13.7 billion years after the Big Bang.

All of the events described occurring after the decoupling of the universe can be characterized in terms of the collision Types A, B, C, and D outlined previously. Post coupling, the elemental constituents of mass and light in the universe still "observe" each other moving between instances of zero relative velocity (nodes); they just "meet" each other with less frequency under generally cooler conditions when compared to the radiation dominated era.

The Discrete Motion Paradigm exposes a **common theme** in the seemingly chaotic universe. Through the collective eyes of the substance of the cosmos, *the universal perspective*, one can see that every instance of elemental relative motion is but one more segment of a series of noncontinuous "steps." Each step being a collision event or node for a basic object where the velocity of its mass center is zero for an instant of time relative to another basic body's mass center. Essentially, the universe to date can be viewed as an immense "collidoscope" in which the slowly declining frequency

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[12]Smoot and Davidson, chart found between p. 150 and 151.

of elemental collision events over time, if matched with appropriately weighted shades of color, reveal themselves. See Figure 9.

While most of the subject material so far has involved a recitation of the birth of the universe in light of the *Discrete Motion Paradigm*, the ideas introduced under this heading might also lend more credence, by way of consistency, toward one of three, possible, envisioned, long term fates of the universe. Simply put, one of these scenarios is much more compatible with the *universal perspective* developed above:

1) The universe continues to expand indefinitely with the mass of the known cosmos not sufficient enough to allow gravity to overcome the present expansion (an open universe).

2) The expansion will be reversed by gravity assuming enough matter exists in the universe. An inward acceleration under gravity causes the matter of the universe to ultimately revert again to a state of singularity, the "Big Crunch" (a closed universe).

3) The universe expands forever, but the expansion rate approaches zero (a flat universe).

At the present time, a preliminary verdict has come in from the WMAP (Wilkinson Microwave Anisotropy Probe) spacecraft as to whether or not the universe will halt the expansion *under current scientific models*. Astrophysicists are continually on the lookout for matter which has yet to be discovered, hidden in exotic forms or places, that would make a strong case for one of the above three outcomes. WMAP data indicate that 74% of the matter in the universe is "exotic dark energy" and 22% is "cold dark matter." Regular matter composes only 4% of the universe! WMAP science has found that the universe is flat (option 3) by accurately measuring the angular width of the brightest primordial, microwave background fluctuations.

The Discrete Motion Paradigm suggests the universe behaving in a "closed" fashion from the viewpoint of theoretical aesthetics and coherence. The universe and its component, "citizen" foundational objects simply evolve between ultimate, large, "communal" nodes: The Big Bang is the "opening bell" from which *discrete* movement begins, and the Big Crunch sounds the "end of the trading day" where all noncontinuous movement ends. In between, all transactions are "brokered" in smaller steps (nodes) where elemental objects' mass centers stop and start with relative velocity in mind. Although a "closed universe" implies that space has a finite volume under current cosmology, the implications of infinity brought up earlier will suggest otherwise. Put another way, there may not be a direct link between the geometry of the universe and its fate as is currently thought.

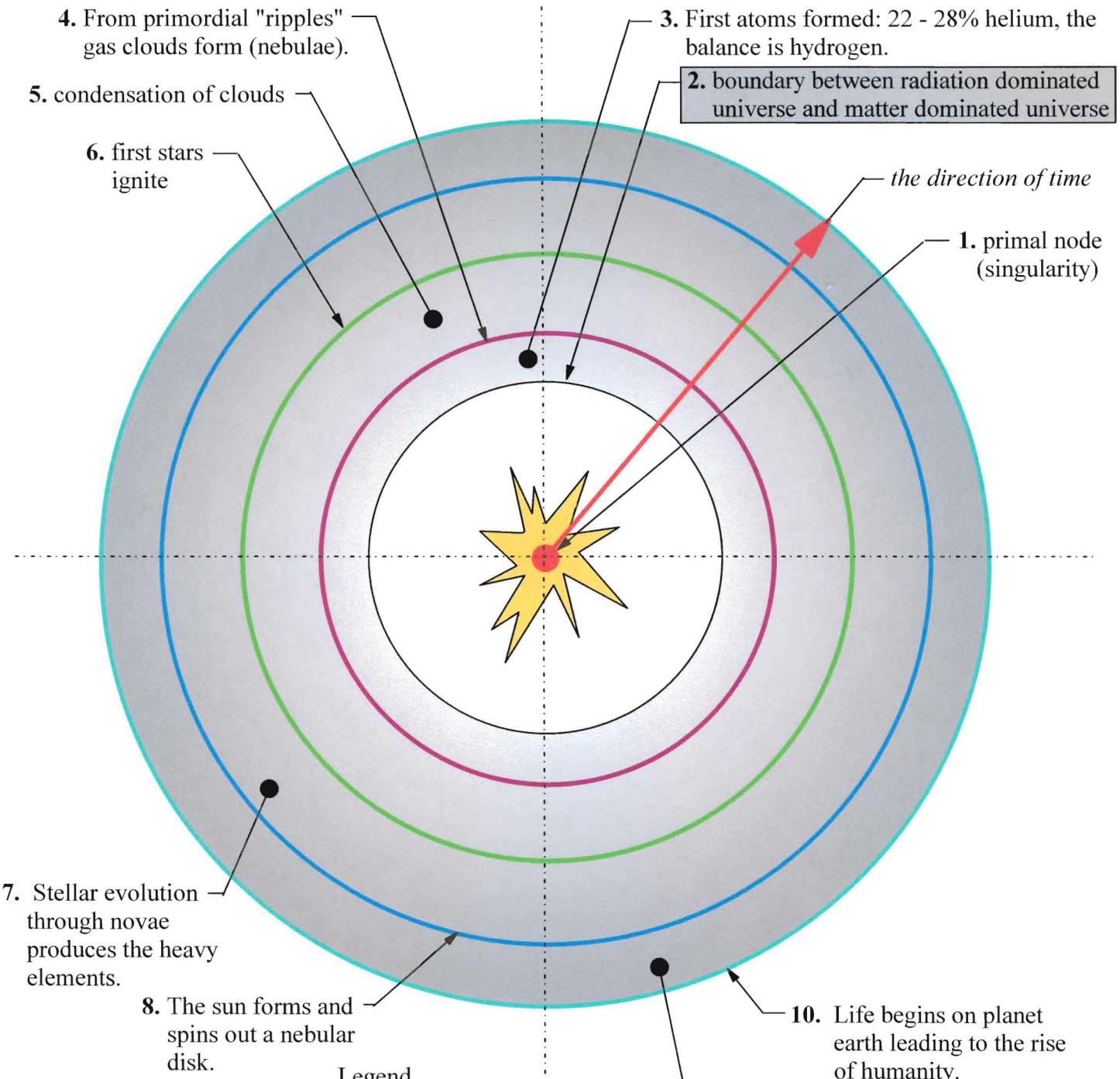
Much of the development and exposition of the ideas presented thus far has departed from the direct, day to day, observations of human beings for illustrative and foundational purposes. The *general* theory of discrete motion describes how all elemental objects' mass centers move between instances of zero relative velocity from the universal perspective. Now it is time to return to the world of the VCR / DVD player mentioned in the beginning to discover how *"special"* discrete motion enables "movie actors" to understand each other as well as the script and gives a film meaning - one step at a time...

The Basis of Abstraction

A better understanding of the concepts that follow dictates that the relative formalism in language associated with a writing of this kind be temporarily suspended until the next heading.

Figure 9

History of the Universe by Collision Event
The "Collidoscope"



While a more "sophisticated" presentation of arguments might satisfy an academic audience, a more transparent, less encumbered approach allows for improved comprehension among all readers. Thus, the first person will be used for didactic purposes here. With that disclaimer done, onward...

In the production of any good movie, people with an abundance of talent and a myriad of skills work together over a period of time toward the goal of a finished film. Whether the final product is Oscar material or not, a movie set during production is a hub of activity which encompasses a broad, rich spectrum of human thought, movement, and expression. It is for this reason that I have chosen to use the activities associated with a fictitious movie set as the backdrop for this discussion.

Producers, directors, actors, cinematographers, set designers and builders, script writers, musical score writers, wardrobe specialists, sound and lighting technicians, and special effects mavens all contribute to the final cut in different ways, but all use the same "hidden device" as a means of expressing their talents. The greater analogy to be drawn here is that all of us as human beings in any capacity use this identical mechanism or tool as integral to forming the concepts that shape and cradle our shared reality. The "greater movie" that *is reality,* composed of our abstractions, incorporates common methods of "production" with the cinema that is art. Carl Jung once commented on (abstraction) fantasy in this way:

> "When a man has a certain fantasy, another man may lose his life, or a bridge is built... Everything you do here - all this, everything, was a fantasy to begin with, and fantasy has a proper reality. That is not to be forgotten; fantasy is not nothing. It is, of course, not a tangible object; but it is a fact, nevertheless."[13]

Jung realized that fantasy (abstraction or thought) in essence "creates" reality. Although he remarked that fantasy is not tangible, I hope to demonstrate how the genesis of our thoughts very much depends upon a tactile process. We will examine and expose this foundational link and the consistency between the abstraction of the mind and the reality that results. By spending time with various people on the previously mentioned, hypothetical, movie set, commonalities that relate their activities will emerge. Now for illustrative purposes, I will take the role of a correspondent for a large newspaper doing a "piece" on a *behind the scenes* look at what's involved in making a major motion picture. Lights, Camera, Action...

Driving to the studio, I'm gratified that the production executives have given me carte blanche. This is a major movie in the making with some of the most popular stars in lead roles. The film is called *Timeline* and is based on the very real science fiction novel of the same title by Michael Crichton. (At the time of this writing, no actual movie based on Crichton's book exists. However, that does not preclude the highly probable fact that it may be produced in time.)

Passing through the guarded gate, I park my rental car in the nearest visitor's spot. As I gather my mini tape recorder and note pad, I do not lose my alter ego as the writer of this book, the one you are reading. In other words, I bring with me to this latest assignment all of the ideas presented in the previous sections, and these thoughts will be in my mind as I begin my day on the set.

Because a film's music or sound track must represent the overall feeling and mood of the story being told, I've decided to go first and interview the man responsible for writing the original score for

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[13]Carl Jung, in an interview with Richard Evans in *Jung on Elementary Psychology.*

the entire movie. Luck is with me today because I will get to drop in on and observe the last rehearsal before the final tracks are recorded. I take my place sitting in the back of the studio among a few other guests as the orchestra musicians are completing their warmups. As the musicians ready themselves, I ponder the plot of the movie:

Timeline is a story of adventure set in "two different epochs" where "present day" academicians (historians) travel back in time on a rescue mission. Using new found technology, a small group goes back to medieval Europe to save a colleague and professor from an early demise, who after a similar voyage back in time, is trapped in feudal France. The story gets very interesting indeed when the protagonists (academicians) discover that unscrupulous men from the present have travelled back to this era and assumed roles of leadership.

A megalomaniac president of a "present day," secretive, high tech firm provides the means of time travel through proprietary devices based on a new paradigm in physics. Bent on using time travel as a mass means of entertainment and thus earning large profits, the former scientist turned businessman could not have predicted that some of the people he had sent "in" to scout out the past would decide to stay there in order to satisfy their own blind ambitions.

Using their expertise in order to extricate the professor, the academicians do their best to blend into this strange world from the past that they have made a life of studying. In the process of recovering the professor, many swashbuckling and dangerous exploits ensue...

In a few minutes, the accomplished score composer appears and assumes the conductor's podium. He's dressed in a black turtleneck shirt with long sleeves and is ready for business. After a few initial instructions, the music starts. I muse that it's quite a rare opportunity to listen to original music of this calibre at this stage of its development - before it has even been recorded once!

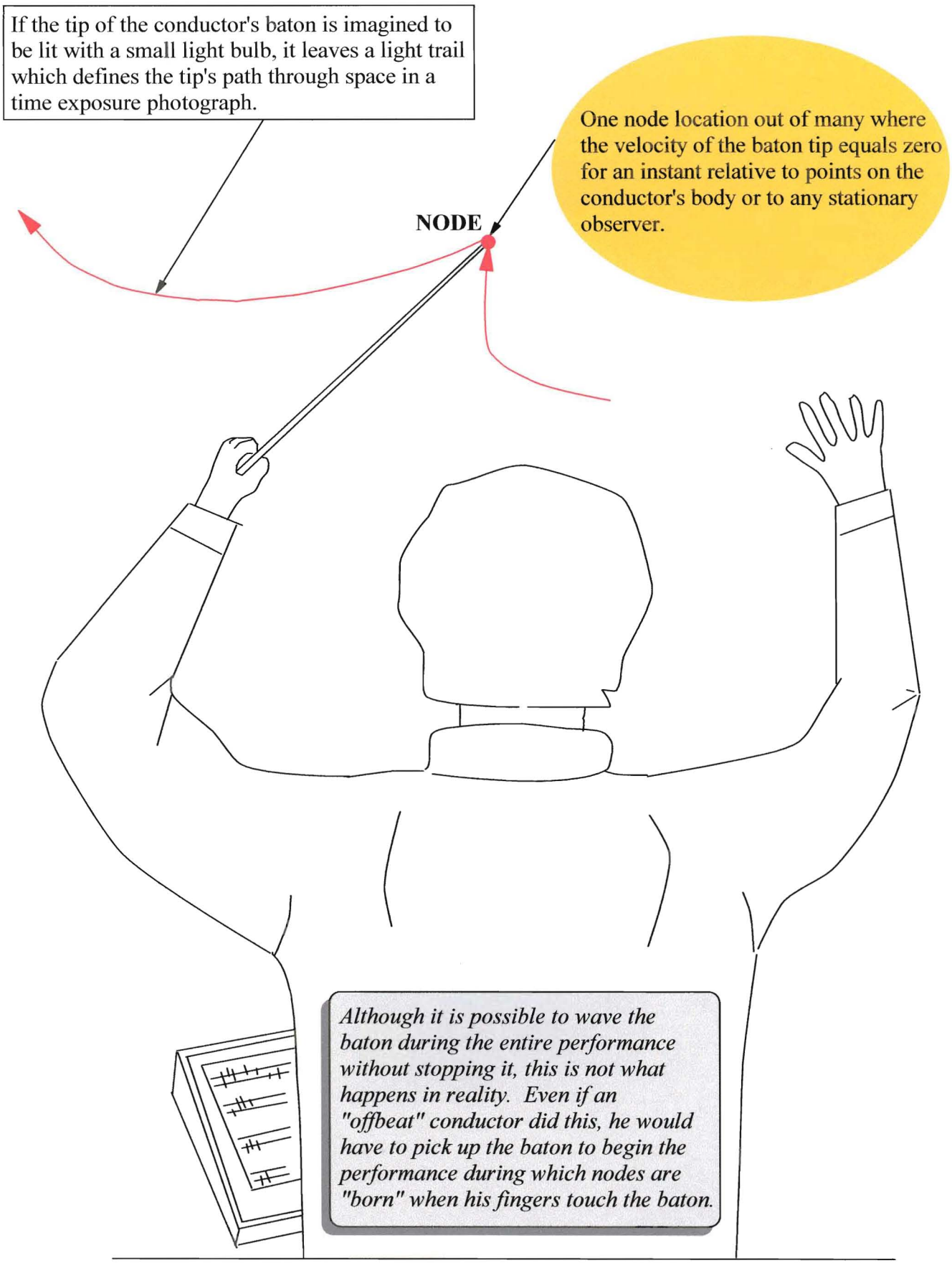
The main theme of the composition is quite dynamic, using all the instruments that a symphony orchestra can muster and then some. I notice light "spots" flashing in rhythm with the musician's movements as their brass instruments reflect the studio lights about the darkened room. *Back and forth the reflected light spots move.* The string section and its composite bow movements are somewhat hypnotic in effect, especially when choreographed by necessity to the music. *Up and down go the bows.* Watching the woodwind players moving their fingers, I note their fast and dexterous fingers moving up and down and back and forth across their instruments.

Reaching a pivotal portion of the score, the composer/conductor really feels the emotion of his music, and his baton dances rapidly with verve in all directions. Paying particular attention to the conductor at this point, I observe that while the movement of his baton seems chaotic to a musical novice such as myself, it is by necessity in step with the score's meter. More than that, there is a hidden simplicity that characterizes the baton's movement - its tip without fail stops and starts relative to the maestro's body or relative to any "body" in the recording studio for that matter.

This effect becomes quite pronounced as I visualize the tip of the baton as being a miniature light which leaves a streak of light defining its path as in a time exposed photograph. As the baton sweeps around in various movements, my imagined light path highlights the "node behavior" of the tip of the baton. See Figure 10. The tip's velocity relative to the conductor is zero and then returns to zero periodically throughout the performance. **A *special* form of discrete motion has revealed itself as pivotal and integral to the production of music this morning!**

Not only in the motion of the tip of the baton does this *special* discrete movement become apparent but also in the playing of all the instruments - fingers, keys, drumsticks, slides, and bows all containing reference points, not necessarily on their mass centers, which move between instances of

Figure 10
The Concept of Motion Tracing



zero velocity relative to other non mass center locations. *The tenets of general discrete motion are still very much in effect because the mass centers of the atoms composing the musicians' bodies and instruments are moving between nodes relative to the universal perspective (mass centers of other elemental matter and light objects) whether they are playing or not.*

However, it is more convenient many times for illustrative purposes to refer to the special case of discrete motion over the general one: the special case being the existence of "imaginary" or theoretical points on bodies not at the center of mass of an object that also display discrete movement behavior in relation to other points or a general stationary observer. For the rest of my visit on the set, I will reference mostly the special case. **The general case is ongoing and ever present in the discrete movements of elemental objects from the universal perspective.**

After listening to the rousing soundtrack, I have some time scheduled to interview the composer. Asking a series of standard questions regarding the inspiration for what we had just heard, I decide to get from the source some basic ideas of how original music as a concept of expression is born:

Q. *How exactly do you begin the large job of composing music for a major motion picture?*
A. First, I try to immerse myself in the script. By that, I mean that I look to get a feel for what the script writer and the director have in mind for the pace of the film, its messages, if any, and the physical nature of the sets, both in the studio and on location. Once satisfied on these fronts, I can begin my task in earnest.
Q. *How do you synthesize the first elements of major melodies? Do they just come to mind after considering the elements you just mentioned?*
A. Well, it's a little more involved than that; actually, I usually sit down at the piano in my study and after some moments of contemplation begin to piece together a melody. I get a few notes going in my head and then try them out on the piano. For me, it's an iterative process, the base inspiration comes from my mind and my musical experience, but I need the piano and lots of time to work out the details of the final score.
Q. *So, the piano is integral to the creation process?*
A. Yes, most definitely. Although different composers have differing requirements as to how much physicality they require for composition, most of us would say that some instrument is needed to aid in the creative process. Hearing the notes come back at you from an instrument instead of "playing them in your mind" allows a composer to add textures to piece of music that normally would not be possible otherwise.

I thank the Maestro for his time and congratulate him on his spirited music and performance this morning. *After this interview, I conclude that special discrete motion plays a large part in the composing of music, not just solely being the key to its reproduction.* Before going to an eagerly anticipated catered lunch on the production set, I have the opportunity to watch the filming of a pivotal scene in the film in which the "time traveling" rescuers are chased about a castle after being discovered.

Because this scene involves "special effects" and much physical action on the part of the actors, the director makes a large effort to minimize the number of takes required to finish the scene. I notice that prior to shooting, the actors gather in small groups rehearsing their lines making sure that they will deliver their dialogue correctly and on time. Just as with the orchestra earlier in the day, I witness a subtle commonality emerging in the midst of the busy, noisy set.

Within each group of actors going over their lines, although I cannot not hear their actual

words being spoken over the din, I can see their lips moving in a discrete manner: opening and closing, pausing relative to each other and to me for a moment periodically. Their tongue movements are also discrete, stopping and starting relative to linguistic points of articulation (spots in the mouth required to produce certain sounds).

Again, using the motion tracing concept, the "light paths" of arbitrary points on the actor's lips and tongues display special discrete behavior: coming together, stopping their motion relative to each other or to an observer and then moving apart. See Figure 11. **I begin to realize that as with the production of music, language itself depends upon reference points on "objects" that move discretely in relation to one another.** Sign language as a means of expression is more obviously a special discrete motion exercise with points on the hands, arms, and fingers moving quickly between instances of zero relative velocity in relation to points on the "speaker's" body and to each other.

All of the practice and preparation of the actors pays off as the action filled scene goes without a hitch, and the youthful director with a smile yells, "Cut, that's a wrap." Along with the movie knights and damsels of feudal Europe, I then enjoy a festive lunch on the set, admiring the detail in the period clothing of the hungry cast all around me.

After eating with the cast and being inspired by the elaborate costumes worn by the actors, I ask if there are any period sets currently under construction. I'm told that there is indeed a rather large, interior castle, banquet hall backdrop being built in another area of the studio lot today. After getting directions to the banquet hall set from a studio carpenter and after a ten minute walk in the windy but sunny, southern California, autumn afternoon, I arrive at the construction site where the hectic sounds of circular saws and banging hammers greet me.

The set is quite cavernous and has three sides which form the interior walls as well as a detailed roof. Construction workers work with speed and skill as the "castle dining room" has to be finished by tomorrow for an important scene. Following the completion of the interior walls, artists converge on the work in progress, and by using paint and foam, create the illusion of stonework on the walls.

Artisans of different skills contribute to a convincing atmosphere in the castle: Woodworkers put the finishing touches on an immense table and chairs. Oil and canvass artists work to produce art that will adorn the currently bare walls. Metal craftsmen fashion various items including wall mounted "torch holders." Woodcarvers add detail and "age" to interior doors as sculptors and potters fabricate feudal dining table accoutrements and decor.

Slowly dying down to an ebb from a noisy flow, the bustle begins to subside as a very convincing feudal dining hall emerges. **As I watch the finishing touches being applied to the set, I ponder the fact that the physical reality of this construction project in all its details has only been achieved as a result of special discrete motion.**

Craftsmen and artists handling tools and working with materials in a *discrete, noncontinuous fashion* collectively have recreated the unique setting of a medieval banquet hall. Every hammer, saw, screwdriver, tape measure, square, drill, knife, punch, chisel, spatula, and paintbrush was picked up from rest at some point (a node for both points on the tool in question and for several points on the hand of an artisan) and then discretely used in the special case in conjunction with some material, whether it be wood, metal, wallboard, foam, canvass, clay, or oil based paints, before being laid to rest. See Figure 12. Even the construction materials and artists' supplies themselves were manipulated discretely in the special case, with points on all going from one instance of zero relative velocity to another before finally resting relative to each other in the finished set.

Now five in the afternoon, my day at the movie set of *Timeline* draws to an end. I take my last look at the detailed, recreated, dining hall before setting off to the parking lot where I had earlier

Figure 11
Special Discrete Motion as Integral to Speech

Actors in *Timeline* rehearse lines before makeup and wardrobe.

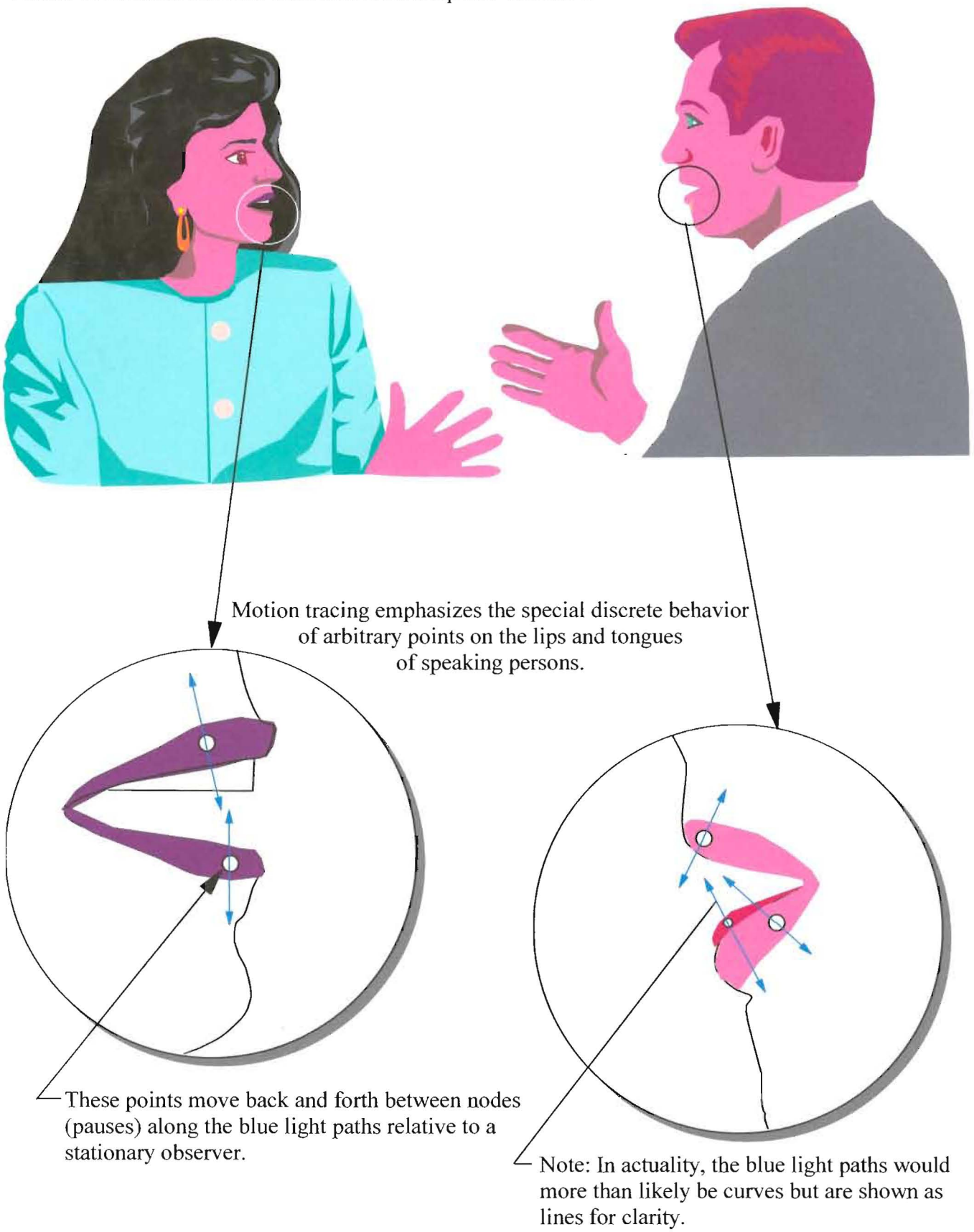
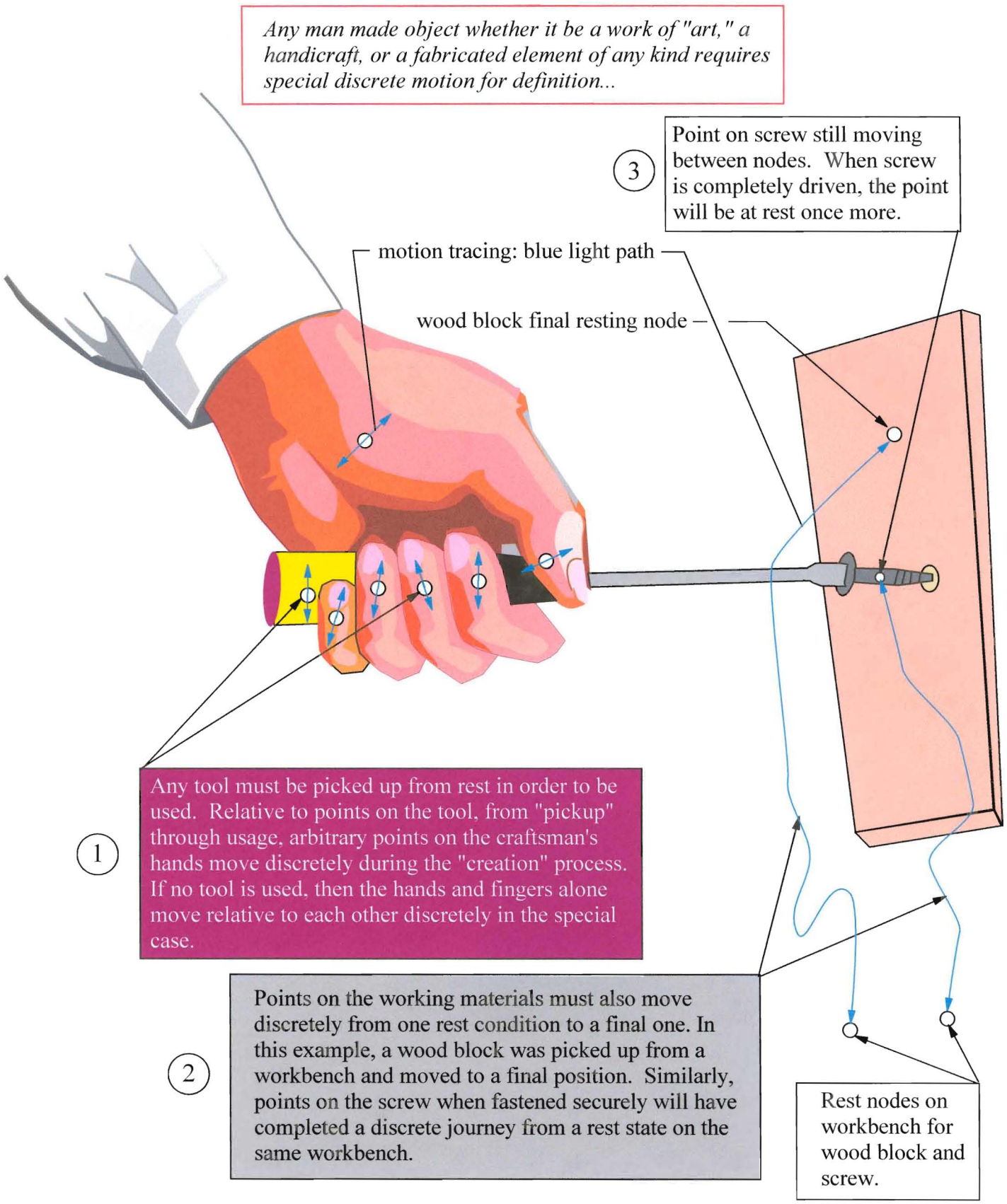


Figure 12

Special Discrete Motion Responsible for the Physical Geometry of Manufactured Objects



left my almost new, rental car in the morning. It's a long but pleasant walk between many studio buildings with an orange, setting sun in my face against a richly blue sky.

Along the way, I review my observations made during my visit to the Hollywood studio in relation to the musings of Carl Jung mentioned early in this chapter. The idea that *fantasy creates reality* was the gist of Jung's comments. At this moment, I begin to understand a greater commonality forming against the backdrop of the day's events:

Fantasy is related to abstraction. While fantasy connotes more whimsy than abstraction, both words denote an active thought process. Thinking involves the use of abstractions, and fantasy is a connected collection of such thought. In this way, abstraction, being a sub unit of the thinking process, is more fundamental than fantasy. What then is an abstraction "made of?"

Intelligence and thought require the "art of abstraction" which is the ability to use symbols (creations of the mind) in describing physical and nonphysical phenomena or to produce a desired effect. On the movie set today, I had witnessed several prime categories of abstraction that had created significant "realities," and they all involved special discrete motion. *After thinking a bit more along these lines, I surmise that all levels of abstraction and human endeavor are built from four basic categories: art, music, mathematics, and language.* While this list is seemingly a short one, after closer inspection, I am satisfied that the list is indeed comprehensive. **Most importantly, each of these categories of "base" abstraction is defined and given meaning exclusively by the phenomenon of reference points on objects moving in a discrete fashion (special case).**

In the instance of art, I reflect upon the activity I witnessed during the set construction of the feudal dining hall. In order to realize any of the paintings that adorned the walls of the castle, an artist picked a set of pigments and then applied them to the canvas. But in applying the paint to the canvas with subtle strokes, the artist invoked special discrete motion. His brush must stop and start, and the motion was modulated, confined to the canvas.

By using the motion tracing concept, I saw that any painting, sketch, sculpture, building construction or handicraft of any kind can only be realized through special discrete motion occurring in a particular event space. Geometry and the abstraction of void discussed in the first section are considered part of this "art" category because their conception requires a diagram or "picture" of some kind to be drawn (special discrete motion).

Similarly, in the realm of music how are the multitudes of frequencies and intensities produced that are characteristic of the broad spectrum of instruments available? Forgetting the musical ability of the musician for the present and concentrating on the means of production, I see that all initiation of sound is totally dependent on special discrete movement. A drummer's movements are obvious. Any woodwind, brass or horn player requires that his lips, fingers, and diaphragm move in a special case discrete manner. Utilizing the motion tracing concept, an opera singer's well exercised vocal cords and lungs can be seen to be moving in a similar manner. A pianist uses the keyboard as the visible boundary of his special discrete movements.

The Maestro in his interview with me today also strongly suggested that music with any complexity of composition is best composed with an instrument nearby. The implication being that special discrete motion is necessary in developing new music. While it might be possible for a music prodigy to sit down and play beautiful new, rich music the first time through without previously using an instrument for feedback and reference, the composition will reside exclusively in the composer's head until an instrument is played.

Not having a physical means of expression (special discrete motion) guarantees that the prodigy's "music" will be untranslatable to others, and thus, his music cannot be repeated or performed. The prodigy could write his music down in a score, but that process is obviously an

exercise in special discrete motion and as such, renders his music translatable to others as abstraction. Music also necessitates a sense of timing, the ability to count beats, and this thought leads me to consider the realm of mathematics as I'm halfway to the parking lot.

While none of the activities during my day on the set directly demonstrated how abstractions of a mathematical kind rely on special discrete motion, my walk gives me time to fill in the gaps and formulate some consistency. The essence of mathematics is making equivalence and non equivalence statements: saying one quantity is equal to, greater than, or less than another. In order to make comparisons of magnitude, the concept of integers or counting numbers became necessary. But what is a number? It is an abstract construct which requires special discrete motion for definition...

As an exercise, try defining the number three to someone, assuming they have no idea of what the number three represents. There exist only two basic options. You can point to three objects and announce that is three or you can tap on a surface three times. Either way you have utilized special discrete motion for your definition. In other words, numbers have no meaning without a special case, discrete motion definition.

Physical clarity mimics my thoughts as my footsteps create rhythmic nodes with the pavement of the street I am walking on. Each step personifies a potential new integer, and each building I pass represents the same opportunity for "counting." Every studio building (a man made object) as mentioned earlier can only be realized as a result of special discrete motion activity. I can only "count" separate, individual objects which owe their genesis exclusively to this process of motion that stops and starts relative to an observer (universal observers in the general case).

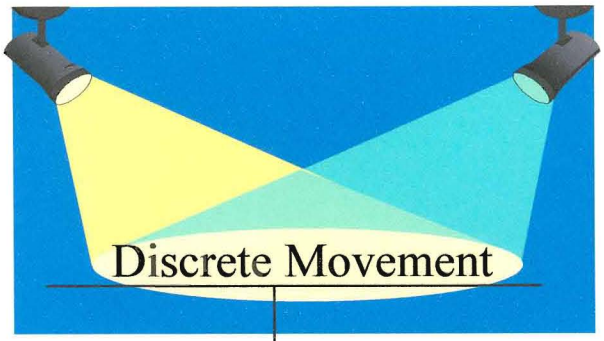
Algorithms of any kind require comparative quantitative statements in order to function: If $a > b$, then go to..., If $a < b$, then go to..., etc. In a flow chart of logic this redirection represents a node for any data being quantitatively analyzed and sorted. A data stream is static for an instant while it is being evaluated for disposition in any computer. No quantitative comparison is possible without introducing a node in the flow of logic. The "gatekeeper" of mathematical musings always incorporates at least one relative "stop" sign, if only for an instant, in any abstraction of the mathematical kind.

Likewise, language and linguistic ability are learned uniquely through special discrete motion definition. Children acquire any word, be it noun, verb, adjective, or adverb, in any language by the discrete actions of adults. For example, a young mother might glance and point to her husband exclaiming "daddy" to her infant. Soon "daddy" becomes an integral part of her infant's budding vocabulary thanks to her special discrete method of denotation. Once again, the act of writing is the "quiet" transcriptional form of the "language abstraction" and is totally dependant on a writer handling objects with points on them that stop and start in relation to each other.

Any linguist will tell you that humans mechanically speak as a consequence of tongue movements and points of articulation. By watching the actors on set today, and applying the motion tracing concept to them as they spoke their lines, I saw that the movement of their lips, tongue, vocal cords, and diaphragm was discrete in form. Therefore, all aspects of language, from the production of sounds to the imprinting of language skills, is a special discrete motion exercise.

In summary, the special case of discrete movement is the foundation of all abstraction, what most consider the quintessential ability which separates humanity from all life on earth and inspires our noblest moments. As previously discussed, art is the realization of a physical geometry or object through discrete movements. Music requires discrete movement for composition and reproduction. Mathematics exists as a science of comparison which requires discrete movement to define the basic unit of comparison, the integer. Language is that collective body of associations which needs discrete motion for definition and articulation. See Figure 13.

Figure 13
Discrete Movement



The primary association is that all elemental objects stop and start moving relative to each other's mass centers from the *universal perspective*.
General Case

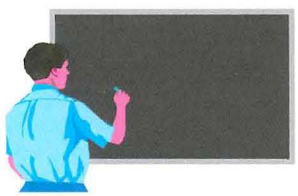
Basis of all Abstraction

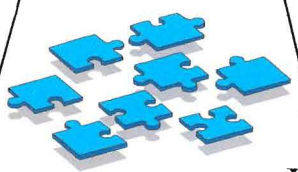
"secondary associations"
Special Case

MATHEMATICS

Science of comparison which requires *special discrete movement* to define the basic unit of comparison, the integer. (Quantitative)

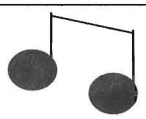
$a + b = 1,\ c - 2 = 0$





MUSIC

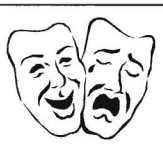
Special discrete movement necessary for production and documentation.



LANGUAGE

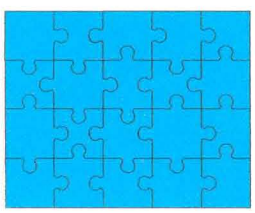
Common associations that require *special discrete motion* for definition and articulation. (Qualitative)

Je suis une fille.



ART

Special discrete movements define physical geometry.



The many pieces of a common thread which together complete the picture of the tools of awareness.

While these base abstraction categories are fundamental in the sense that they represent the main divisions of abstraction that we use to think, create, and communicate, I decide to refer to them as **secondary associations.** I do this because they are all *predicated* on and reflect the primary observational association (the general case) that all elemental objects in the universe stop moving and then start moving again relative to each other for some portion of their history from the universal perspective. Special discrete motion represents a subset of the general case and without it, there exists no ability to abstract.

Additionally, our five senses only respond to stimuli generated by means of general discrete motion. Eyes only react to light that "strikes" rods and cones, specialized cells on the retina. The impact of the photons with these cells is a general case node event. Ears only hear sounds after pressure waves cause the tympanic membrane (ear drum) to vibrate between nodes (general case). Noses only smell after molecules come in contact with olfactory sensing cells (general case node event). Skin only senses touch after something has been touched (general case node event), and tongues only taste when food has been placed on the tongue's receptor cells (general case node event).

Research has shown that if the human brain is not stimulated adequately in each sense during a critical period in an infant's development, the ability to see, hear, smell, taste, or touch is severely damaged or lost totally. This means that the music composer prodigy discussed previously, if deprived of discrete, sensory, auditory input, could not even muster an internal melody of chopsticks.

By now, I'm opening the door to my rental car, returning to it for the first time since I left the studio parking lot this morning. As I sit in the driver's seat and prepare to leave, points on my hands and body are returning to rest and moving again relative to points on the car. Turning the ignition key brings the engine to life. Putting the transmission in reverse, pressing the accelerator, turning the steering wheel, putting the car in drive, and pressing the accelerator again all cumulatively propel me past the studio guard at the gate who waves me on. I wave good-bye to the guard after a long day well spent. Driving to the airport, I am caught in an typical Los Angeles traffic jam. At a fundamental level, I begin to speculate on how best to quantify the movements of my car or anything else that moves, my present predicament serving as untimely inspiration...

Quantification of Discrete Movement

By identifying and scrutinizing the "everyday themes" or phenomena that make up day to day living, one could perhaps gain insights which point toward a greater understanding of the human physical condition. So far, it's been shown how the fingerprint of infinity surfaces when analyzing the true character of any space. This realization is theme one.

Later, the pervasiveness of randomness (uncertainty) and its role as a discrete agent of action in fundamental science and in people's lives otherwise was discussed. This observation is theme two. Generating the Sierpinkski Triangle by a random process reinforced these ideas when an infinitely regressing pattern was born, incorporating nested, outwardly bound space (void).

Recognition of the fact that all motions of any elemental object are discontinuous from the "universal perspective," was presented as the *general case* of discrete movement - theme three. Additionally, the discrete motion of imaginary points on any object (the *special case* of discrete movement) was shown to be the basis of all abstraction.

The reader should keep all of these concepts in mind because they will be reintroduced and integrated later as parts of a greater, more meaningful whole, the description of which is the aim of this work. For now, this inquiry will dig deeper and consider how to best quantify discrete

movement, a process of interaction that encompasses and defines the human experience.

In the top half of Figure 14, a three dimensional "event space" which contains two node events and a path between them is shown. This path, illuminated by the motion tracing concept, is the path of an elemental object's center of mass (com) as it travels between nodes a and b. Any two consecutive nodes and the path between them defines a **basic structure** for the interaction of elemental objects in the universe as outlined previously. That is to say, an elemental object's mass center can be viewed as going from one instance of zero relative velocity to another from the universal perspective. *(Photons, having no rest mass, will be "dealt with" later in a consistent manner.)*

Now, how can the dynamics of this base structure best be quantified? Because the conservation of energy is such a foundational law in physics, an energy approach would seem appropriate in describing the dynamics of the base structure. Energy or work is defined as:

$$W = Fd$$

Where W *(in watts) is the work done on a body, and* F *is a force acting on that body (in newtons) in the direction of a displacement* d *(in meters).*

Or more generally in vector notation : $W = F \cdot d$

From Newton 's second law of motion : $F = \frac{dp}{dt}$ *Thus,* $W = \frac{dp}{dt} \cdot d$

Where p *(in kg m/s) is the linear momentum of a body given by:* $p = m v$

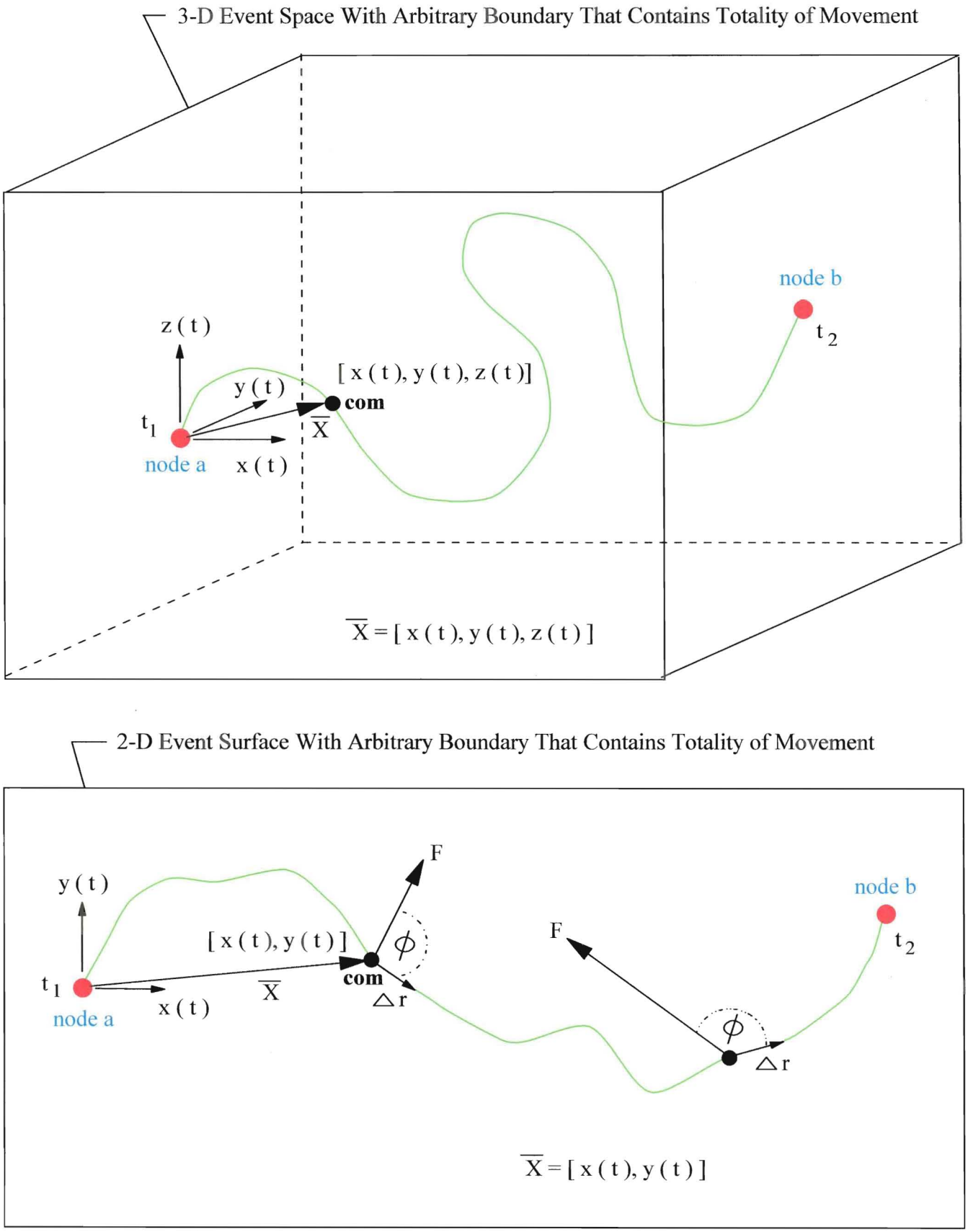
Consequently, a relationship exists between the change in momentum of an elemental object and the work done on it: work being the energy applied to the "body."

The lower half of Figure 14 depicts a two dimensional version of the three dimensional *basic structure* shown above it in the figure. *Located at the first node of the basic structure is the origin of the coordinate system which will be the reference frame for this discussion.* Also, a vector is shown which locates or "tracks" an elemental object's center of mass (com) as it journeys between nodes and in particular, nodes a and b as shown. This vector's coordinates (x and y) are functions of time:

$$\overline{X} = \left[x(t), y(t) \right]$$

A resultant, variable force **F** will act on the elemental object's com between nodes a and b. **F** will vary in both magnitude and direction, and as it does so, becomes responsible for the variances in linear momentum the object experiences between nodes on the path. While elemental objects in motion can possess both translational and rotational energy, the rotational energies (if any) of the elemental objects due to angular momentum changes will not appear in this basic structure quantification scheme. Because elemental objects are idealized as being ultimately small spheroids of mass *m* with a center of mass (com) at their geometric center where **F** acts, no energy due to rotation is seen at point com. *Only the com displacements between nodes are to be considered.*

Figure 14
Discrete Movement Quantified



A common derivation in physics yields the work done on the elemental object on the path between nodes a and b:

$$W_{ab} = \int_a^b (F_x\,dx + F_y\,dy)$$

Integrals like the one above are called *line integrals.*[14]

Generalizing to the three dimensional case, the line integral for the work done on an elemental object between nodes a and b becomes:

$$W_{ab} = \int_a^b (F_x\,dx + F_y\,dy + F_z\,dz)$$

The *work-energy theorem* states that the work done on a *particle* by the resultant force is always equal to the change in kinetic energy of the particle. **In this case, an elemental object has an initial kinetic energy at the instant of leaving node a and has a final kinetic energy at the instant before experiencing node b.** Therefore, the change in translational kinetic energy between nodes a and b is equal to the work done by the force **F** on that path. Keeping in mind that elemental objects routinely travel at velocities that are a significant portion of the speed of light, (c), one must account for mass variance as stipulated in special relativity to calculate the work done between nodes a and b:

$$W_{ab} = \int_a^b (F_x\,dx + F_y\,dy + F_z\,dz) = \frac{1}{2}m v_b^2 - \frac{1}{2}m v_a^2 \rightarrow (\Delta m c^2)_b - (\Delta m c^2)_a \text{ thus,}$$

$$W_{ab} = \left| \left[(m_r - m_0)c^2\right]_b - \left[(m_r - m_0)c^2\right]_a \right|$$

Where m_r is the relativistic mass of the elemental object and m_0 is the rest mass of the same object.

Given that: $m_r = \dfrac{m_0}{\sqrt{1 - (v / c)^2}}$ *and substituting into the above equation and simplifying gives:*

[14]Halliday and Resnick, p. 122, 123.

$$W_{ab} = \left| \left[m_0 c^2 \left(\frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} - 1 \right) \right]_b - \left[m_0 c^2 \left(\frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} - 1 \right) \right]_a \right|$$

$$\text{with } v = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2} \quad \text{at a given time } (t)$$

While the above equation yields suitable results for the work done on elemental matter objects between nodes a and b, photons, because they have no rest mass, cannot be described this way. In 1923, A. H. Compton demonstrated that photons when scattered off electrons experience a change in energy (their wavelength becomes longer after the collision event). This shift in photon energy after a collision with an electron is called "The Compton Effect." The energy of a photon is given by:

$$E_p = \frac{hc}{\lambda}$$

Where h is Planck 's constant , c is the speed of light , and λ is the photons 's wavelength .

In the case of this analysis, a photon experiences this change in energy at any node event. Therefore, generalizing the Compton Effect to include photon collisions with any elemental object gives the change in energy or the work done on a photon *across* any node:

$$W_p = \left| \frac{hc}{\lambda_f} - \frac{hc}{\lambda_i} \right|$$

Where λ_i is the photon wavelength prior to a node ,

and λ_f is the final photon wavelength after the node .

As a consequence, the work done on a photon can be easily determined across nodes as opposed to between nodes as presented for matter objects. *However, in order to be consistent with the photon, work done on a matter object can also be found across nodes as well as between them.*

Additionally, the expansion of space itself between galaxies and during the inflationary portion of the very early universe makes it desirable to have a local (across node) work derivation for a matter

object versus a work computation based on a matter object's journey between nodes: a local analysis avoids any treatment of consequences stemming from a matter object's movement through "plastic" space. A node is indeed a very compact phenomenon with only elemental objects involved. Thus, a node being an extremely small event coupled with being of very short duration effectively shields "across node," work derivations from the consideration of expanding space.

Accordingly, matter objects' work calculations can reduce to that of local across node analysis: from this perspective, a matter object's change in energy is measured only at node locations - not between them. The work done across a node for a matter object becomes just the change in total energy experienced:

$$W_{mo} = \left| \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \right| \quad \textit{or at high speeds :}$$

$$W_{mo} = \left| \left[(m_r - m_0) c^2 \right]_f - \left[(m_r - m_0) c^2 \right]_i \right|$$

Where subscript i indicates the initial velocity or energy of a matter object just before a node event, and subscript f indicates the final velocity or energy of that same object just after the node event.

Note that the work done by the virtual "force carrying" objects (photon, gluon, weak gauge boson, and graviton) obviously modifies the total energy of a matter object as it moves between nodes. These individual gauge node events sum to yield a cumulative effect creating a variable force that shapes an object's total energy at any time, but the specific virtual gauge node events themselves are not considered part of a basic matter object's work "history." The variations in a elemental object's mass permitted by the Heisenberg uncertainty principle allow for the emergence and absorption of virtual gauge particles. This process is a node phenomenon, but *"work history"* as developed here will only sum the changes in energy across nodes involving non gauge matter objects for simplicity. See Figure 15. **The major point to be made is that the complexity or work history of an elemental object at any time can be simply defined as the *sum* of its across node energy changes experienced since the Big Bang.** *Complexity is an index - not an object's energy at a particular time (t).*

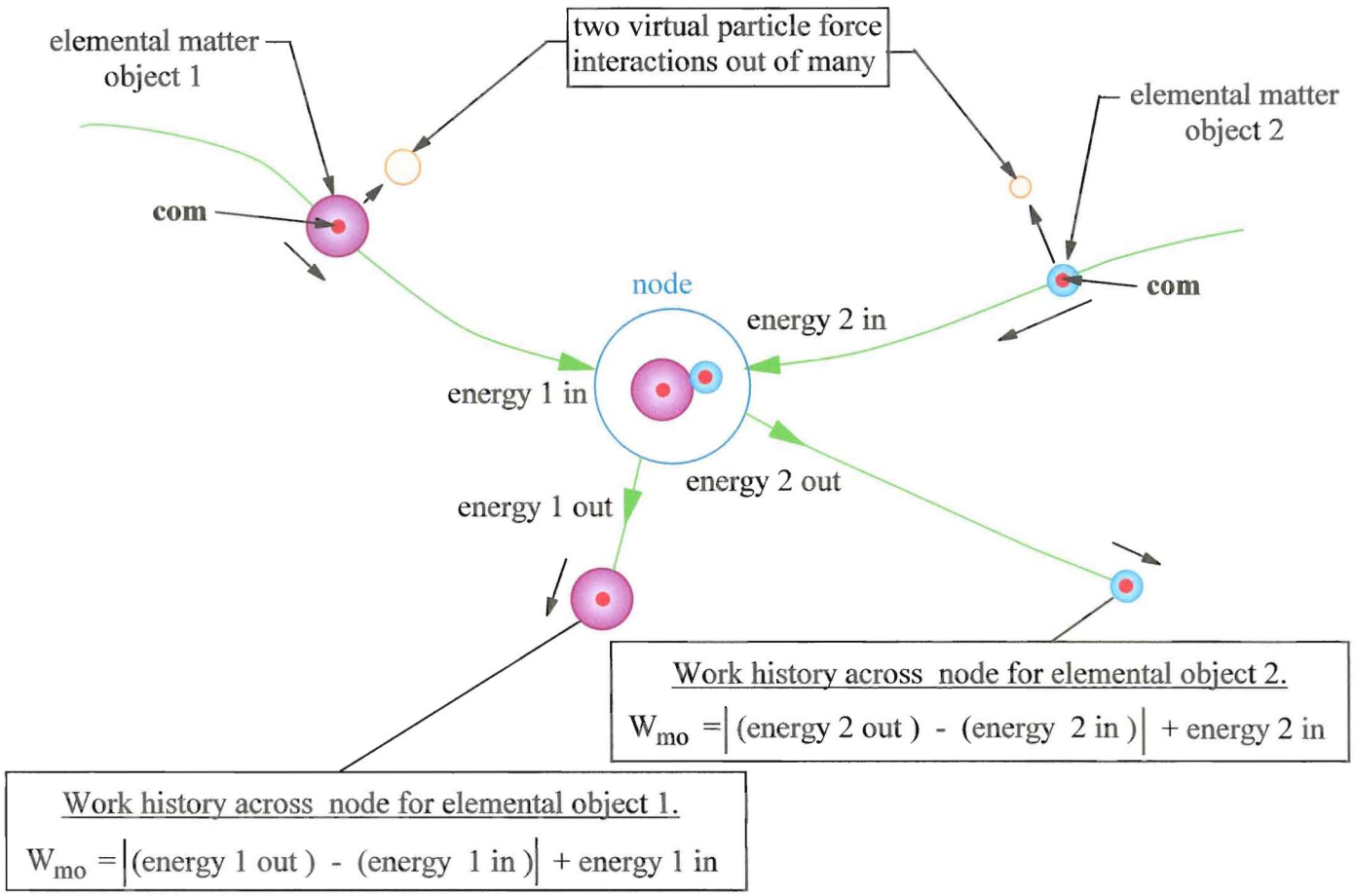
Figure 16 illustrates a sample work history (complexity) calculation, while Figure 17 graphically depicts the evolution of matter work history or complexity from the Big Bang to the present time. In Figure 16, several particles are created from high energy photons in the lower left corner of the diagram. These particles as well as two "stray" photons (photons a and b), are given arbitrary initial energy values at "birth" (complexities = 0 at this moment). The energy values are shown as integers for ease of computation and are vague in terms of their units for the same reason.

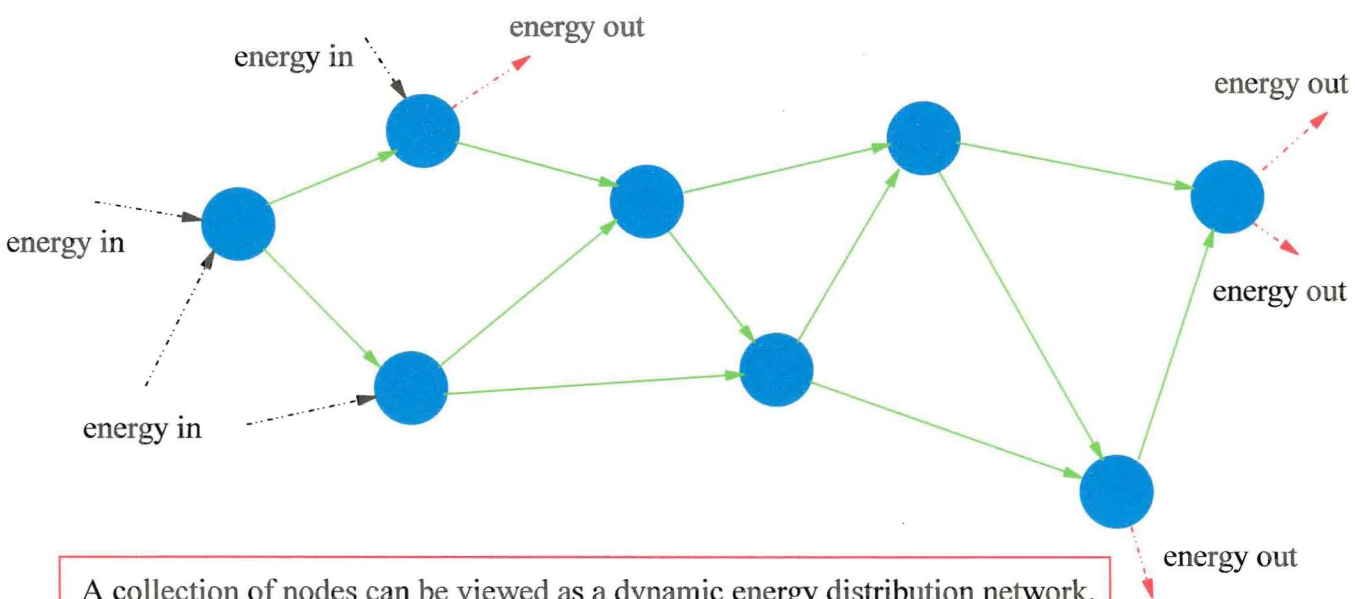
As previously mentioned, material particles in actuality have both a translational and a rotational component to their total energy. In this analysis, the rotational energies of matter objects are not considered as they add unnecessary difficulty to the complexity calculation without adding any illumination. If so desired, a more detailed work history could be derived incorporating the changes of both rotational and translational energy across nodes for matter objects, but nothing would be made more clear by this effort: *the focus of this discussion of nodes as arbiters of energy remains unchanged with greater precision in computation.*

Working through the example interactions (nodes) in figure 16, an atom of hydrogen comes

Figure 15

Across Node Matter Object History / Complexity





A collection of nodes can be viewed as a dynamic energy distribution network.

Figure 16
Sample Complexity Calculation for a Hydrogen Atom

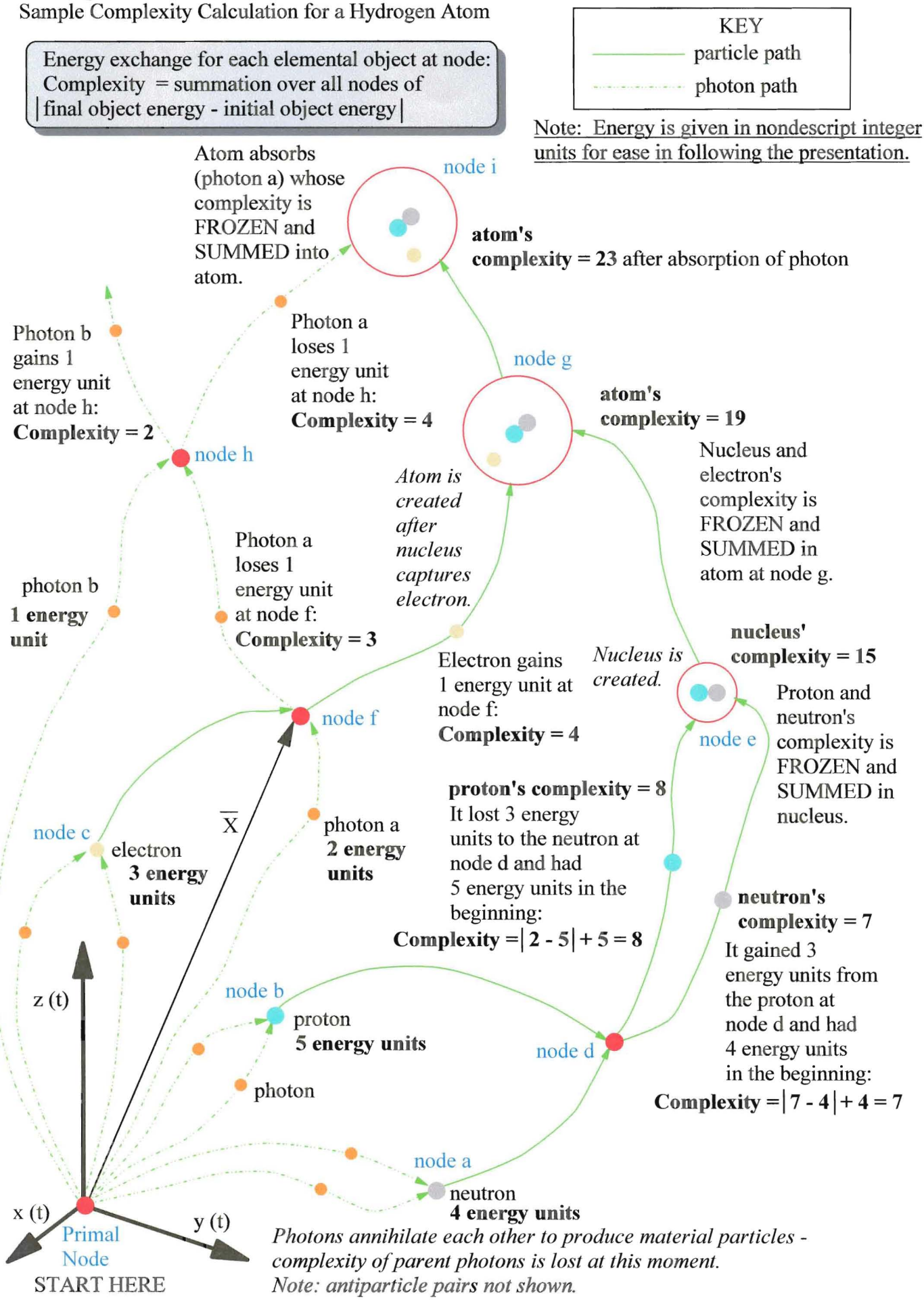
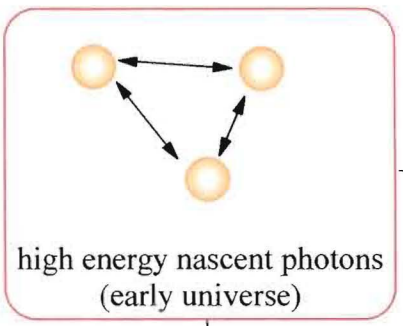


Figure 17

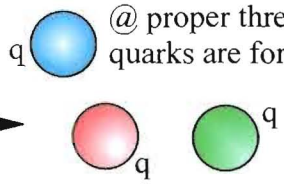
Chronology of Matter Work History or Complexity - Summary

Note: Antimatter twins of matter particles are considered annihilated for purposes of this presentation.

GENERAL DISCRETE MOTION



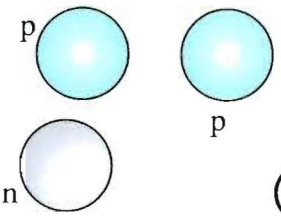
high energy nascent photons (early universe)



@ proper threshold temp. quarks are formed*

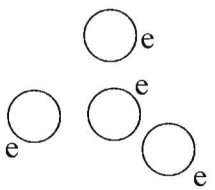
- history of "parent" photons lost (L)

Quarks are bound into hadrons.



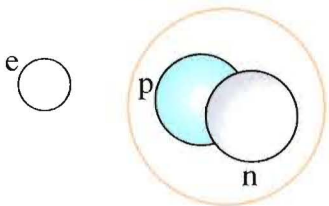
- History of bound quarks summed and frozen into hadrons. (Σ) (F)

@ proper threshold temp. electrons (leptons) form*

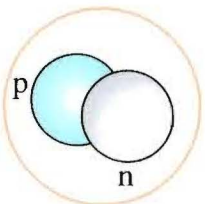


- history of "parent" photons lost (L)

DECOUPLING - electrons bind with nucleus

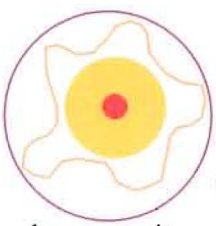


- History of nucleus and electron summed and frozen into atom. (Σ) (F)



- History of bound hadrons summed and frozen into atomic nucleus. (Σ) (F)

Stellar Evolution - Supernovae



(Σ)

-Nuclear constituents rearranged with higher sums in heavier elements.

N_2
$C O_2$
H_2O (Σ)

- History of atoms summed into molecules and compounds.**

DNA (Σ)

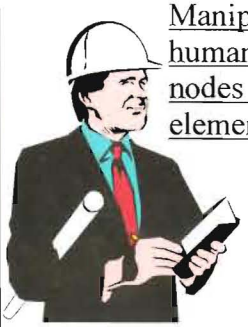
- History of atoms summed into amino acids and thus, DNA.

****Note that atoms are the largest elemental objects considered and by definition contribute no frozen histories to other objects.**

As a result of the above...

Free photons, electrons, and hadrons because of partial frozen histories are much more "coherent" (by several orders of magnitude) than individual atoms.
WORK HISTORY = COMPLEXITY = DECOHERENCE

*Threshold Temperature: Characteristic temperature at which the energy and decoherence of photons is such that a particle of a particular type can be created from them.



Manipulation of objects by humans increases number of nodes experienced by elemental objects:

additional history summation by means of abstraction - *SPECIAL DISCRETE MOTION* (Σ)

into being with an associated complexity which is the summation of the frozen histories of its bound constituents. *Bound elemental objects in this sense are objects that are incapable of being directly observed (imaged) in their* ***"bound"*** *state. When in a bound state, an object's work history or complexity is said to be* ***"frozen."*** While frozen, an object's work history is held static and does not increase or decrease; it is part of a larger elemental object whose history is termed ***"active."*** An active work history or complexity is calculated or adjusted at every node because the object is free and not bound as part of another elemental object.

Finally, the hydrogen atom, after its own genesis of increasing complexity, absorbs a photon thus preventing the photon from participating in more interactions. The photon at this point is *bound,* and its complexity is *frozen.* As the hydrogen atom continues through space, its active history or complexity will grow with each node experience while the histories of the bound photon, proton, neutron, and electron are shielded from change. Note that under the next heading it will become apparent that the frozen history of a bound object is retained as part of a parent composite object's total complexity even if a frozen object becomes free, i.e., photon or electron emission from an atom. Observations of quantum behavior are also consistent with *newly freed* objects' complexities being "reset" to a lower figure.

In summary for a composite object (any state of matter composed of atom objects or their constituents) the complexity is given by:

$$C_{\omega} = \sum_{n=1}^{n} c_n$$

Where C_{ω} *is a composite object 's complexity at a particular time t,*
c_n *is a component elemental object complexity comprising* C_{ω},
and n is the number of components .

C_{ω} *is more precisely determined by*:

$$C_{\omega} = \sum_{j=1}^{j} \sum_{k=1}^{k} \left| E_{F_{jk}} - E_{I_{jk}} \right|$$

Where E_F *is a component elemental object 's final energy leaving a node ,*
E_I *is a component elemental object 's initial energy entering a node ,*
j *is the number of component elemental objects , and*
k *is the number of nodes experienced from the primal node to the present .*

Figure 17 presents an overview of evolving complexity from the early moments of the universe to now. Following the directional arrows and the flow of time in the figure, high energy photons in the early universe first form quarks and leptons at the appropriate threshold temperatures. The work history or complexity of the nascent photons is lost at this point because the photon "bodies" themselves are annihilated in the process of creating material particles. Of course, the energy of the photons is converted into the masses of the new particles, but the work history of those

photons, being an index of summations of energy changes across nodes for each photon, only has meaning when associated with an existing entity.

As the universe cools, the quarks are bound into hadrons, and the work histories of these constituent quarks are summed and frozen into individual hadrons. Thus, each hadron is born with an associated complexity that is the result of the combined inheritance of its bound quarks.

Later, when matter elements decoupled from the background radiation, the first atomic nuclei and atoms formed. As atomic nuclei came into being, the work history legacy of the bound hadrons that compose every nucleus was summed and bestowed on each new nucleus. Likewise, every new atom born had an initial complexity associated with it: this complexity being the summed work history of both the bound leptons and the bound nucleus that compose it.

Over time, through the mechanism of stellar evolution, atomic nuclei of higher complexity are synthesized in the cores of stars. The total number of energy exchanges across nodes for each nucleus and atom grows larger in heavier elements.

Eventually, the active work histories of individual atoms are summed into molecules and compounds. Because atoms are the largest non-bound elemental objects considered in this analysis, their histories are never frozen, and they always have the potential to *actively* contribute to the complexity of the substances they compose. Further history summation of grouped atoms in time leads to DNA, life, and the rise of humanity with every human being embodying the expression of a genome of unknown complexity. *Finally, all that is done to express and understand shared reality is continuously recorded in the changing complexity imparted to the surrounding physical universe...*

Now larger pieces of a maturing consistency in this investigation become apparent: The elemental objects that make up the universe interact discretely at nodes, exchanging energy from the universal perspective. As shown in the bottom of Figure 15, node locations can be visualized as being elements of a vast energy distribution network where the "work" of the cosmos takes place. The exchange of energy at nodes is the only device by which "meaning" is given to motion and to life. **This "web of nodes" shapes the trajectories of elemental objects and over time bestows a work history or "character" to those same objects as well as grouping them into combinations of ever increasing complexity.** The bulk of this section was spent deriving a quantification scheme for this behavior based on previous observations made in this investigation.

Each elemental object was shown to have a number associated with it which "tells its history" in terms of energy exchanges at nodes. *This number is called an object's complexity, and it serves as a primary reference when investigating the "resume'" of any material entity or photon.* The higher this number, the more complex an object is, the less "coherent" the object is said to be. Likewise, the smaller this number, the less complex an object is, the more coherent the object is said to be. The context of the word, coherence, in this instance comes from the world of quantum mechanics which is a required next stop by necessity before further elaboration. Quantum mechanics at its core embraces and recognizes the unpredictable nature of the very small and the boundaries of observation.

The Limits of "The See and Touch Experience"

In quantum mechanics, the role of the observer is central, and no phenomenon (elementary object) exists until it is observed or registered. Registration "collapses" uncertainty into certainty through observation or measurement. Young's double slit experiment remains the time-honored, best demonstration of this property of elemental objects. In this experiment, a photon can apparently propagate through two small slits in a screen simultaneously as a probability wave (a coherent state)

and then interfere with itself unless it is observed prior to reaching the final screen.

Any act of observation must be a node event as described rigorously before in this narrative. Photons colliding with a detector (other elemental objects of some sort) causes the photons to decohere from probability clouds into individual objects. *From the reference frame of the universal perspective, any act of observation (node event) increases the complexity of the elemental objects involved and is the mechanism of registration.*

Offered as a proposition consistent with the *universal perspective*, **it is this increase in complexity that causes decoherence for an elemental object** - an object's or compound object's size is irrelevant. Certainly, larger objects whose constituents have experienced many more nodes are much more complex than simple elementary objects such as photons and electrons.

In fact, given that "...photons do nothing but go from one electron to another, and how reflection and transmission are really the result of an electron picking up a photon, 'scratching its head,' so to speak, and emitting a *new* photon,"[15] it is reasonable to suppose that photons have their complexity reset to zero at every reflection or transmission event. Photons lose the ability to be observed when they are absorbed or *bound* by electrons. The absorbed photon, using nomenclature developed and introduced in this paper, is *frozen* and thereby "yields" its work history (complexity) to the electron that absorbed it.

When a photon is emitted, one can say that it has had its complexity reset to "0" because of being frozen as an indistinguishable part of another body. Likewise, other frozen elemental objects (hadrons and leptons for example) once freed from more complex matter can be thought to have their complexities reset to "0." Thus, the "quantum effect" of non locality and extreme coherence dominate in these once frozen objects when they are free.

The level of complexity that turns coherent objects into non coherent ones is not precisely known, but it can be said that the basic elements of matter and light can spend much of their time in a frozen state, jumping between more complex matter objects (nodes) when free. It is in this dynamic that non locality predominates. It seems that the freed elemental objects are *obligated* by nature to lose their identity because the universal perspective does not register them as "individual objects" in the frozen state, and they are not backwards traceable through such conditions (the frozen node).

One might ask how does an individual elemental object *know* or retain its complexity (work history) moving between nodes from the universal perspective? In principle, this question is no different than asking during a double slit experiment how a quantum *knows* what its "brethren" have done in forming an interference pattern and where it fits in that complex scheme.

Also, how does a quantum *know* that it will be observed in a particular way "prior" to the observation being made in John Wheeler's delayed choice experiment? Apparently in either case, **information** is being "passed" by unknown means. *A scheme for this data exchange mechanism consistent with the discussions so far in this analysis will be proposed in future sections.* "This (conduct) is clear evidence for the holistic nature of quantum systems, with the behavior of individual particles being shaped into a pattern by something that cannot be explained in terms of the Newtonian reductionist paradigm."[16]

In a model where the universal perspective registers collision events as increasing complexity, the proposed paradox of Erwin Schrödinger's "cat in a box" thought experiment is better understood.

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[15]Richard P. Feynmann, *QED: The Strange Theory of Light and Matter*, p. 76.

[16]Paul Davies and John Gribbin, *The Matter Myth*, p. 212.

Of course, the radioactive decay (freed, frozen elemental objects), that may cause the early demise of a hapless cat through a trigger mechanism, exists as a wave function with probability being the only relation determining possible outcome.

However, the cat is an exceptionally complex composite "object." Its main constituents have fully decohered and left the realm of the quantum long ago. There is no superposition of two animal states - a box containing a cat in limbo (neither fully alive or fully dead) whose fate is determined when an observer opens the box containing it. There is no collapse of a wave function pertaining to the cat. Indeed, the cat may be alive or dead based upon the behavior of the coherent radiation, but there is nothing mysterious about that.

Quantum mechanics was born largely as a result of physicists examining more closely light's (electromagnetic radiation's) properties in relation to matter. As mentioned previously, Max Planck first noticed that black body radiation could only be analyzed correctly if the energy in a heated cavity is considered **discontinuous** in nature (coming in energy "packets"). Ultimately, Planck's fundamental quantum relation prevents the equal allotment of energy (equipartition) across the spectrum and allows for the "ultraviolet drop off" seen in cavity radiation when n and f are high:

$$E = nhf$$

where E = *energy* ,

n = 1,2,3,4.... (*all positive integers*),

h = *Planck 's constant , and*

f *is the radiation frequency* .

Later, Einstein postulated that the photoelectric effect (the ejection of electrons from illuminated metals) is best understood if light is quantized *in general* as a set of particles or photons with energies given by:

$$E = hf$$

with $E, h,$ *and* f *defined as above* .

Once again, a "continuum" view of nature (that of light) "fell victim" to a more apt description of observed phenomena, and light was **broken into pieces** - *the quantum way.*

Prior to the above observations being made, the bright line emission spectrum of hydrogen came under scrutiny in hopes that it would possibly give clues to some theory of atomic structure. Johann Jakob Balmer, a Swiss, mathematics school teacher, derived an equation which yielded the first four visible hydrogen emission line frequencies and others in the ultraviolet range:

$$f = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

where R (Rydberg constant) = 3.29163 × 10^{15} cycles /sec , and n_f and n_i are integers 1,2,3,4,5,6...

Notice again that **discrete** quantities serving as input,

$$\left(n_f \text{ and } n_i\right),$$

"regulate" this important relation.

Niels Bohr, just before World War I, made his first of many contributions to quantum mechanics by quantizing the angular momentum of an electron in orbit around the nucleus of an atom:

$$L = mvr = n(h/2\pi)$$

where L = angular momentum ,
m = mass ,
v = velocity ,
r = radius oforbit ,
h = Planck 's constant , and
n = 1,2,3,4, etc .

Thus, according to Bohr, an electron could only orbit the nucleus in ***"discrete"*** or standard states. An electron could go from one allowed orbit to another, but the transition is abrupt and therefore, is characterized as a **"quantum leap."** Bohr theorized that when an electron leaps from one allowed energy state to another one, an emission or absorption of electromagnetic radiation occurs with a frequency given by the Planck/Einstein relation:

$$hf = E_i - E_f$$

where h = Planck 's constant ,
f = frequency of radiation ,
E_i = initial energy state , and
E_f = final energy state .

Employing these relations and the laws of classical physics (Newton et al.), Bohr derived the aforementioned Balmer formula! The fact that the Balmer formula "fell" out of Bohr's quantum considerations when mixed with a little classical physics is amazing...

The key point to remember here in regard to this inquiry is that early quantum mechanics relied on integer quantum numbers to generate values for fundamental unknowns. The continuum view of nature had yielded to "discrete" analysis embodied by the incorporation of counting numbers (1, 2, 3, etc.) related to particular states. At first look, this occurrence is a bizarre situation but again very consistent with the *Discrete Motion Paradigm* where objects in the universe demark their journey through space in a series of steps or collisions... Could it be that the early quantum mechanics was reflecting the legacy of this notion?

Ultimately, Bohr with the help of Arnold Sommerfeld and Wolfgang Pauli solved the mystery of the Zeeman Effect and the Anomalous Zeeman Effect (the appearance of new spectral lines when excited atoms were put in a magnetic field) with the incorporation of more quantum numbers in the mathematics governing the quantum transition condition.

The new quantum theory was born in a twelve month period from June 1925 to June 1926. Werner Heisenberg, having a distaste for Bohr's atomic model and taking to heart Bohr's advice that **atoms were not things**, developed Matrix Mechanics with the aid of Max Born and Pascual Jordan. Starting with the idea that an atom resembled a simple virtual *oscillator* and using the correspondence principle (where the world of the quantum overlaps classical physics), Heisenberg created a mathematical **code** for determining the correct frequencies and amplitudes of atomic spectral lines.

Central to this theory is the quantum condition given by the commutator:

$$\left[p(t), q(t)\right] = p(t)q(t) - q(t)p(t) = -i\hbar$$

where :

$p(t)$ *is a particle 's momentum at a time* (t),

$q(t)$ *is a particle 's position at a time* (t),

$\hbar = \dfrac{h}{2\pi}$ *with* h = *Planck 's constant* .

This operator predates Heisenberg's uncertainty relation:

$$\Delta p(t)\,\Delta q(t) \geq h \quad \textit{where} :$$

$\Delta p(t)$ = *uncertainty of momentum measurement at time* (t),
$\Delta q(t)$ = *uncertainty of position measurement at time* (t), *and*

h = *Planck 's constant* .

and defines the relationship between **discrete** elements of a systematic matrix logic which can produce values for spectral line frequencies and relative intensities.

The physical significance of non commutability relates to the critical nature of an act of

measurement and to basic limitations on the accuracy of simultaneous measurement of certain paired physical variables - p(t) and q(t) being one such pair. Because our capacity to measure two quantities simultaneously with absolute precision is forbidden by their failure to commute, h in this light, quantifies or sets a limit on what can be known simultaneously in nature.

During this same one year period, Erwin Schrödinger developed the fundamental wave equation of nonrelativistic quantum mechanics. For a single mass, m, experiencing an energy potential, $V(r)$, a common time dependent form is:

$$\left[-\frac{\hbar^2}{2m}\nabla^2 + V(r)\right]\Psi(r,t) = i\hbar\frac{\partial\Psi}{\partial t}(r,t)$$

where Ψ *is the wave function of Schrödinger* ,

$\hbar = \frac{h}{2\pi}$ *with* h = *Planck 's constant , and*

∇^2 *is the Laplacian* .

This equation in various manifestations can be used to describe all of nonrelativistic dynamics, including free systems, where $V(r)$ =0 everywhere, as well as bound systems. The wave function for a bound particle experiencing an energy eigenstate of energy, E_n, is given by:

$$\Psi(r,t) = \psi_n(r)e^{-E_n t/\hbar}$$

Substituting this result into the time dependent Schrödinger equation yields the time independent equation:

$$-\frac{\hbar}{2m}\nabla^2\psi_n(r) + V(r)\psi_n(r) = E_n\psi_n(r)$$

This operator equation is similar to a classical Newtonian conservation of energy relation with the operator $i\hbar\nabla$ taking the place of p in the classical definition of kinetic energy,

$$K.E. = p^2/2m.$$

The particle's kinetic and potential energies are transformed into the Hamiltonian which acts on the wave function to yield the dynamic of the wave function through time and space. ***Quantized energies of a system are thus generated by the Schrödinger equation.*** The time independent Schrödinger equation can be generalized to describe more than one particle and multiple particle interactions.

The meaning of the various wave functions, denoted by Ψ above, has been the subject of some controversy. Max Born originated the interpretation according to

which the squared magnitude of the wave function represents a spacial probability density. Thus, for a single particle, the expression

$$|\Psi(r,t)|^2 d\tau$$

represents the probability of finding a particle in the volume element $d\tau$ at position r at time t. For a many-particle wave function, the corresponding expression

$$|\Psi(r_1,r_2,\ldots,t)|^2 d\tau_1 d\tau_2 \ldots$$

gives the joint probability at time t of finding particle 1 in $d\tau_1$ at r_1 and particle 2 in $d\tau_2$ at r_2 and so forth. .....The centrality of probability at this fundamental level of physics, with the consequent lack of determinism in predicting the result of a single observation, has troubled many, including Albert Einstein. Nevertheless, the routine use of this interpretation over the years has led to no experimental inconsistencies, and it remains the consensus of practicing physicists.[17]

In 1926, Paul Dirac synthesized a version of quantum mechanics that blended the earlier work of Heisenberg's "Matrix Mechanics" and Schrödinger's "Wave Mechanics" under a single mathematical umbrella. Dirac's "Quantum Algebra" links measurable quantities with operators acting on a Hilbert space of vectors which describe the state of a quantum mechanical system.

Each state of a dynamical system at a particular time corresponds to a normalized "ket" vector and its associated direction. A complete algebra involving three kinds of quantities, bra vectors, ket vectors, and linear operators, was developed in which the commutative axiom of multiplication does not hold.

Any result of a measurement of a real dynamical variable, ξ, is one of its eigenvalues. A real dynamical variable whose eigenstates form a complete set is termed an observable. Employing Dirac's bra-ket notation, the Schrödinger equation becomes:

$$H\Psi(\xi t)\rangle = i\hbar\frac{\partial}{\partial t}\Psi(\xi t)\rangle$$

This equation's solutions, (ξt), are time dependent wave functions. "Each solution corresponds to a state of motion of the system, and the square of its modulus gives the probability of the ξ's having specified values at any time t. For a system describable in terms of canonical coordinates and momenta we may use Schrödinger's representation and can then take H to be an operator of differentiation..."[18]

Gerard 't Hooft's summary of the next innovation in quantum mechanics, *(Relativistic) Quantum Field Theory*, involves a preliminary discussion of particle "in- and out-states" that is very reflective of the discrete motion paradigm's roots:

Relativistic Quantum Field Theory is a mathematical scheme to describe the

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[17]Rita G. Lerner and George L. Trigg, *The Encylopedia of Physics* 2nd Edition, p. 1089.

[18]P.A.M. Dirac, *The Principals of Quantum Mechanics* 4th Edition, p. 111.

sub-atomic particles and forces. The basic starting point is that the axioms of Special Relativity on the one hand and those of Quantum Mechanics on the other, should be combined into one theory. ...*How would one reconcile Quantum Mechanics with Einstein's theory of Special Relativity?*...

...One would set up abstract Hilbert spaces of states, each containing fixed or variable numbers of particles. Subsequently, one would postulate a consistent scheme of interactions...where we start with a certain number of particles that are far apart but moving towards one another. This is the 'in' state $|\psi\rangle_{\text{in}}$. After the interaction has taken place, we end up with particles all moving away from one another, a state $|\psi'\rangle_{\text{out}}$. The probability that a certain in-state evolves into a given out-state is described by a quantum mechanical transition amplitude, ${}_{\text{out}}\langle\psi'|\psi\rangle_{\text{in}}$. The set of all such amplitudes in the vector spaces formed by all in- and out-states is called the *scattering matrix*.

...A quantized field may seem to be something altogether different, yet it does appear to allow for the construction of an interacting medium that does obey the laws of Lorentz invariance and causality. ...Realizing that the energy in a quantized field comes in quantized energy packages, which in all respects behave like elementary particles, and, conversely, realizing that operators in the form of fields could be defined also when one starts up with Hilbert spaces consisting of elementary particles, it was discovered that quantized fields do indeed describe subatomic particles.[19]

Frank Wilczek's comments on quantum field theory provide insight into the ramifications of its construction and visualization: "Undoubtedly the single most profound fact about Nature that quantum field theory uniquely explains is *the existence of different, yet indistinguishable, copies of elementary particles.* Two electrons anywhere in the Universe, whatever their origin or history, are observed to have exactly the same properties. **We understand this as a consequence of the fact that both are excitations of the same underlying stuff**, the electron field. The electron field is thus the primary reality. The same logic, of course, applies to photons or quarks, or even to composite objects such as atomic nuclei, atoms, or molecules. Maxwell thought the similarity of different molecules so remarkable that...he concluded that 'the formation of a molecule is therefore an event not belonging to that order of nature in which we live...it must be referred to the epoch, not of the formation of the earth or solar system...but of the establishment of the existing order of nature...'"[20]

QED (Quantum ElectroDynamics), one of the most well tested and successful theories in physics, is a quantum field theory of the electromagnetic field developed between the late 1920's and the 1950's by Feynmann, Schwinger, and Tomonga principally. Two observables of QED, the anomalous magnetic moment of the electron and the hyperfine splitting of muonium, agree with the theory to parts per billion.

In spite of the great success of QED, *ultimately all that can be known or determined about a non classical, physical system is a set of probabilities:*

1. Every event has an associated probability amplitude ϕ. The probability of the event is determined by the square of the amplitude:

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[19]Gerard 't Hooft, *The Conceptual Basis of Quantum Field Theory*, p. 1, 4.

[20]Frank Wilczek, *Quantum Field Theory*, p. 2.

$$P = |\phi^2|.$$

2. If an event classically occurs in several alternative ways, ie. $i = 1,...n$, where each event is characterized by an amplitude ϕ_i, then the total probability amplitude of the event is given by the sum:

$$\phi = \sum_{i=1}^{i} (\phi_i) \quad \textit{with the probability given by}:$$

$$P = |\phi_1 + \phi_2 + \ldots + \phi_i|.^2$$

There is interference (a state of coherence).

3. If an event occurs in such a manner that it can be broken into several distinct steps $j = 1,...,m$ each of which has a probability amplitude ϕ_j, then total amplitude of the event is given by the product:

$$\phi = \prod_{j=1}^{m} \phi_j .$$

4. If an experiment is conducted which can determine which of several alternatives is being taken, then the probability of the event equals the sum of the probabilities for each alternative:

$$P = P_1 + P_2 + \ldots + P_n .$$

Interference is lost. (A state of decoherence of alternatives .)

The second great lesson of quantum mechanics, other than non determinism at the micro level, is obviously the necessity of quantizing elements of physical systems in order to achieve meaningful results. Why is quantization (taking description out of the continuous realm) so important in the characterization of nature at this level? Is nature ultimately noncontinuous in some manner? Could the physical universe be directing us in our quantized theories to pay attention to a structure or dynamic that is not recognized now?

This confluence of "theme" is an example of an ***echo***, a personal term given to *resonances* in observation which point toward perhaps a new paradigm where the large and the small scale mesh in an unknown architecture. The discrete motion *("quantized or discontinuous motion")* of all elemental objects relative to the universal perspective is another such *echo* pointing toward unrecognized common ground.

In 1927, Bohr authored with the help of Heisenberg, Born, and Wolfgang Pauli a collection of ideas which became known as the Copenhagen Interpretation (CHI). Essentially, Bohr concluded that the description of a state of an atomic system before a measurement is undefined, having only

the potentiality of certain values with certain probabilities.[21] As part of CHI, Bohr offered the Principle of Complementarity which states that the particle and wave properties of objects are mutually exclusive, yet both necessary for a complete understanding. Therefore, one can examine objects as being a particle or wave with no contradiction because an object will behave as a particle or wave depending on the experimenter's choice in observing apparatus. Experimental data, gathered under different conditions, cannot be combined but should be thought of as being complementary.

CHI maintains that quantum mechanics does not allow separation between the observer and the observed - both parts of a single system. The implication of possible action-at-a-distance or nonlocality ran contrary to Einstein's theory of relativity (communication faster than *c*, the speed of light) and separateness. Thus, Einstein along with Boris Podolsky and Nathan Rosen developed the EPR Paradox as a response.

The EPR Paradox outlined an experiment involving two electrons in a *singlet state* that have opposite spins which cancel each other and yield a total spin of zero. According to CHI, the spin of either electron is unknown until one is measured, and at that time *instantaneously* the spin of the other electron assumes the opposite spin. This action was not possible according to Einstein.

John S. Bell, a CERN, Belfast physicist, created an *inequality principle* to test the EPR Paradox 30 years later. Using correlated, polarized photons instead of electrons, Bell proposed that if his inequality was violated during the experiment, this meant that nature is nonlocal. Experimental efforts by John Clauser at Berkeley in 1978 and others by Alain Aspect's group in Paris in 1982, indicated that Bell's inequality was violated. The proof of Bell's theorem remains an open question today because of doubts surrounding the mathematics of the measurements in these experiments.

"From 1954 to the end of his life, Heisenberg (d. 1976) was immersed in attempts at deriving all of particle physics from a fundamental non-linear wave equation. His articles on this subject contain several quite interesting remarks, notably on symmetry breaking, but were not influential in the long run. His last published paper which appeared shortly after his death concludes with this message: 'The particle spectrum can be understood only if the underlying dynamics of matter is known; dynamics is the central problem.' "[22]

The dynamics that Heisenberg so sought to better understand perhaps can only be realized on a new stage, a new platform for movement that combines all of the themes or *echoes* discussed and presented so far. A new stage for "action" built from developed, first principles will be constructed in the following pages.

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[21]J.P. McEvoy and Oscar Zarate, *Introducing Quantum Theory*, p.161.

[22]Abraham Pais, *Inward Bound*, p. 585, 586.

The Geometrical Genesis of the Informational Realm

The Necessity and Construction of the Infon

Many commentators readily declare that the early 21st century is the information age without any hesitation or serious contemplation about what really constitutes "information." From the discussions thus far in this investigation, information can clearly and consistently be defined as *that which is encoded by the discrete motion of objects or by the discrete motion of stationary reference points located on objects.* All information consists of multilayered and contrasted abstractional elements which are solely created as a result of the discrete motion of objects and/or associated reference points.

These abstractional elements have previously been termed **secondary associations** because they echo and reflect the heritage of the primary observational association (the general case) that all elemental objects in the universe exhibit discrete motion for at least some portion of their history from the universal perspective.

Because abstractions are the sole tools used in forming consciousness and because the material universe innately exhibits the dynamic behavior required to form these associations, a proper physical model of the cosmos should reflect this overwhelming convergence of trends. A new, theoretical, fundamental object called the **Infon**, ("Informational Entity or Being") with a name coined from a combination of the noun, *Info*rmation, and the Greek verb, *on*ta, meaning "being," will be developed. The infon will bridge the gap between material objects and information to show that these "items" are best understood as the same construct.

Before discussing the infon further, an important concept needs introduction. A primary justification for the existence of the infon is based on the proposed principle of ***Geometry - Motion Reflexive Equivalence:***

> *Any geometry (form, shape, or configuration) of matter elemental objects results exclusively from the discrete movements of those same basic objects. Therefore, in order to preserve relational consistency, if the discrete movement of mass, i.e. a force, is observed with no detectible physical basis of action, a geometrically, unique quantum* ***form*** *or* ***shape*** *must be ultimately responsible for and motivate that movement. Unique forms and discrete movement are different aspects of the same phenomenon; one cannot exist without the other.*

For example, there are many familiar, stationary objects/forms (relative to an observer) located in a typical home office or study - an ergonomic chair, a desk, a computer, writing instruments, papers, books, and perhaps a clock - that are the result of a series of movements that "formed" them. They each have a complexity (work history) which numerically documents their associated, discrete birthing motions. See previous heading entitled, *Quantification of Discrete Movement.* Without this necessary coupled motion these items would never exist as individual macro objects.

Now, consider what happens when one of the books is pushed over the edge of the desk: after the book clears the edge of the desk from the initial push, it accelerates and hits the floor. Where did the force come from to move the book quickly to the floor? Of course, the unseen motivator was gravity, but because movement occurred with no apparent physical cause, it is

reasonable to hypothesize, based on Geometry - Motion Reflexive Equivalence, that a unique, linked, quantum form is responsible:

If movement is observed that has no initial physical component (no momentum transfer), then because of the stated principle that (discrete) motion cannot exist independently of form, a quantum entity of distinct shape (form), the infon, exists by definition. **For consistency, the infon should be an "informational unit" that communicates its state through the expression of a unique geometry resulting from the discrete motion of its elements.** Thus, the infon completes a circle of logic by employing objects of form and discrete motion (the essence of information genesis) as its only "modality." See Figure 18. Using terminology developed recently, the infon is the ultimate "qubit" or quantum bit.

Although Geometry - Motion Reflexive Equivalence directly points towards the elemental object, force carrying quanta (photon, gluon, weak gauge boson, and graviton) as having a geometric form by definition, all other elemental objects can only exhibit uniqueness in character if they too are modeled as being composed of infons of differing geometric/vibrational modes. (Unique infon vibrational patterns correspond to distinct, dynamic, geometric configurations or forms. See Figure 19.) Physical property distinctions between elemental objects as well as the objects themselves are pieces of *information*, which in this paradigm, has only one consistently developed source: the infon.

Therefore, infons are the singular origin of all elemental objects and thus, the purveyors of all force and matter. The beauty of the infon concept is that it "carries" the physics of force, matter, and light in a manner totally congruous with the way in which abstractions of the mind are developed. Both categories of *information*, the "physical" as well as the "mental," share the same genesis - *discrete motion as embodied by the action of the infon.*

In Figure 18, for illustrative purposes, a conceptual schematic for a representational infon is shown as being five rectangles (objects/forms) moving discretely (back and forth) relative to each other in the center of the "circle of logic." A similar, convenient description of infon geometry and modality appears in Figure 19. It is now time to develop a more detailed and appropriate structure for the infon based upon the concept of void discussed previously under the *Foundations* section.

Since the infon incorporates the two basic ingredients from which all matter and consciousness spring, objects and discrete motion, a possible geometry or form for its discretely moving elements needs to be derived. Because the infon is obviously theoretical, there are many geometric configurations that can be used for its "oscillating parts" in representing force, matter, and light *(information)*. Any geometry under consideration for the infon should be transformational and represent the broken symmetry of a Euclidean geometry for both **simplicity and consistency of definition**. One such configuration possesses qualities over all the others that become more meaningful during a discussion of hyper and transdimensionality. The cube from the first section returns in a primary role in the genesis of the infon.

A cube is a natural choice for beginning the structure of an infon because no more complex geometry is needed. A sphere might be an equally useful base "form," but the development of the abstraction of a cube yields a more intuitive, natural understanding of three dimensional and higher spaces which will be important aspects of this discussion. For similar reasons, a rectangular, Cartesian coordinate system is better for this purpose than one based on polar coordinates.

If four diagonal lines are drawn joining the vertices of a cube and these same lines are used to define cutting planes, then six, individual, identical, right pyramid elements result. See Figure 20. There are an infinite number of ways of "breaking" a cube to obtain the geometry of the discretely moving parts that will constitute an infon. The above approach maximizes the number of elements created from the cube while minimizing the introduction of new geometry to form those same

Figure 18
The Creation of the Infon and the Circle of Logic

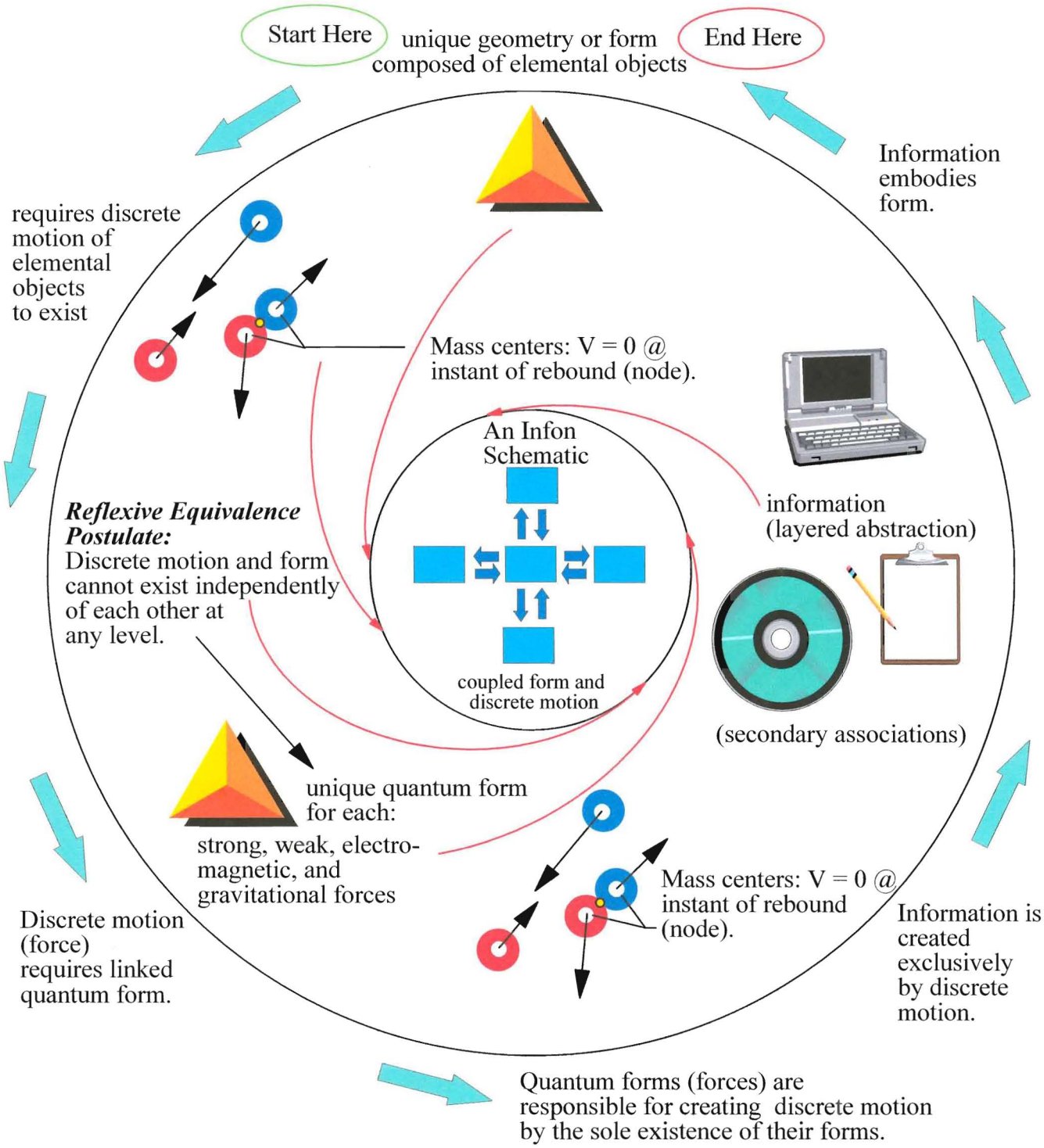


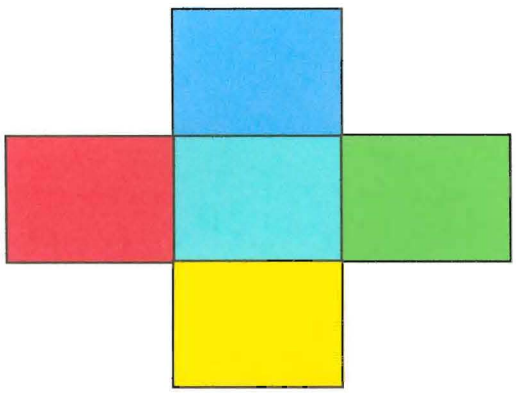
Figure 19

Schematic, Illustrative, Infon Geometric / Vibration Modes

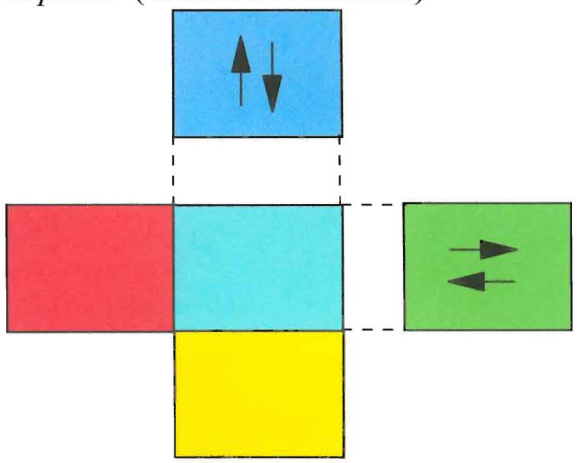
These *mode shapes* exhibit a particular, instantaneous, broken symmetry of the infon at a given time.

(Note: many more mode shapes are possible - only a few examples are shown.)

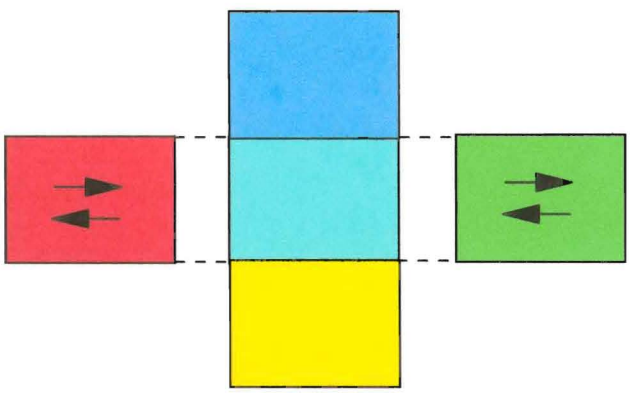
non unique geometrical state, vibration of all elements = 0 (no information content)



unique geometrical state, two elements vibrating *in phase* (information encoded)

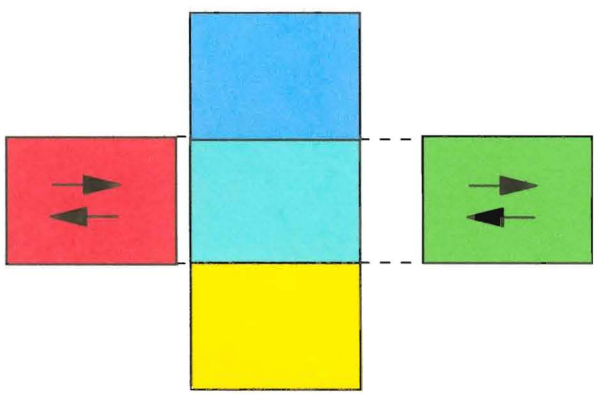


unique geometrical state, two elements vibrating *in phase* (information encoded)

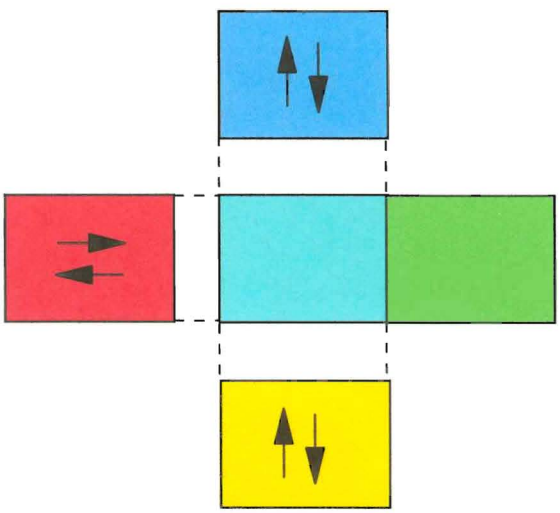


Information content different between these two infons because of phase shift between them.

unique geometrical state, two elements vibrating ***out of phase*** (information encoded)



unique geometrical state, three elements vibrating *in phase* (information encoded)



unique geometrical state, one element vibrating (information encoded)

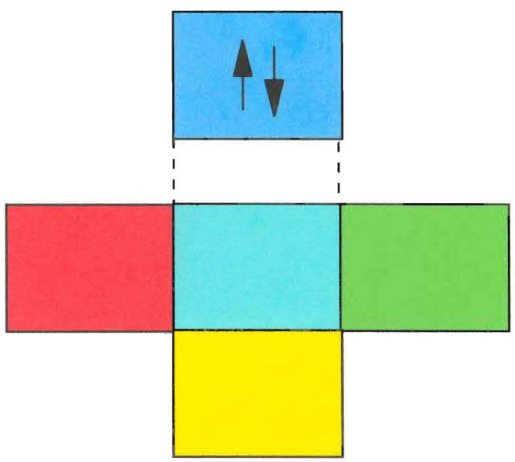
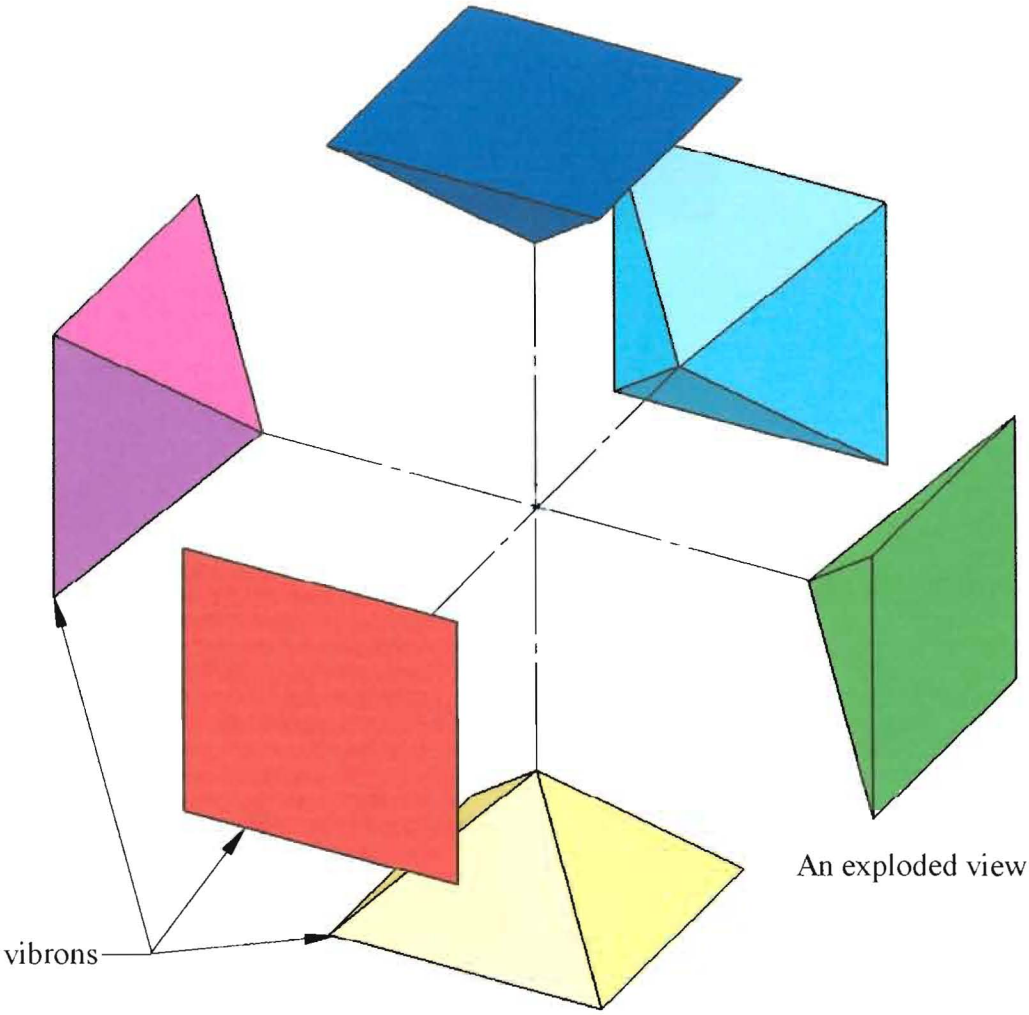
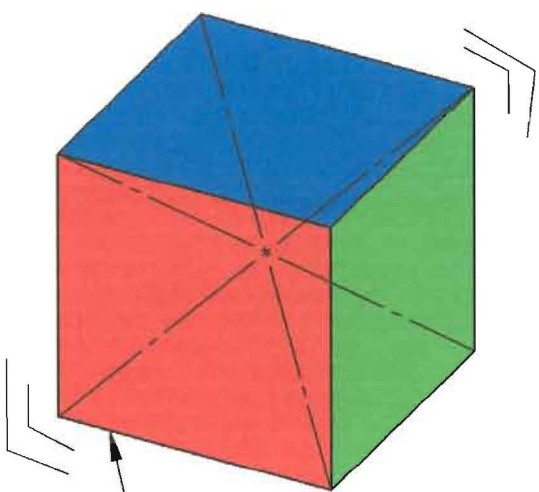


Figure 20
Proposed Structure for the Infon



An exploded view of the infon.



A hexahedron (cube) can be cut along diagonal lines joining its vertices to yield six right pyramids. These six elements ("vibrons") vibrate relative to each other, and thus, they can "carry "and manifest information - a simple infon is born.

elements. Additionally, the resulting sub-parts or elements express symmetry about the center of the cube which is aesthetically pleasing and balanced.

Thusly generated, these six sub-elements of a cube will be called ***"vibrons"*** (vibrating entities) because their discrete movement relative to each other by definition establishes the mode or information content of an infon. Now that a scheme for infon structure has been developed, what is a logical and consistent mechanism (in line with the discussions thus far) that could drive the relative vibration of the vibrons?

Figure 21 shows a representative vibron in an isometric view. Cutting planes A and B generate Section Views A and B of the vibron. *Because inwardly bound void defines the vibron's surface geometry, it is not possible to say with any precision where the vibron is located.* Inwardly bound void is a dynamically "shrinking" abstraction with no end or limit as previously described and as a result, cannot define an absolute position for the geometry it creates. As seen in the figure, a ***Zone of Uncertainty*** accompanies the points, lines, and planes that create vibron boundaries. At any instant or "snapshot" of their collective retreat into the very small, there is always "room" for other possible locations of similar geometry.

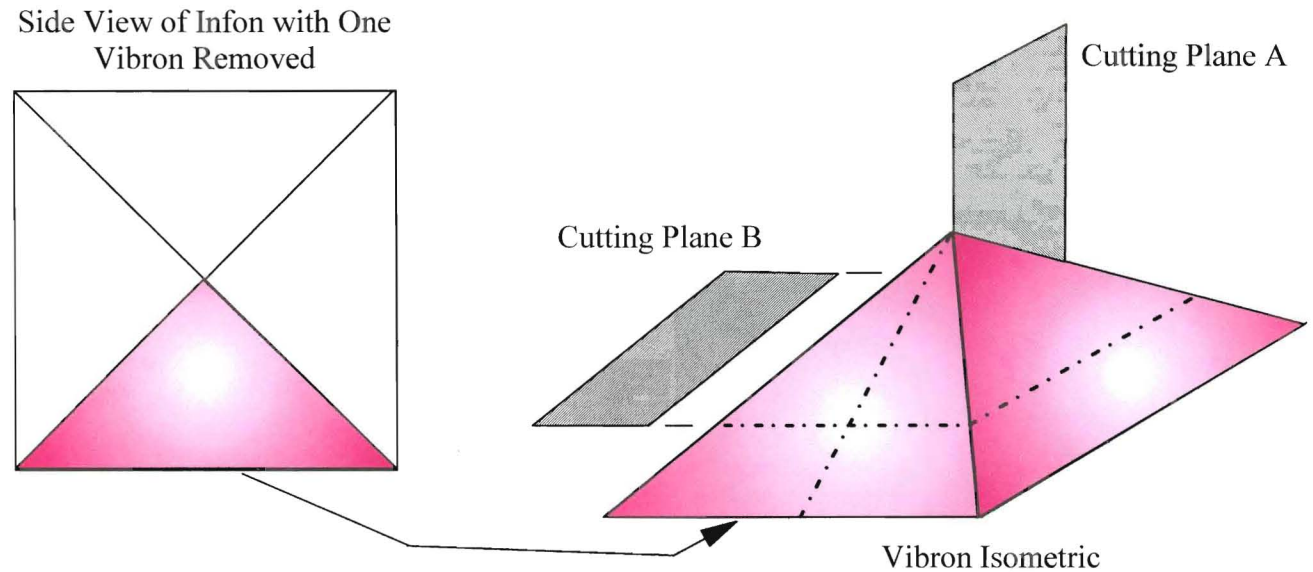
One interpretation of this condition is to say that the vibron, itself, can exist at any of a multitude of possible locations that the abstraction of void allows for at a given time or instant. This uncertainty in position, which is innate to geometrical constructions made of inwardly bound void, enables by definition the phenomenon of "vibration" of those same abstractions. *Therefore, **uncertainty** serves as the "engine" or motivator for the discrete motions of the elements (vibrons) that constitute an infon.* Just as nature evolved from basic objects moving between nodes from the universal perspective, parallel behavior is allowed and surfaces in the derivation of the abstractional components that make an infon. In this instance, geometrical abstractions (vibron domains) can be viewed as moving between instants of zero velocity during vibration relative to each other.

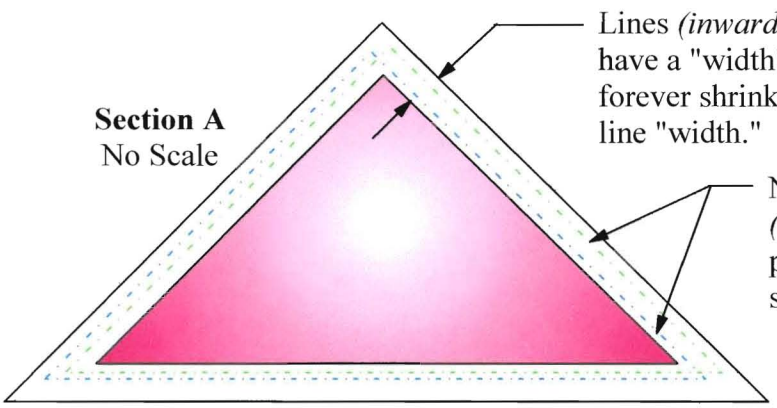
The uncertainty associated with and characteristic of inwardly bound void is perhaps more fundamental than Heisenberg's uncertainty principle yet amazingly analogous in theme. The construction of geometric abstractions allows for uncertainty as a basis for theoretical "action" whereas the uncertainty in measurement of a physical action or event is limited to being equal to or greater than h - Planck's constant. Interestingly, the tools (geometric abstractions) used to make an observation are driven by the same characteristic that returns after an experiment: uncertainty.

Keeping in mind that non determinism (uncertainty) has been shown to give "life" to void by permitting the conceptual vibration of similar geometry, a comparable scheme for generating dimensions will be developed using the familiar "themes" of discrete motion and inwardly bound void. At the top of Figure 22, a point moving back and forth between two boundary points along the x-axis creates one dimension and a line. This moving point can be thought of as vibrating between the two boundary points. Two dimensions are created when the resulting line moves along the y-axis perpendicular to the x-axis. This line can be visualized as vibrating between boundary points that define a square. As the resulting square moves along the z-axis perpendicular to the xy-plane, three dimensions are created, and the square can be seen as vibrating between boundary points that define a cube. Following a similar pattern and methodology, the resulting cube traces a hypercube or tesseract when moving along the q-axis which is "perpendicular" (in a mathematical sense) to the xyz-space. As the cube vibrates between the boundary points that define a hypercube, *at least* four dimensions result... *(Actually, a hypercube defines a new domain that describes three new dimensions under this scheme - more later.)*

Per discussions in the first section, elemental objects from the universal perspective gain complexity as a result of the relative discrete motion that occurs at nodes. Also, all abstractions

Figure 21 Uncertainty as the "Engine" of the Infon

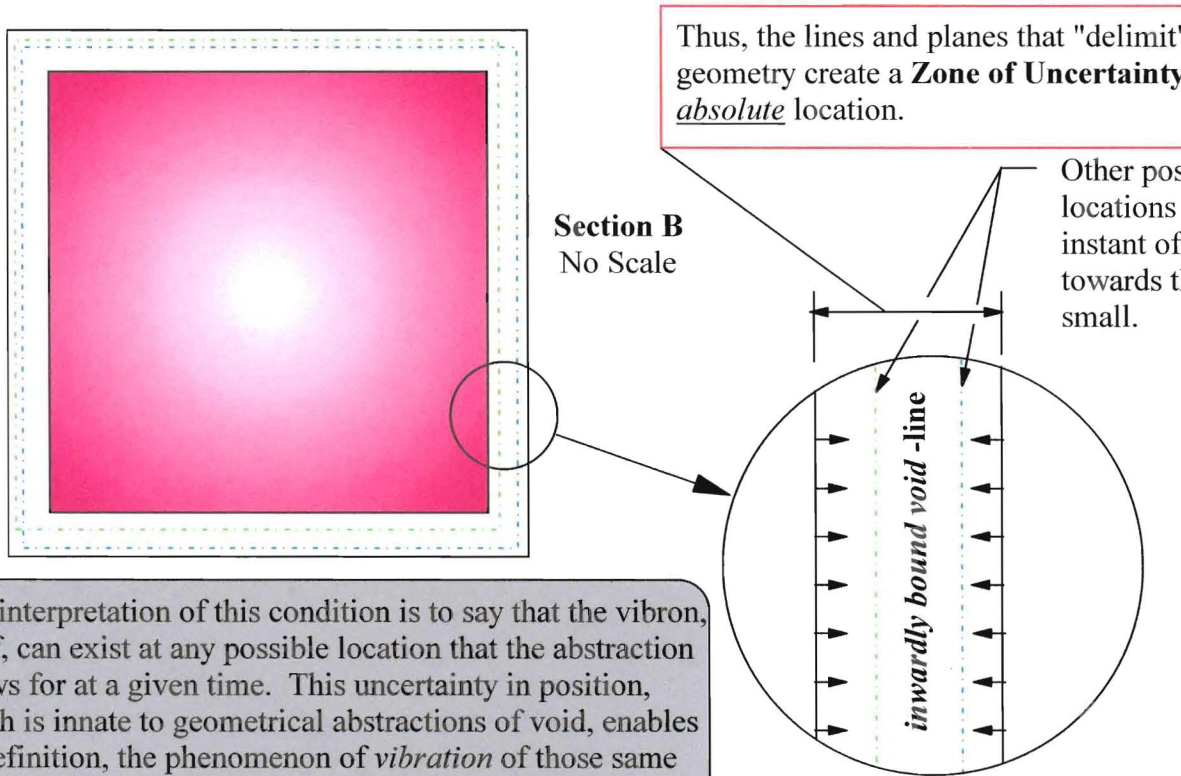




Lines *(inwardly bound void)* that define surface geometry have a "width" at any particular instant in time as they forever shrink. This "snapshot" shows an exaggerated line "width."

Note below that the abstraction of a line *(inwardly bound void)* allows for other possible locations for lines that define similar geometry at any instant.

Thus, the lines and planes that "delimit" vibron geometry create a **Zone of Uncertainty** in *absolute* location.

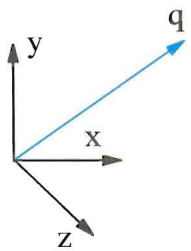


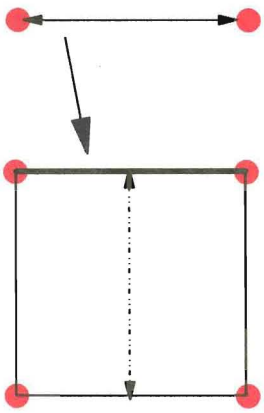
One interpretation of this condition is to say that the vibron, itself, can exist at any possible location that the abstraction allows for at a given time. This uncertainty in position, which is innate to geometrical abstractions of void, enables by definition, the phenomenon of *vibration* of those same abstractions.

Figure 22
Discrete Motion of Inward Bound Void Develops Dimensional Scheme

Discretely moving geometry (inwardly bound void) defines the meaning of dimension:

boundary point ●

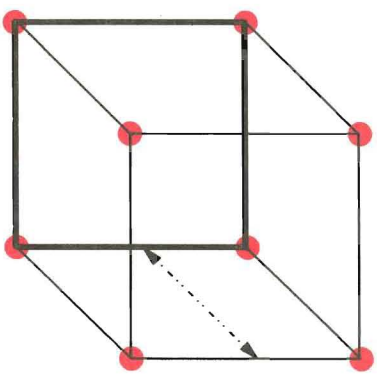


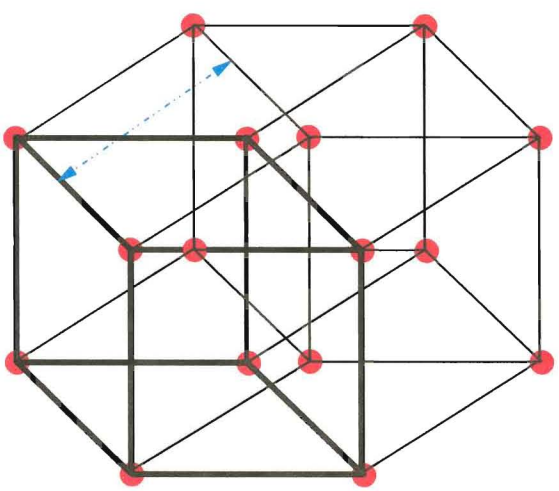


Point traces a **line** along x-axis.
One dimension is created.
Point can be visualized as vibrating between boundary points.

Line traces a **square** when moved along the y-axis (perpendicular to the x-axis).
Two dimensions are created.
Line can be visualized as vibrating between boundary points.

Square traces a **cube** when moved along the z-axis (perpendicular to the xy-plane).
Three dimensions are created.
Square can be visualized as vibrating between boundary points.





Cube traces a **hypercube** or **tesseract** when moved along the q-axis (perpendicular to the xyz-space).
At least four dimensions are created.
Cube can be visualized as vibrating between boundary points.

require discrete motion for definition. The infon, a new, fundamental, theoretical object just proposed, encodes information by means of the discrete motion of its constituent vibrons. Vibrons, which compose the infon, were recently shown capable of discrete motion due to the *uncertainty in the abstraction of void* which bounds each vibron. Lastly, the discrete motion of elements of void between boundary points defines the concept of dimension. **Obviously, discrete motion and uncertainty *echo* over and over their importance and necessity in any thorough, foundational theory which attempts to describe the natural world.**

Now, consider the hypercube generated by the orthogonal vibration of inwardly bound void at the bottom of Figure 22. When viewed from a particular angle, the hypercube displays a most useful projection as shown in Figure 23. From this vantage point, a smaller cube becomes visible embedded within a larger cube and is shaded in the figure. In a manner completely in step with the arguments and narrative thus far, the shaded cube centered in the larger cube can be equated to a *nested domain* defined and generated by the action of creating a fourth dimension. (See heading one and two under the first section for a discussion of *domain* in this context.)

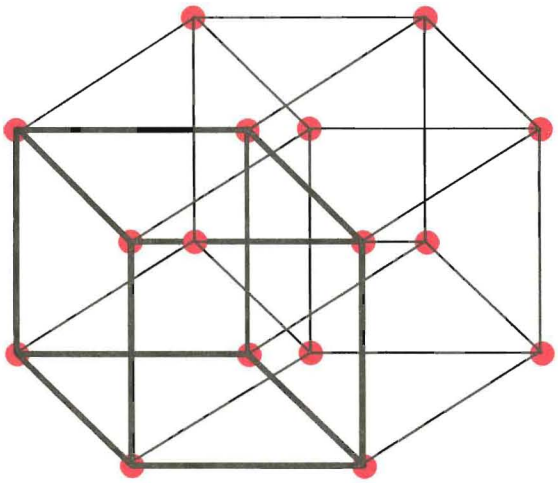
Although it is hard to visualize vibrating in a direction normal to xyz-space to create a hypercube, it is not so difficult to see that the nested cube in Figure 23 results solely from a consistent method of deriving dimensions. *Thus, the appearance of a **nested domain** can be associated with the existence of a higher dimensional space.* Curiously, the same six vibrons that define an infon and originate from a single cube in Figure 20 can be rearranged to form another vibron as seen in Figure 24. This feature of this particular infon geometry aides in the visualization of an infinitely recursive pattern of relative, nested, **infon domains** or sub cubes. These infon domains correspond in a meaningful manner to the natural generation of hyperdimensions or spaces. See Figure 25.

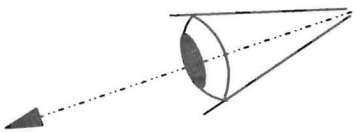
A nested domain (in this model a cube within a cube) defines or yields higher dimensional spaces through the mechanism of *compounded or relative uncertainty.* As seen in Figure 25, normal, three dimensional space is defined by the large, non nested, infon domain the figure, which has its own associated zone of uncertainty. The other three, nested, infon domains depicted contain vibrons that vibrate in their own *domain's exclusive* zone of uncertainty relative to the other three dimensional infon domains shown. **It is proposed that the relative uncertainty in the location of nested infon domains, u_r, that exists between successive, nested infon domains, creates hyperspaces**. The vibrons that "experience" new dimensions within the relative, nested infon domains do not have to vibrate in an orthogonal direction; they can exhibit any form of relative motion allowed for in a particular infon domain's zone of uncertainty. Also, it is important to remember that the uncertainty associated with inwardly bound void allows these vibrations to occur conceptually.

Each hyperspace infon domain "holds" or carries an additional three new dimensions which are isolated from the other infon domains by the action of *relative uncertainty*. Please note that this scheme *is not* a Kaluza - Klein theory of multiple dimensions where the "spatial fabric" of the universe has "extended" dimensions (normal 3-d space) and "curled-up" hyper dimensions. All dimensions in this derivation are of the same category and share the same genesis. Hyper dimensions cannot be directly observed or experienced because they are quarantined by the compounding of uncertainty in the location of the geometric elements that define relative infon domains. Hyper dimensions in this model evolve from the geometric derivation of "regular" dimensions.

Multiple dimensions arise here as a natural consequence of basic infon definition: Infons are constructed from elements of void (vibrons) that possess a coupled uncertainty in absolute position. Uncertainty associated with void is the engine that drives the vibrons as well as the relative motion of nested infon domains. **The relative uncertainty in position of nested infon domains can be viewed as a consistent method of generating an infinity of *hyper* or *hypo* domains carrying**

Figure 23 Hypercube Reveals Nested Domain





Hypercube when viewed from a particular direction has this projection.

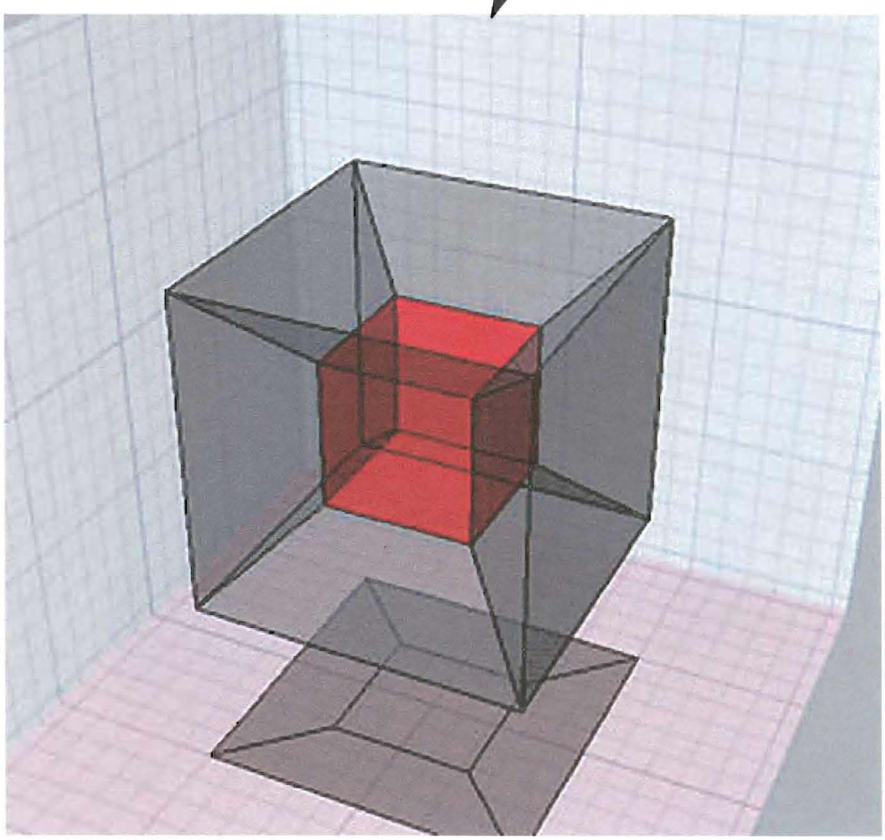


Image courtesy of Drew Olbrich

The shaded cube in the center of the larger cube is a ***nested domain*** generated by the derivation of a fourth dimension. Accordingly, a nested domain can be construed as being a marker characteristic of higher dimensions.

Figure 24
Visualization of Iterative Structure
of Proposed Infon

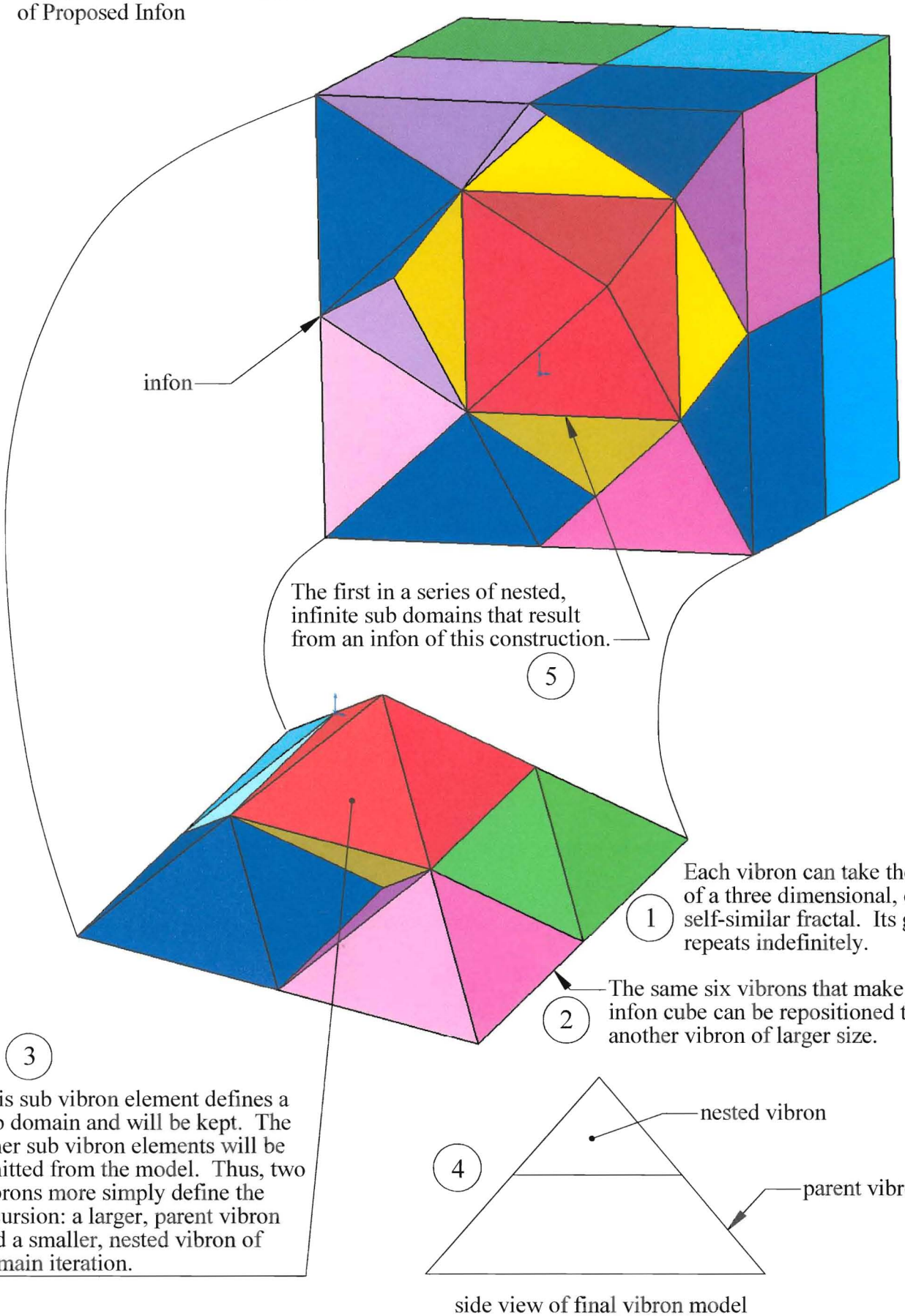
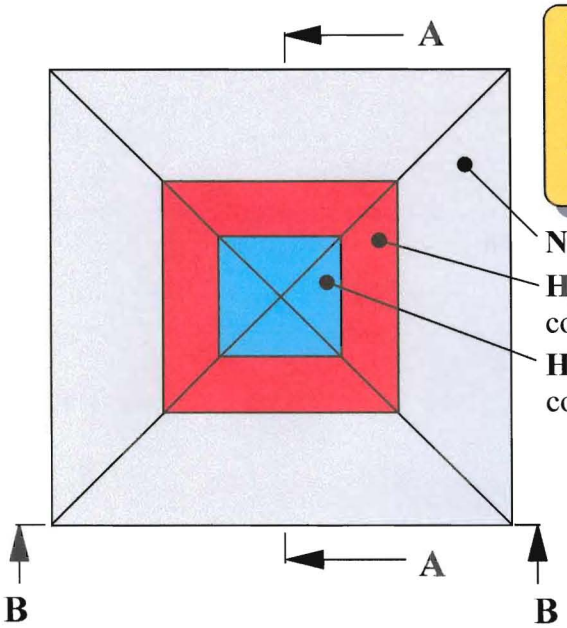


Figure 25
Nested Infon Domains Yield Higher Dimensional Spaces



Side view of infon with facing vibron removed.

Relative uncertainty in location that exists *between* any two nested infon domains creates hyperspaces. This "compounded" uncertainty between infon domains isolates each 3-dimensional realm. ***Each instance of inwardly bound void, IBV, (a domain boundary) creates its own exclusive zone of uncertainty.***

Normal Space - Dimensions 1, 2, 3 carried by "base" infon domain.

Hyperspace "Infon Domain 1" - Dimensions 4, 5, 6 carried by compounding of uncertainty with Normal Space infon domain.

Hyperspace "Infon Domain 2" - Dimensions 6, 7, 8 carried by compounding of uncertainty with Infon Domain 1.

Pattern continues into infinity. - Thus, an infinite number of infon domains and dimensions exist.

Note: Infon Domains "below" normal space could certainly exist, and the first would be referenced as Infon Domain -1 with dimensions: -1, -2, -3, etc.

Relative uncertainty, u_r, isolates Infon Domain 1 and its vibrons from the Normal Space infon domain, and thus, Infon Domain 1 vibrons oscillate in higher dimensions to express information.

Hyperspace Infon Domain 1 vibron shown vibrating relative to normal space vibron in its own unique zone of uncertainty.

Normal Space vibron

Zone of Uncertainty for Infon Domain 1

Zone of Uncertainty for Normal Space Infon Domain

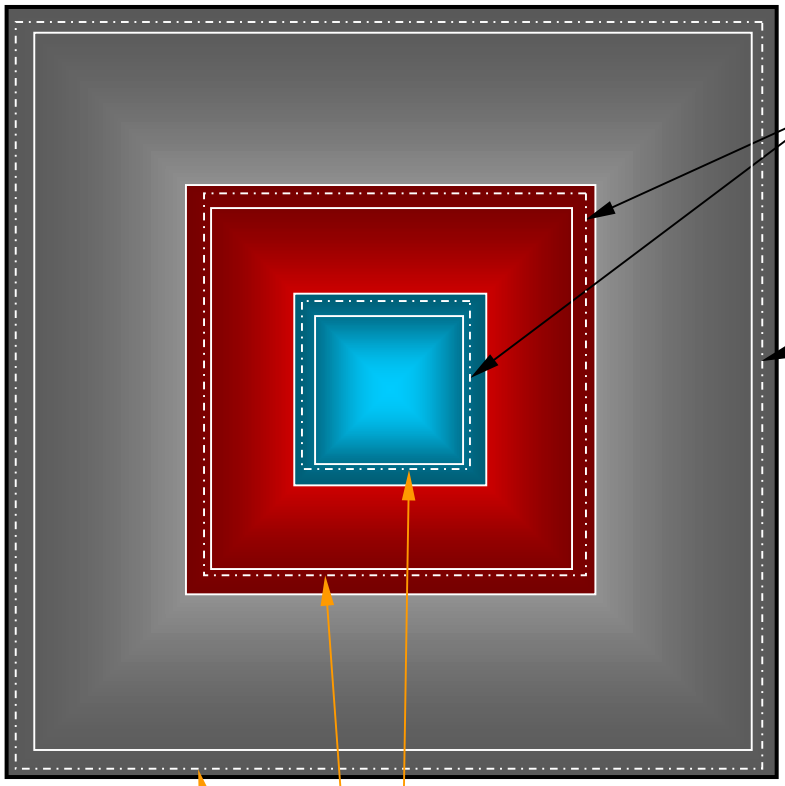
Section A-A lower vibron only with Infon Domain 2 omitted for clarity (no scale)

The Logic and Stipulations That Govern the Geometric Abstraction Called the Infon

- Since the nested cubes define by means of compounded or relative uncertainty (u_r) hyper or hypo dimensional realms (infon domains and associated vibrons), there is no contradiction of logic or of geometric abstraction where it appears that the defining geometry *overlaps*.
- Hyper or hypo infon domains and their constituent vibrons cannot conflict or interfere with normal space infon domain geometry because they originate in hyper or hypo dimensional space (domains). An observer in normal space (or any other singular domain) cannot detect other nested, domain geometry because of the speculated, complete isolation that results from the action of u_r.
- The infon as sketched is an encompassing schematic or geometric model of action constructed from the viewpoint of all dimensional spaces (domains) simultaneously for purposes of visualization.
- The infon domains and related vibrons are modeled as being non solid because it is their defining planes and lines, inwardly bound void (IBV) that gives rise to u_r and the definition of their form and geometry. Also, it is important to remember that a geometric solid is really outwardly bound void (OBV) contained by a "layer" of IBV. IBV is the "actor" of note and defines relevant geometry.

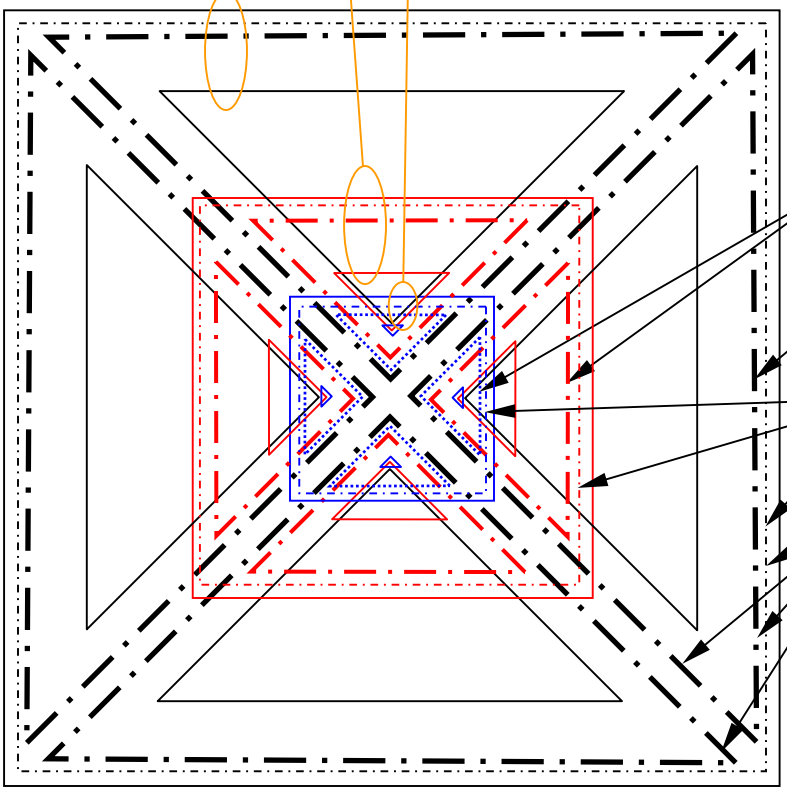
Figure 25 (continued)

Infon “External” View B-B



Isolated infon domain boundaries carrying three dimensions each are shown in their *exclusive* zones of uncertainty.

“schematic microscope” magnification of a domain boundary line at an instant of time: a <u>unique</u> *instance* of IBV (one of three)



Vibrons of each domain are revealed within their associated zones of uncertainty.

domain boundary lines

Coincident lines share the same zone of uncertainty, and thus, they share the same relative uncertainty with respect to the other domains.

Infon Schematic (Snapshot)

three dimensions each.

Additionally, the three dimensions of conventional space are best visualized as being orthogonal vibration progressions of elements of void with higher dimensions being defined by the compounding of uncertainty in the position of relative infon domains. Therefore, the expression of information by this construct is layered or hierarchical due to the existence of multiple domains. (A quantitative derivation of the concepts presented in this heading will be explored later in the text.) Figure 26 reemphasizes the prominence of the *theme* of uncertainty in a graphical summary. The infon concept will be paired with future observations to generate a new, physical representation of nature.

Continuous Motion - More Mythology than Fact?

Much of the narrative thus far has been fashioned as prelude and complementary knowledge to the simple fact that an infinite continuum (distance) separates any two geometric points... While this condition is widely known and accepted within the literature, once again, closer examination of the infinite reveals details that point toward the emergence and dominance of a discrete mode of action and understanding versus a continuous one. A thorough physical theory reconciles and incorporates this infinity as part of a truly representative description of nature.

Figure 27 graphically depicts two geometric points A and B with a intervening distance L between them. Point B is shown moving toward a stationary point A. Following the incremental steps outlined in the figure, point B can never close the recurring gap, Δx, between itself and point A because the inwardly bound void that defines both points never quits shrinking. Thus, an infinite distance separates any two theoretical, geometric points if the gap that separates their mutual centers can never be completely spanned. Normal treatment of this "paradox" requires the application of a limit in which $\Delta x \rightarrow 0$. While this remedy might be satisfying to a mathematician, *it does not change the very real fact that Δx never goes away.* (Note that an elemental object's mass center, a theoretical, geometric point location, substituted for Point B in the figure, would also never arrive at Point A by the same argument.)

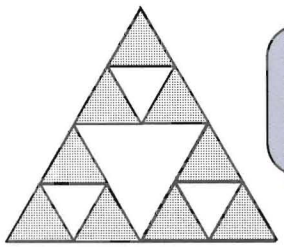
Some might argue that this infinity exists only in an abstractional or theoretical sense because "the material or stuff" of the universe certainly moves across these intervening distances. While no doubt the non-generational, elemental objects that make up the material world do cross the distances (outwardly bound void) not allowed for in the example above, ***we are in no position presently to say exactly how this is done.***

Bohr's diffraction limit guarantees that no observation of non-generational, elemental objects can be so precise as to monitor their locations exactly. The inaccuracy of any position measurement is approximately equal to the wavelength, λ, of the radiation being used to locate an object. Also, the Heisenberg Uncertainty Principal guarantees that no observation of elemental objects can be so precise as to be able to monitor their momenta and locations exactly. The uncertainty in a simultaneous measurement of momentum and position is always greater than or equal to a set limit approximately equal to Planck's constant h.

Non-generational, elemental objects are the focus here because they are more basic than atoms and, in fact, compose them. Therefore, if non-generational, basic objects can cross infinite distances, then, obviously, the matter they can constitute does so as well.

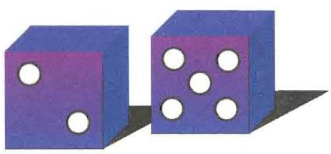
While the wavelengths of imaging radiation can be very small quantities, the Planck length is much smaller, and the infinitesimal, Δx, from the abstractional setting of Figure 27 can be much, much smaller... Accordingly, a "window" of opportunity exists to blend the infinities inherent in

Figure 26
Uncertainty as a Major Theme or Echo

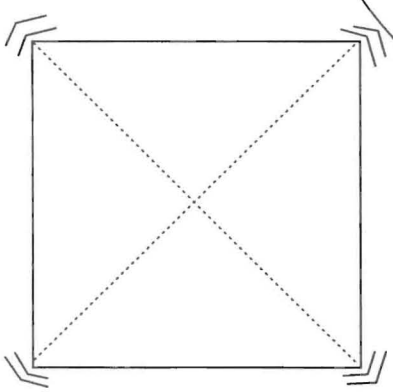


Plotting the Sierpinski Triangle can be viewed as a predictive physical experiment that foreshadows a consistent method of defining extra dimensions.

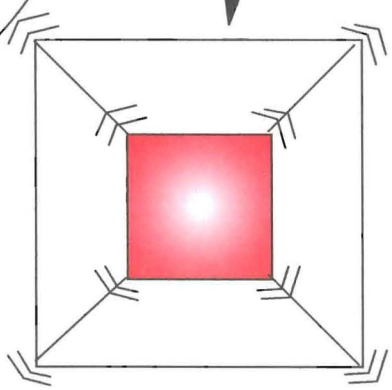
The Sierpinski Triangle - Uncertainty defines an infinitely recursive, nested domain geometry.



Uncertainty - The driving source of information generation.

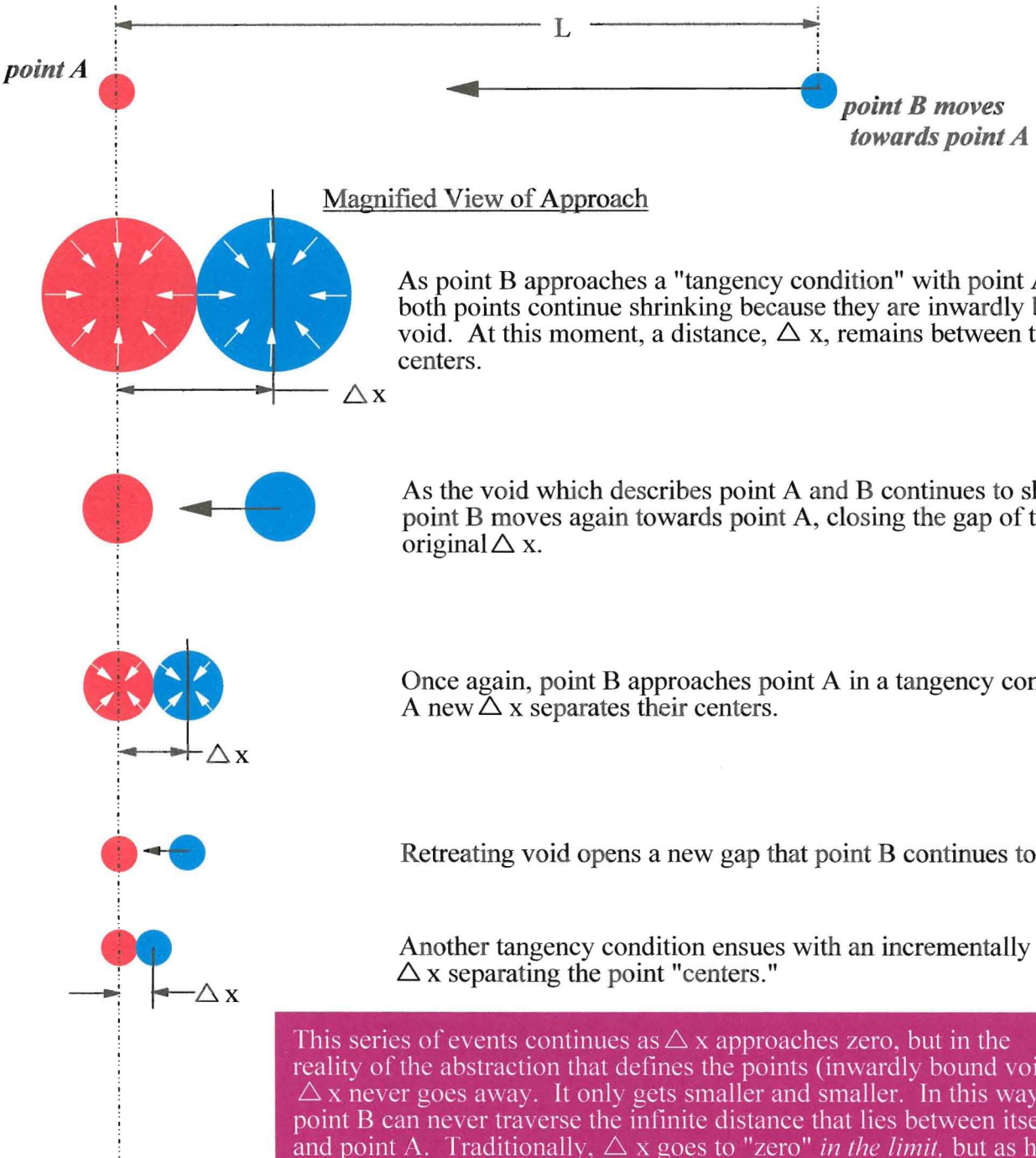


The Infon - Means of "expression" *(discrete motion and coupled geometry)* driven by vibron movement caused by the uncertainty in position of inwardly bound void.



The Hypercube - Fourth dimension created by the relative uncertainty in position of infon domains. "Compounded" uncertainty isolates extra dimensions.

Figure 27
An Infinite Distance Separates Two Geometric Points



As point B approaches a "tangency condition" with point A, both points continue shrinking because they are inwardly bound void. At this moment, a distance, △ x, remains between their centers.

As the void which describes point A and B continues to shrink, point B moves again towards point A, closing the gap of the original △ x.

Once again, point B approaches point A in a tangency condition. A new △ x separates their centers.

Retreating void opens a new gap that point B continues to close.

Another tangency condition ensues with an incrementally smaller △ x separating the point "centers."

This series of events continues as △ x approaches zero, but in the reality of the abstraction that defines the points (inwardly bound void), △ x never goes away. It only gets smaller and smaller. In this way, point B can never traverse the infinite distance that lies between itself and point A. Traditionally, △ x goes to "zero" *in the limit,* but as has been discussed before, a limit is a mathematical device not reflective of the true nature of inwardly bound void - it has no limit in its abstractional construct.

So how can the infinite distance (outwardly bound void) between points A and B be traversed in a way that is consistent with the definition of void being that which cannot be limited? Perhaps it is not possible to travel between two points in a <u>continuous</u> fashion...

geometric theory with the limits found in observing nature to generate a more comprehensive world view. See Figure 28.

Given that:

a. The distance between points M and N in Figure 28 is *infinite and real.*

b. The distance between points M and N can be traversed by non-generational, elemental objects.

c. The exact location of any non-generational, elemental object's mass center, Q, is below the resolution of any possible observational technique.

Then, without any conflict of observation or logic, ***Transformation***, a new theory of motion that complements and relies on ideas presented earlier, can be shown to offer solution and insight into the very ***real*** "dilemma" of an infinite distance existing between any two theoretical, geometric points and the fact that everyday objects in motion manage to traverse this same infinity. Transformation ultimately reconciles and blends this abstractional infinity with a new description of physical movement. Before explaining how the conjunction of previously discussed themes leads towards the transformation hypothesis, the Planck length needs to be revisited for a moment.

As mentioned before under the first heading, the Planck length is the dimension at which space is predicted to become "foamlike" and the dimension at which general relativity is no longer valid. Below the scale of the Planck length, quantum fluctuations in the fabric of spacetime would become enormous. *Fundamentally, the Planck length is the length below which normal associations of space and time are predicted to break down.* Derivation of the Planck length entails using dimensional analysis and some major constants in physics. Arranging these constants so that their units mathematically cancel, leaving a distance unit of measure, yields the Planck length:

$$l_p = \sqrt{\frac{\hbar G}{c^3}} = 1.6 \times 10^{-35} \ \textit{meters}$$

$$\textit{where } \hbar = \frac{h}{2\pi} \ \textit{with } h = \textit{Planck's constant} = 6.63 \times 10^{-34} \ J \cdot s,$$

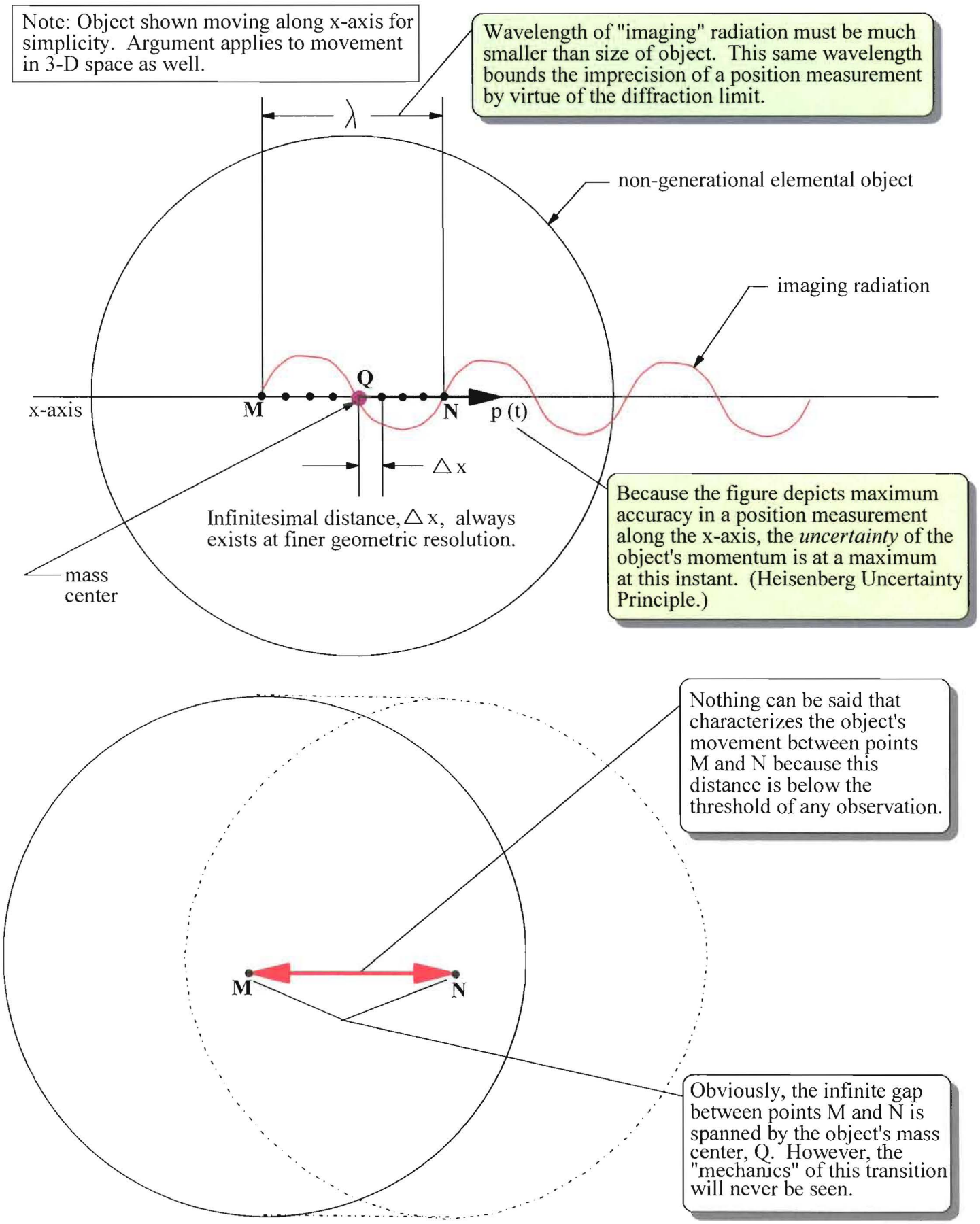
$$G = \textit{gravitational constant} = 6.67 \times 10^{-11} \ \frac{N \cdot m^2}{kg^2},$$

$$c = \textit{the speed of light in a vacuum} = 3.00 \times 10^{8} \ \frac{m}{s}$$

Since it (the Planck length) involves gravitational and spacetime inputs (G and c) and has a quantum mechanical dependence ($\hbar$) as well, it sets the scale for measurements - the natural unit of length - in any theory that attempts to merge general relativity and quantum mechanics."[23] Traditional ideas of space and time are no longer presumed to be valid in the realm below the Planck length, and

[23]Brian Greene, *The Elegant Universe*, p. 397.

Figure 28
Imaging Non-Generational Elemental Objects



thus, the usual concept of crossing or travelling a "distance" must also end at Planck length resolution.

Because understanding transformation requires the integration of most of the themes and concepts introduced so far, its explanation involves building layers of logic in presentation. Accordingly, the first approach to take in describing transformation consists of examining the real, physical implications of the Planck length and the mechanics of motion.

Most people have no difficulty imagining or visualizing the movements of objects at most speeds. Even very high velocities up to the speed of light pose no conceptual dilemma in visualization or concept. This situation changes though, in the realm of the very slow and minute.

Consider for a moment a "speck" of dust that is traveling at a constant velocity of one millimeter every 10,000 years. As the mind struggles to visually conceptualize the motion of the dust particle as continuous through the millimeter over a 10,000 year period, the mental image of this motion invariably moves toward the discrete for most observers at such exceptionally slow velocities. The dust particle can be imagined to move more easily in small, noncontinuous increments of displacement as it makes its painfully slow journey. This "more comfortable," natural visualization of the just barely moving dust speck under these circumstances may have a real physical foundation.

Although the dust particle is moving quite slowly over a small distance, the implications of much slower movement in the Planck length realm ultimately "bridge the gap" so to speak between geometric theory and physical objects in motion. See Figure 29 for the discussion which follows.

In Figure 29, a non-generational, elemental object, P, has a velocity defined in terms of the Planck length as being *six Planck lengths per hour*. (Note that in the figure, only P's center of mass is depicted graphically - point Q. The actual object P is too large to be shown because the Planck length is the *physical* lower limit for the theoretical infinitesimal, Δx, of Figure 28.) At such a minuscule velocity, the dynamics of motion become more clear.

From the standpoint of the *material,* observable cosmos, the Planck length is the smallest physical distance that has meaning. Therefore, from a **physical** or **observational** perspective, there exists no smaller displacement because such movements escape definition and are not capable of being discerned. **Certainly, intervals smaller than the Planck length do exist because void has no lower limit in its abstractional underpinnings.** However, the Planck length represents the smallest "tick mark" on the scale by which nature can be measured and currently understood, and thus, is an index of substantial importance.

The great constants of physics have yielded a fundamental lower bound for distance measurement as shown previously. Thus, it is not possible to move in a conventional sense in any increment smaller than the Planck length because such a displacement cannot be characterized or realized by observational science. A conventional movement smaller than the Planck length is not logically defined for any "physical object." *When for the sake of consistent argument, object motion is restricted to Planck length "fine graining," transformation results because the infinity that is the Planck length is traversed as a fundamental increment by definition.*

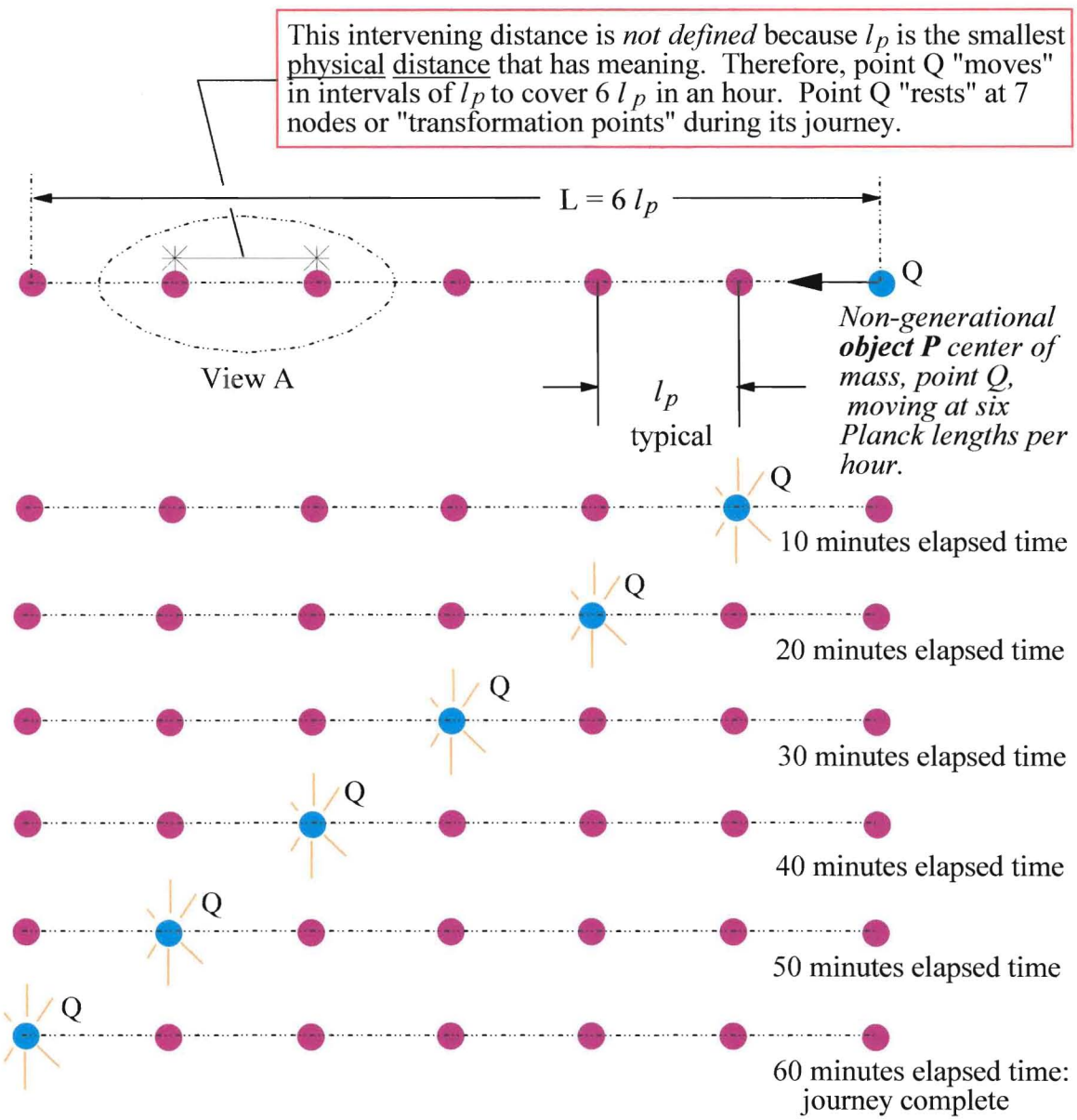
With these facts being the case, when object P's center of mass moves in Figure 29 at a "hypo-velocity" of six Planck lengths per hour, *it must rest at every Planck length interval for a period of time.* Notice that point Q cannot logically traverse any span less than the Planck length during its journey because, from the standpoint of any possible measurement, no smaller displacement exists or is defined. Accordingly, point Q accomplishes the **discrete** transition from Planck length to Planck length location and crosses the outwardly bound void in between by the mechanism of transformation: Point Q appears at a particular Planck length, "transformation point," stays for a period of time, disappears, and then reappears at the next Planck length interval in the direction of motion. *(Where*

Figure 29

Transformation as a Solution to Traversing Infinite Space (Outwardly Bound Void)

"LIFE IN THE SLOW LANE"

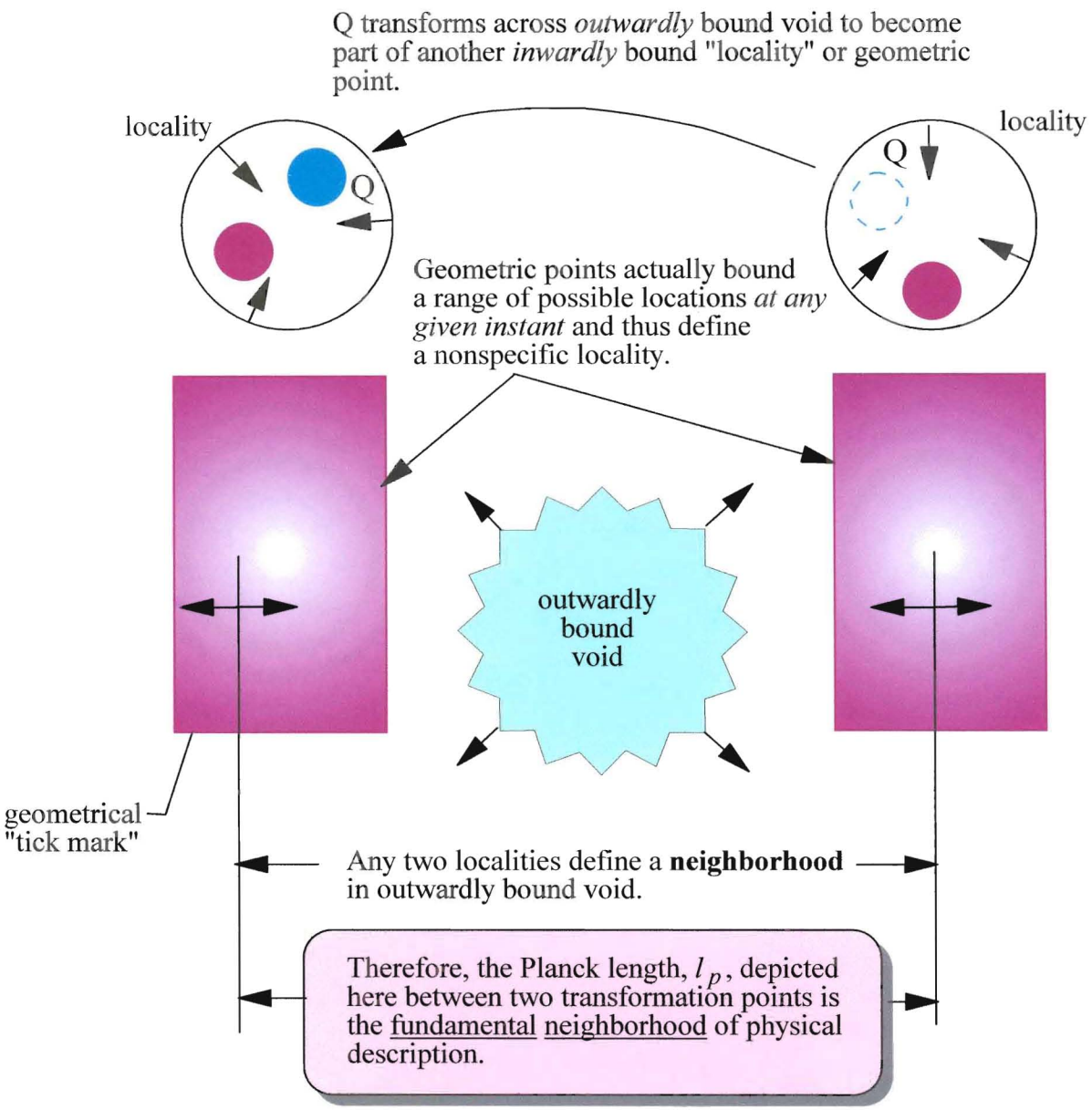
At an exceptionally slow velocity of six l_p (Planck lengths) per hour, point Q's motion can be characterized as being discrete by the arguments below:



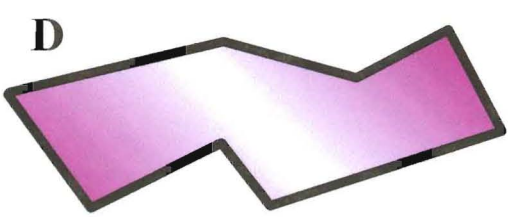
- The space, *outwardly bound void*, between any two elements of *inwardly bound void* (points in this example) is an infinite distance per Figure 27.
- The paradox of crossing an infinite continuum is resolved by considering "transformation points" as a means of motion. The Planck length is the minimum distance that has meaning in our sensed physical reality. Thus, as object P's center of mass moves, it is proposed that it can only do so in increments of l_p .
- As point Q moves from Planck length to Planck length discretely, it spans the *outwardly bound void* in-between by definition. *Point Q appears at a particular transformation point, stays an interval of time, disappears and then reappears at the next Planck length interval in the direction of motion.* (The whereabouts of Q during time spent out of "experiential space" between Planck lengths will be explained later to be a plausible basis for the time dilation effects of special relativity.) **This process is called Transformation.**
- The time required for each Planck length transformation is termed the **Dwell Cycle Period.**

Figure 29 (continued)

View A: Snapshot of Two Transformation Points During Transformation of Point Q.



Note: Given the above definitions, a domain then can be seen as a *closed* neighborhood.



point Q "goes" between transformation points and the details of Q's momentary temporal absence from one transformation point to another will be discussed in upcoming "layers" of presentation.) The total time necessary for each Planck length transformation is called the "dwell cycle period." This scenario represents the first layer of logic in the building of the transformation hypothesis.

As stated earlier, because of Bohr's diffraction limit, transformation (the Planck length fine graining of movement) cannot be detected directly in any non-generational, basic object in motion. The Planck length, our chosen "infinitesimal limit" in Figure 29, is exceptionally smaller than the wavelength of any possible imaging radiation. Thus, if transformation exists, more rationale for the hypothesis must be generated by further argument, presentation, and circumstantial evidence.

The Noncontinuous Structure of Experiential Space

Transformation as presented so far begins the description of a new mechanics which incorporates from the start the fact that an elemental object's mass center in motion must be enabled to bridge the infinite gap (outward bound void) that exists between any two geometric points. Further discussion, mindful of the observational limits found in quantum physics as well as Planck length definition, led to the Planck length "fine graining" of motion. *The marriage of the real infinities of geometric abstraction with the limits of current physical description mandates the development of transformation theory.*

Since the Planck length is the lower bound of physical observation, it is logical and expedient to make the Planck length the "unit index displacement" of transformation because smaller ***observational*** distances have no current meaning, and thus, are not allowed. As mentioned previously, the confluence of the major themes of infinity (with domain), uncertainty, and discrete motion will be naturally blended to complete the characterization of the mechanism of transformation. Careful consideration of all of these elements will provide a new, consistent structure or model for experiential space and beyond.

Before going forward, these facts should be remembered as foundational:

- The birth of any non-generational elemental object can best be characterized as a singular, discrete event: they either "pop" into reality from the vacuum of space at a particular threshold temperature or emerge as virtual particles where they make momentary appearances and then vanish. *In both instances, their collective genesis is a sum of discrete occurrences (nodes) which effectively map "hot spots" of activity.*

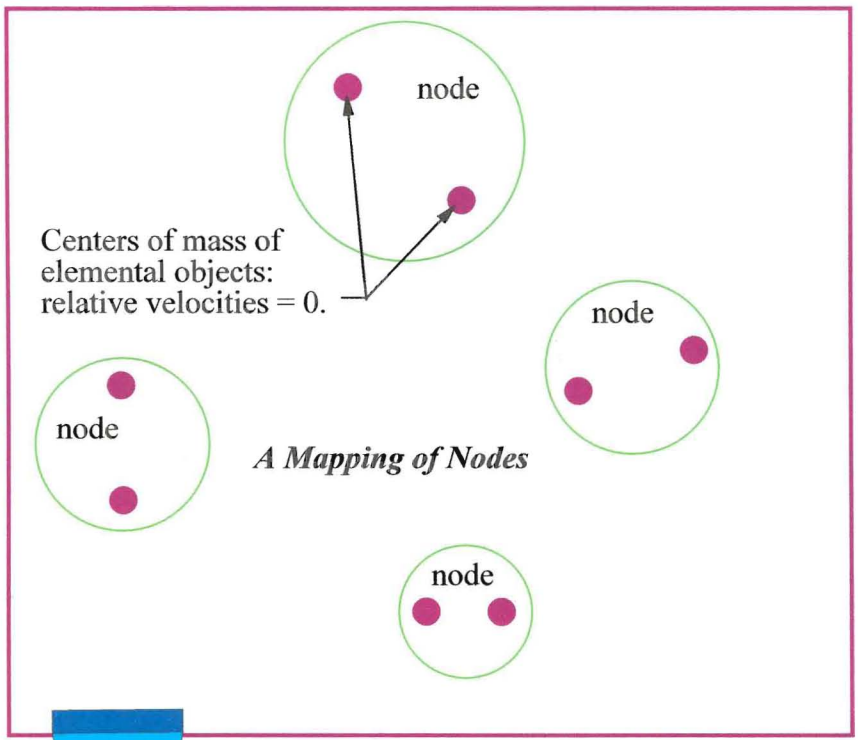
- The discrete motion paradigm guarantees spot or point locations of zero relative velocity for all elemental objects from the vantage point of the universal perspective.

Given that the observable universe already "expresses itself" solely through the discrete node behavior of its elemental objects singularly or in total, and that the transformation of objects relies on transformation points, a seamless combination of these two constructs implies the existence of a framework or skeleton of interaction sites throughout space. See Figure 30.

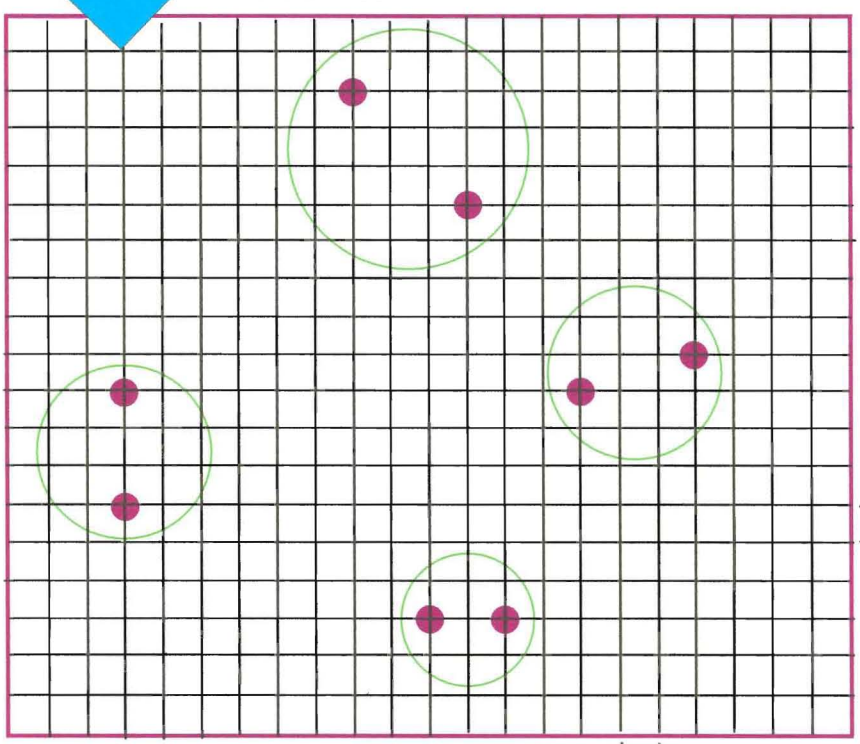
Figure 30 shows three node events occurring at the same time at three different locations in a two dimensional space. Because these are node events, the relative velocities of the mass centers of the shown, paired, elemental objects are zero at this instant. Using the developing terminology of transformation, the mass centers of all elemental objects in the figure at this moment are stationary relative to each other during a portion of their dwell cycle periods and must be resting momentarily

Figure 30

The Union of Planck Length "Fine Graining" and the Discrete Motion Paradigm



Node phenomena when combined with the Planck length, discrete motion requirements of transformation yield a Planck length ***lattice*** of currently undefined geometry. This lattice defines all possible "moves" of elemental objects in space.



Events only happen at nodes, and transformation must occur to enable every event.

Planck length
Typical

on a Planck length interval.

Therefore, a simultaneous collection of nodes in space begins to define a structure or "network" of resting/action points or sites separated by the Planck length. Notice that an independent consideration of the consequences of infinity gave birth to the necessity of Planck length "fine graining." A completely different path of derivation generated the Discrete Motion Paradigm and the node description of all basic objects in motion. Now, both co-evolving observations reinforce and complement each other in developing a theoretical model of experiential space.

Generating a logical basis for the three dimensional geometry which will define this emerging network of interaction points begins with considering the time honored problem of sphere packing. Employing the philosophy of Occam's Razor, *"Numquam ponenda est pluritas sine necessitate."* (Entities or complexities are not to be multiplied without necessity.), the resting/action points that define the framework or lattice of interaction sites should all be equidistant from each other and separated by the Planck length (the fundamental derived length of nature). With this stipulation, a cubic or hexagonal lattice packing of spheres having diameters equal to the Planck length ensures that their center points (interaction points) will all be separated by the same distance, the Planck length.

Considering that nature usually rewards efficiency, the packing density, η, of the spheres should be maximal. The packing density, η, of a packing of spheres is defined as the fraction of a given volume filled by those same spheres. There exists three "periodic" packings for identical spheres: simple cubic lattice, face-centered cubic lattice, and hexagonal lattice. The simple cubic lattice seen in Figure 31 does not guarantee that all sphere center points are equidistant from each other, and therefore, is eliminated from further consideration as a possible geometry for defining the relative positions of interaction sites.

Kepler in 1611 hypothesized that cubic or hexagonal close packing of spheres (which have identical packing densities) yields the densest possible arrangement. This assertion is known as the Kepler conjecture.

$$\eta_{Kepler} = \eta_{CCP} = \eta_{HCP} = \frac{\pi}{3\sqrt{2}} = 74.048\,\%$$

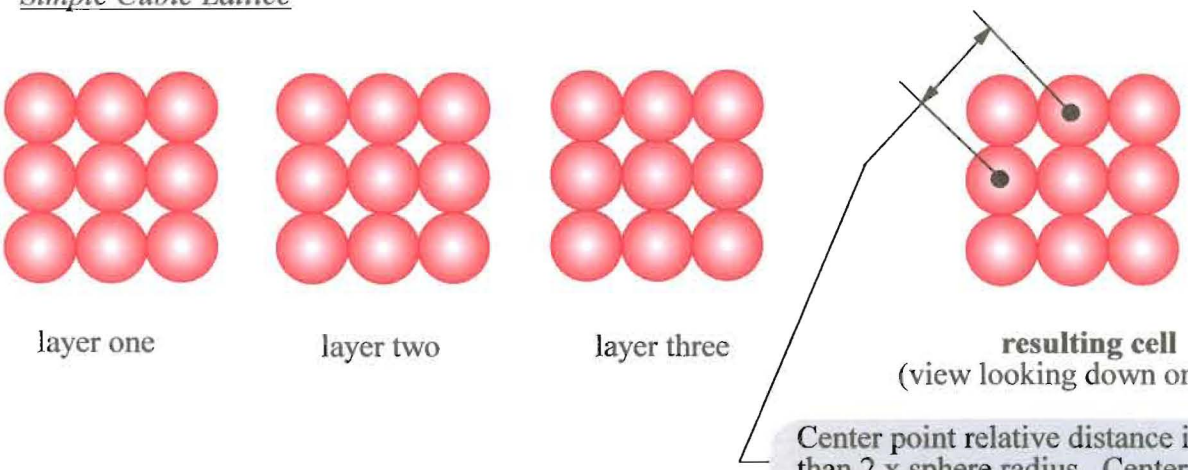
Although intuitively obvious, a proof of the Kepler conjecture has frustrated mathematicians for centuries. Recent efforts by Thomas Hales at the University of Pittsburgh, utilizing computers and optimized code, may have provided a proof, but evaluation is still ongoing.

Of the remaining sphere packing configurations that are still viable, the hexagonal lattice structure is the most simple because there is no relative rotation of spheres between its first and third layers in its "base packing cell." See Figure 31. The base packing cell defines the fundamental, geometric arrangement of spheres that repeats to an infinite extent in three dimensions in both hexagonal and face-centered cubic lattice packings. **While the face-centered cubic lattice and hexagonal lattice packings share the same maximum, possible, packing density, η=74.048%, the hexagonal lattice base packing cell, by virtue of being the simplest, *(Its first and third sphere layers are stacked directly above one another - no relative rotation.)* becomes the *"kernel"* or cornerstone for generating a geometric model of noncontinuous, experiential space.**

Figure 32 shows a three dimensional image of a hexagonal lattice base packing cell. If r in the figure is set to one half the Planck length (each sphere diameter equal to the Planck length), then the sphere centers will all be equidistant from each other and will be separated by the Planck length

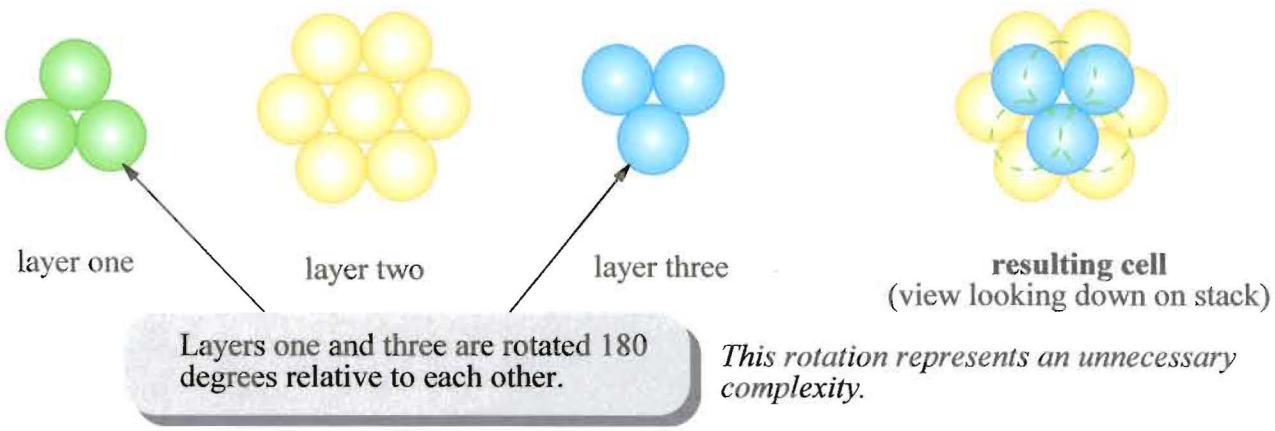
Figure 31
Periodic Sphere Packing

Simple Cubic Lattice



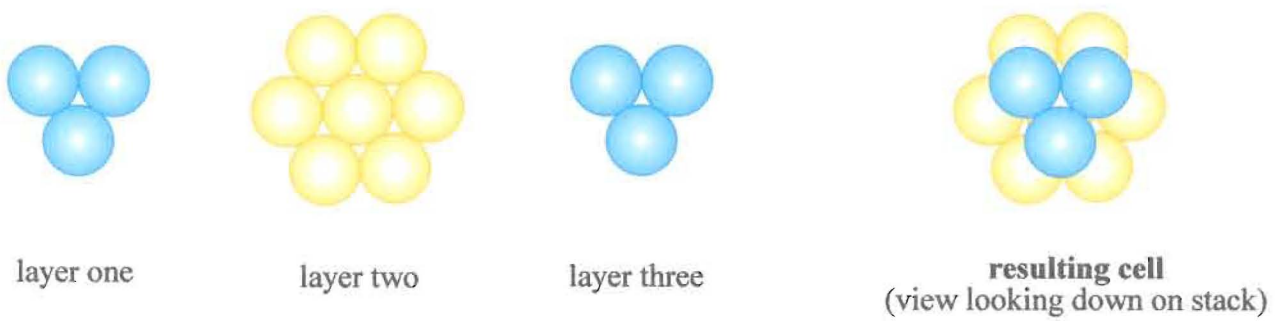
Therefore, the simple cubic lattice is not a candidate for determining the geometry of interaction sites.

Face-Centered Cubic Lattice



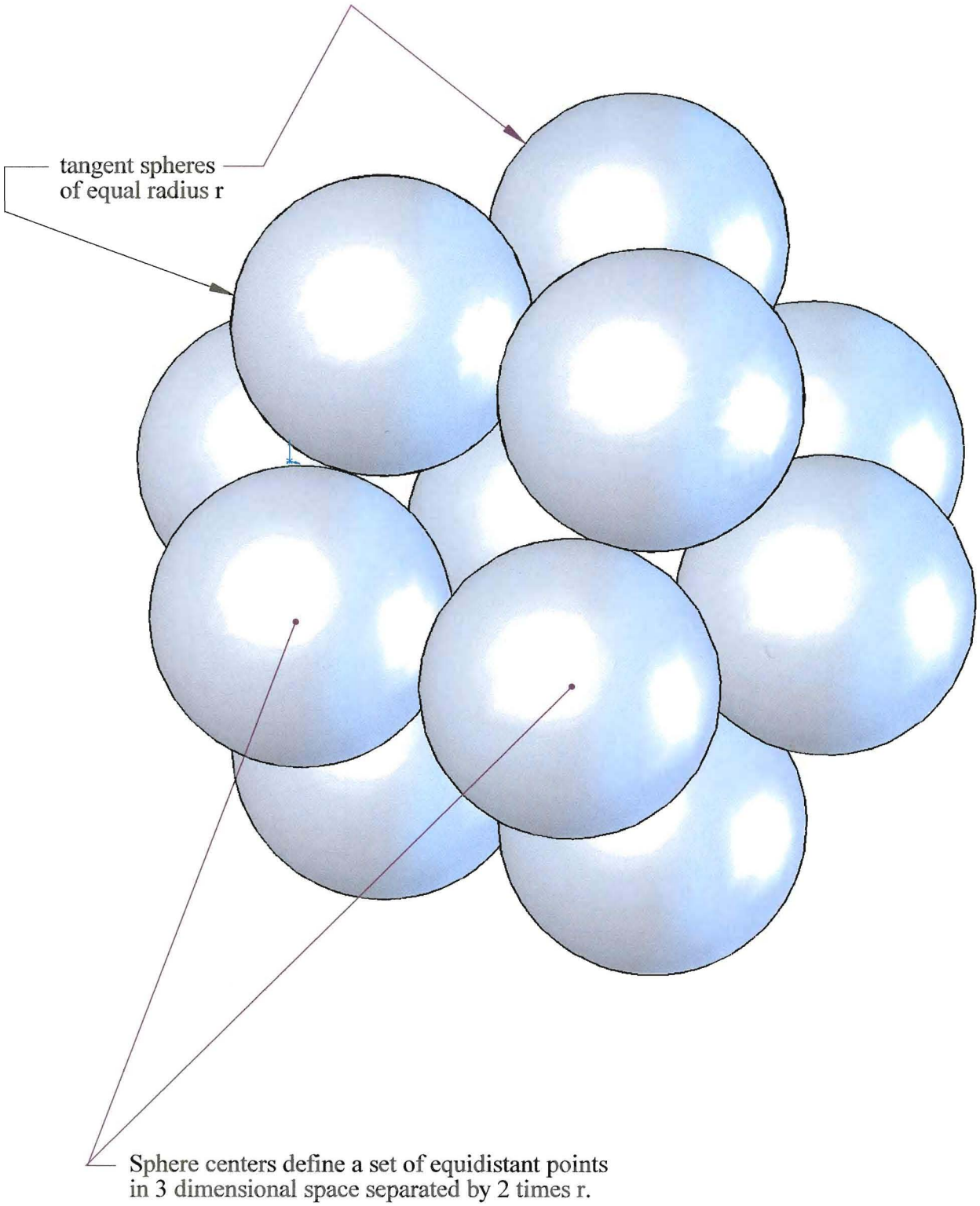
This rotation represents an unnecessary complexity.

Hexagonal Lattice



The simplest and most balanced geometry - no added complexity.

Figure 32
Hexagonal Close Packing of Spheres - Base Packing Cell



as mentioned previously. Removing the tangent spheres exposes the characteristic structure of the hexagonal close packing base cell as seen in Figure 33. *The center points of the original spheres are shown in the figure as nondescript spheroids and locate the cell's* ***resting/action points.***

Because the hexagonal base packing cell yields the three dimensional structure for the arrangement of transformation points, it will be called a **transformation cell.** An infinite cluster of transformation cells demarcates the "network" or lattice of all possible movements (transformations) in space and will be called the transformation array or more succinctly *the array*.

Even though the Planck length is the finest resolution "lens" that science can see through, and as a result, mandates a lower physical bound on measurable length, this condition does not preclude the existence of smaller scale structures whose observable identity is not of size (macro physicality) but of frequency and form. Enter the infon or qubit...

As outlined earlier, information composes the physical universe. All associations are based on and require the discrete motion of elemental objects for meaning and development. Elemental, force carrying, objects (and all other elemental object types for consistency in the model) are best described by *The Circle of Logic* and The Principle of Geometry-Motion Reflexive Equivalence as being made of informational "nuggets" called infons whose composition and modality embody the core of information creation: the emergence of unique forms or geometries by means of discrete movement. Matter, force, and the foundations of consciousness, all different categories of information, emanate exclusively at the most elementary level from the theoretical, but all encompassing, infon. Although theoretical, the overwhelming consistency of the model (The Discreteness Paradigm) that generated the infon concept cannot be underestimated as a factor in favor of "its" true existence as the purveyor of all perceptual phenomena.

Because it is conjectured that all information (matter and energy as a subset) originates on and traverses space by means of resting/action or transformation points, an infon must reside centered at every transformation point location because they collectively are reasoned to be the sole, basic, fundamental sources of all observable information. This notion represents the 2nd layer of logic in the transformation hypothesis.

As information travels from infon to infon, it can only be expressed at the very specific transformation points of the transformation cell lattice cluster or array. *Much like pixels of a CRT (Cathode Ray Tube) television or computer monitor that change color and brightness to give the illusion of movement, infons change in information content to enable "real" physical movement across the infinite outwardly bound void between any two transformation points.* See Figure 34.

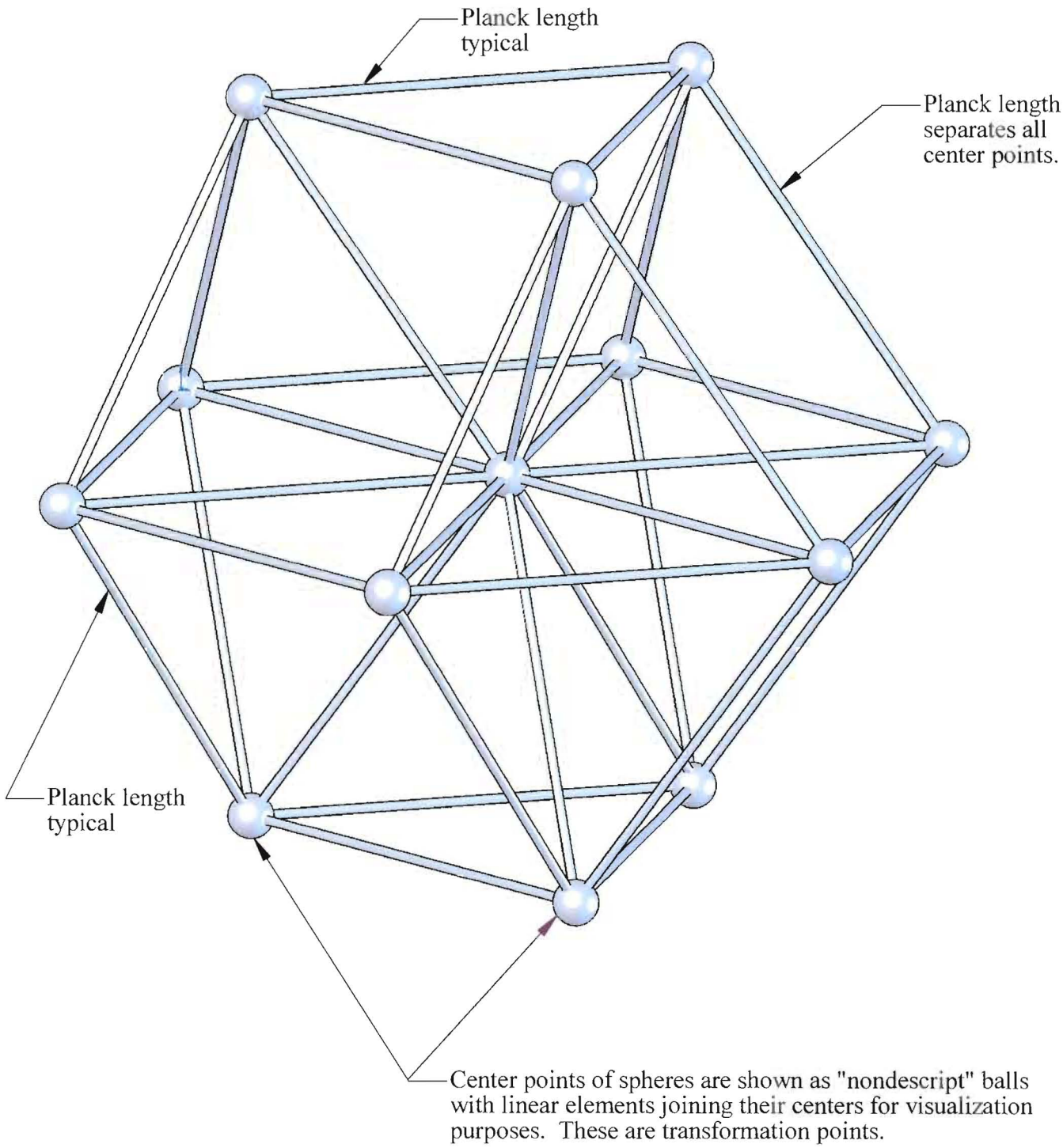
In the figure, several elemental objects are seen transforming across the Planck length lattice that is the array. Only the normal space infon domain is shown. Group 2 and Group 3 labeled objects are made of two or more infons, while the Group 1 object is a singular infon. For the moment, concentrating on the Group 1 object, it has just transformed from Infon A to Infon B. The vibrational pattern or mode of Infon A which defines or actualizes the group 1 object has been transformed across a Planck length interval to Infon B. Thus, the information that characterizes the Group 1 object has moved from Infon A to Infon B, "jumping" the outwardly bound void between them.

Continuing the television screen analogy from above, pixels change color and brightness (information content) from one pixel to the next and maintain picture continuity by means of an electron gun which distributes to each pixel a small portion of the total image. The interconnectivity of the overall picture, parcelled among the individual pixels, relies on a more complete, deeper set of information contained in the original television signal and spread by the electron gun.

In the transformation of the Group 1 object from Infon A to Infon B, the outwardly bound void that surrounds all infons metaphorically becomes the electron gun of perceived reality.

Figure 33
Characteristic Structure of the Hexagonal Close Packing Cell - The Transformation Cell

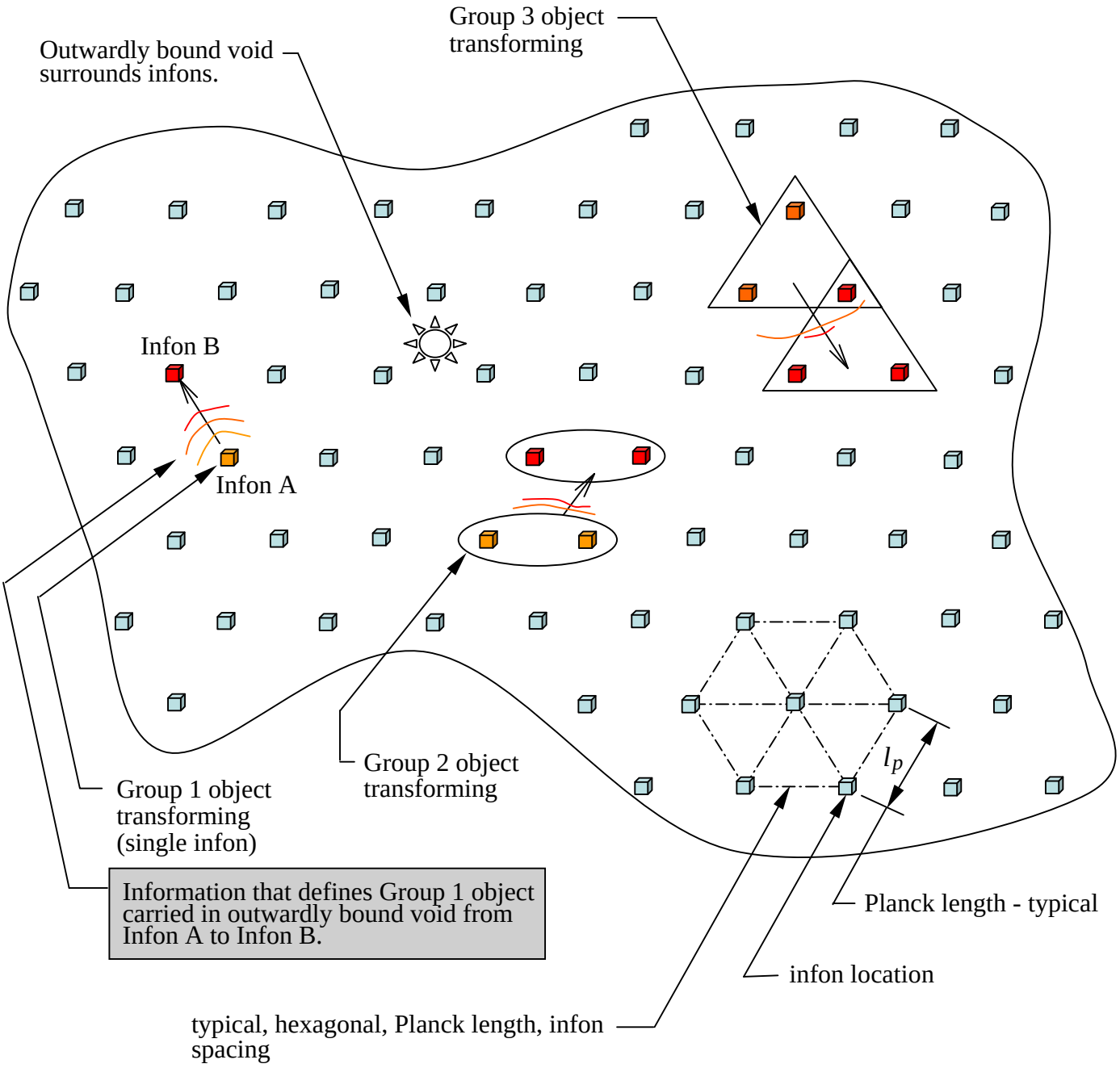
With the tangent spheres removed, their centers create the basic pattern shown below which is repeated in 3-D space to an infinite extent.



Note: A solid having this particular geometry is a Johnson solid called the triangular orthobicupola.

Figure 34 Visualizing Transformation of Objects in Normal Space Domain

Note: Elemental objects are most likely composed of large numbers of infons. Group objects below are strictly illustrative in nature.



Information that defines Group 1 object carried in outwardly bound void from Infon A to Infon B.

View looking normal to “hexagonal plane” defined by transformation cell cluster in space. (2-D lattice) Only two dimensional aspect of array shown for clarity.

Outwardly bound void, in a geometrical sense, holds or contains the sum of all possibilities for information generation. Geometric entities such as points, lines, and planes (inwardly bound void) are subsets of a much more comprehensive "essence" that is outwardly bound void. Clearly, the uncertainty at a time (t) in the absolute location of line elements in inwardly bound void allows for their conceptual vibration which powers the infon.

Pursuing this line of reasoning a bit further: because outwardly bound void is not limited in any way as is inwardly bound void in its abstractional construct, it represents complete, total, and utter uncertainty in geometrical abstraction. Infons locally reduce this grand uncertainty in geometrical abstraction to a magnitude and to a perceivable envelope by being constructed of elements of inwardly bound void which have limits or bounds to their uncertainty in location or locality. Essentially, infons can be viewed as portals or gateways that tap the ultimately, dense information "plasma stream" of outwardly bound void to manifest or project elements of observable reality - elemental objects. See Figure 35.

Ironically, the complete emptiness of outwardly bound void in this model can be said to harbor infinite geometrical uncertainty which equates to an unlimited or infinite information handling capability. This association is the final layer of reasoning needed to complete the theory of transformation of information:

Although an observer of the array at the level of Figure 34 would perceive all object groups discretely transforming from one infon to another across Planck length divides, total continuity of all information during transformation is preserved at its proposed source - outwardly bound void. For illustrational purposes in the figure, waves or rivulets of information (uncertainty) in outwardly bound void depict information movements and thus, drive basic object transformation on the array.

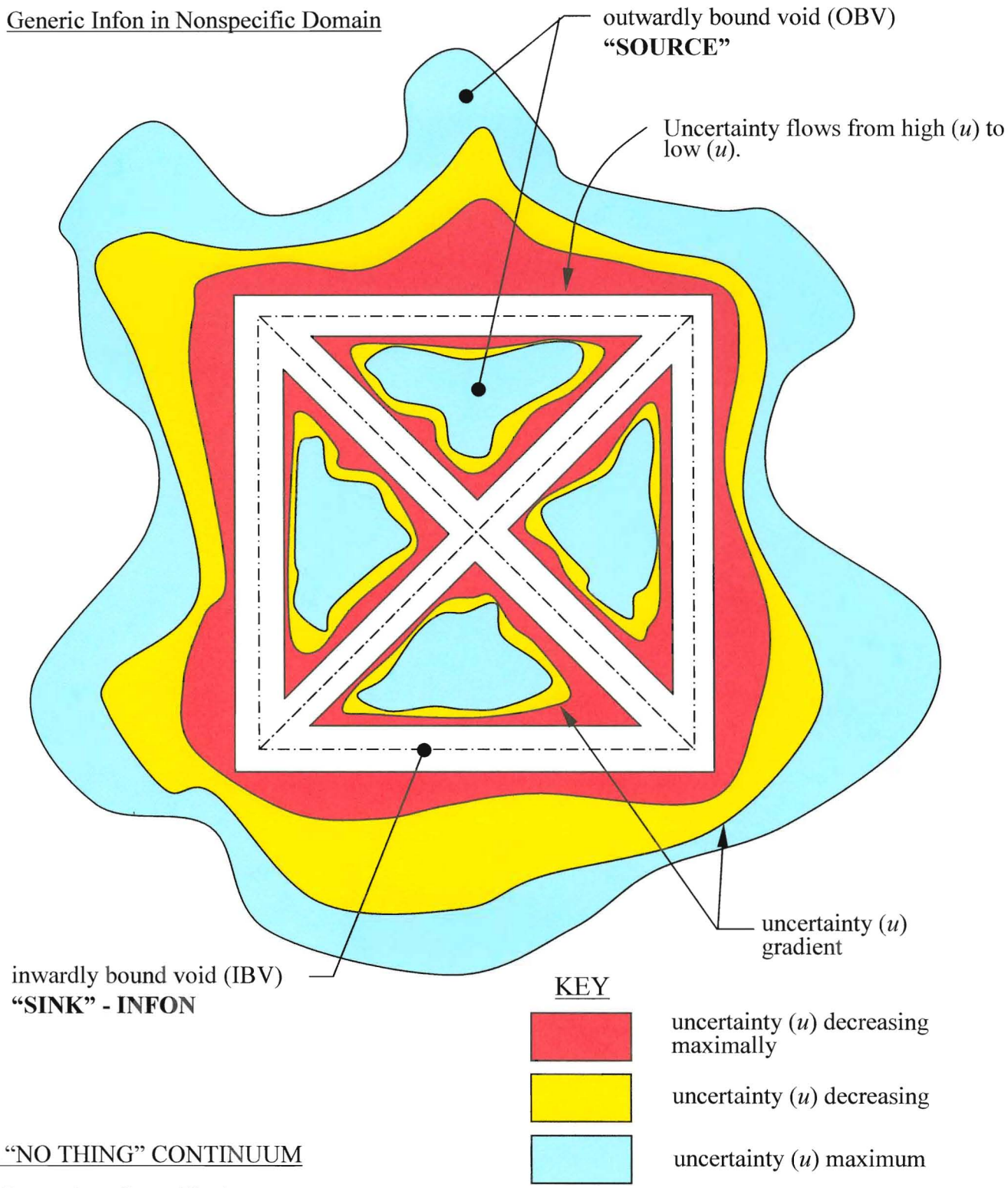
Within the construct of the theory of transformation, information retains its identity and uniqueness in its birthing ground, outwardly bound void. Elemental objects that manifest themselves at array infon locations have no singular or unique identity because they are in essence "projections" of a deeper "undercurrent" of ultimately dense information. While the information that defines elemental object Group 1 is unique and singular as it transforms from Infon A to Infon B in Figure 34, elemental object Group 1, along with any other transforming elemental object, has no claim on material exclusivity. Infon A and Infon B are different entities that project or *actualize* the same information content at two different locations.

As an example, when a common plastic soda bottle is deformed under thumb pressure as shown in Figure 36, Plate 1, the theoretical transformation of the elemental objects composing the plastic of the bottle can be visualized. Is the plastic as it deforms singular and unique (the same "material" before, during, and after deformation) or is the material being recreated during the deformation process? Transformation suggests the latter option.

While at this time, it is not possible to say whether or not elemental objects are composed of singular or multiple infons, Figure 34 shows both configurations transforming on the array. Elemental objects made of two or more infons (Group 2 and Group 3 objects) span at least one Planck length, and therefore, have a "footprint" large enough to be observed without previously noted sub Planck length, observational dilemmas arising.

Even if single infons solely comprise elemental objects (Group 1 objects), their theoretical identity is predicated on geometric forms vibrating in a particular mode. The sub Planck length geometry of an individual infon has no observable macro character; however, its presence should be felt and observed through the action of vibron motion/oscillation or mode variance. Like a myriad of song birds hidden in surrounding trees, a particular call (mode variance or shape) matches a particular bird (infon) even though the birds and the infons, by analogy, are hidden from view.

Figure 35
The Infon – An Information Attractor

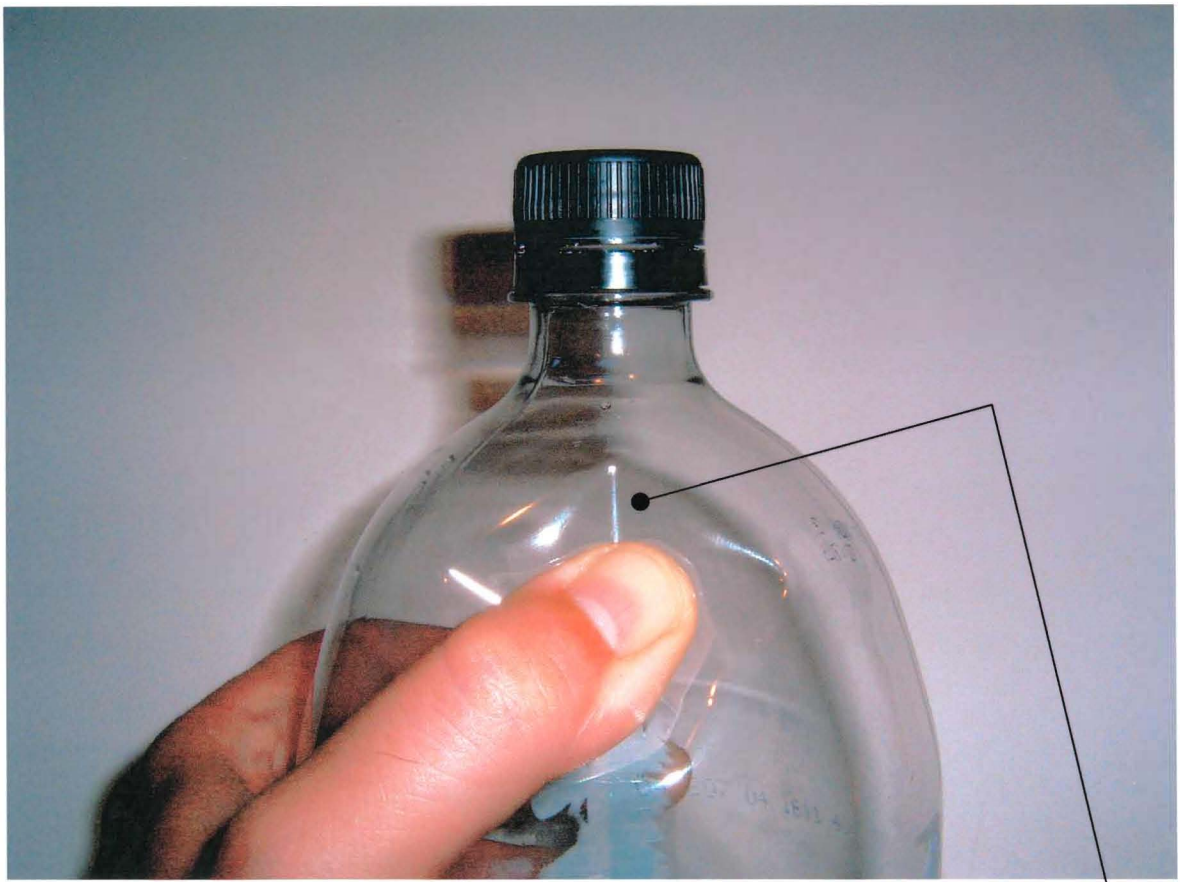


A "NO THING" CONTINUUM

- Uncertainty flows like heat.
- Uncertainty is distilled into observable information by the action of IBV in the infon.
- Information genesis requires an expansive geometric entity (OBV) and a contracting one (IBV).
- A reverse correlation exists with the entropy of matter paradigm: uncertainty flows from high to low density (from more "disorder" to less disorder) – not the reverse.

Figure 36, Plate 1

The Transformation of Objects – A Simple, Physical Illustration



A plastic, soft drink bottle repeatedly deformed with thumb pressure serves as a tool for the visualization of transformation. In particular, if attention is given to the plastic wall of the bottle as it springs back and forth under variable pressure, the plastic can be envisioned to be in a state of constant creation and not merely "moving" in a traditional sense.

Standard notions of matter and space would explain the moving plastic as being the "same material" before, during, and after deformation.

Transformation theory asserts that the plastic is being ***recreated*** *during deformation.* The elemental objects (bits of information) that compose the plastic are being transformed by OBV from infon to infon across the barrier of infinity ignored in present concepts of the physical universe.

Nested, Relative, Infon Domains as the Repository of Forces

Thus far, elemental objects have been described as being "actualized" at specific array locations (at infons) while the information that describes them is carried by outwardly bound void (OBV) from one infon to another across geometric infinities. Although OBV in this model holds the sum of all possible information at any instant due to its definition being that of absolute geometric uncertainty, neither matter nor force bearing elemental objects can be observed or create influence in any domain unless they condense out of OBV at an infon, array location.

Geometry-motion reflexive equivalence requires that force carrying elemental objects (gluons, photons, weak gauge bosons, and gravitons) have a specific geometry or mode shape expressed at an infon location as the foundation of their effect because motion cannot exist independently of form. Forces motivate mass to accelerate, and this acceleration (or change in momentum) can only be experienced through the infons and dimensional domains that compose the discrete, observable universe - the array. OBV may contain all possible information, but inwardly bound void (IBV), the infon network, serves as the *checkerboard* for all possible, recognizable "moves."

Given that elemental matter and force bearing (intermediate vector boson) objects represent fundamentally different phenomena and that both sets of objects must originate from an infon source, *the relative, hyper or hypo dimensional, infon domains previously proposed may give force carriers their distinction over matter objects.* **The action associated with boson elemental objects might well be the result of infons that reside in domains different from a conjectured, normal space, singular domain.** It is entirely possible that infons in the normal space *(experiential)* domain, by means of a unique and characteristic mode variance, could produce the various forces. However, the absolute uniqueness of forces being able to compel attraction or repulsion of matter objects when combined with the practical considerations of this model points toward *extradimensional*, infon domain origins for the creation and uniqueness of those forces.

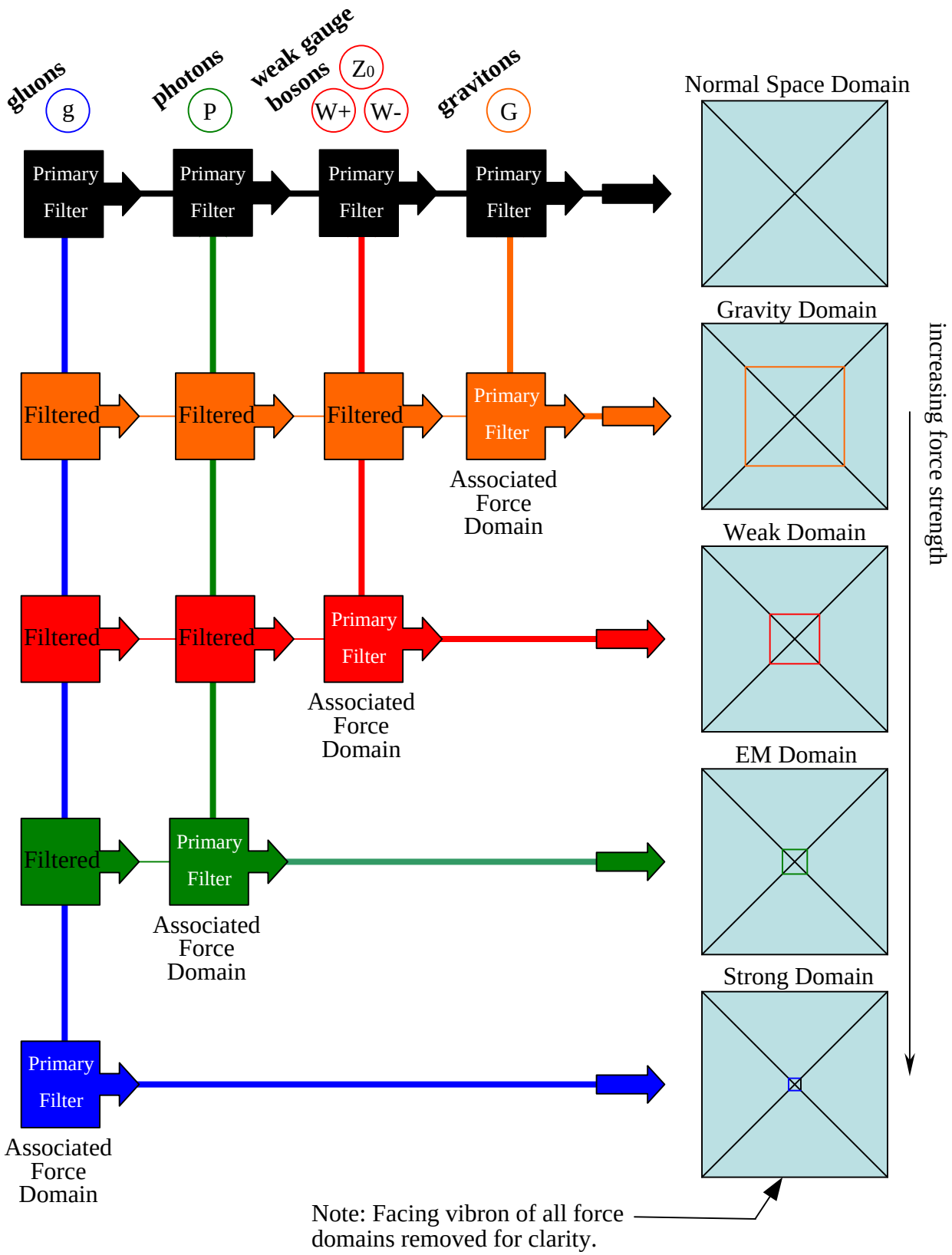
The standard model currently describes the four forces as fundamental interactions that manifest through related, virtual messenger particles (the bosons). The appearance of a messenger particle coincides with measured changes in momenta between charged fermions (elemental matter objects) experiencing a force. Thus, a messenger particle/elemental object is said to mediate, carry, or exchange a particular force.

Accurately predicting the outcomes of experimentation at the atomic scale down to the smallest distances that can be measured in the laboratory, the standard model has been extremely successful. Additionally, evidence of the existence of all the gauge bosons has been seen in experiments. Therefore, any new model or paradigm that attempts to describe the forces found in nature should seek to preserve major observed characteristics of the Standard Model for its own credibility.

In Figure 37, a schematic relates normal space and separate force domains to the proposed effects of boson elemental objects. The previously developed normal space infon domain appears grouped along with four, infon force domains which correspond to the four forces found in nature: gravity, the weak force, the electromagnetic force, and the strong force. These force domains are arranged in order going from the weakest (gravity) to the strongest (the strong force).

Figure 37 shows all infon force domains nested "inside" the normal space infon domain. It could also be the case that the normal space infon domain itself is nested first inside the gravity domain which is in turn nested within the weak domain which is then nested inside the electromagnetic force domain which is finally nested within the strong domain. The order of the

Figure 37
Intermediate Vector Boson Elemental Objects and Associated Infon Force Domains



nesting or regression does not matter. The relative uncertainty in location that exists between consecutive infon domains, u_r, responsible for the isolation of the forces acts in the same manner irrespective of the "direction" of the nesting of the domains.

Therefore, any *active* infon in a particular *force domain* contributes towards the cumulative force felt by an elemental object in the normal space domain. It is not possible to differentiate or to stipulate which infon mode shapes in an associated force domain produce the greatest effect. However, by the logic embodied in the mechanism of u_r, any infon mode activity related to a specific force domain adds incrementally to the total force experienced in the normal space domain. (Although not addressed until now, an IBV element can be viewed as being stationary within its zone of uncertainty. The element's exact location, however, would still be unknown or not defined at any time. Thus, infon vibrons made of IBV elements can be static or dynamic geometric entities: geometric abstraction allows for both conditions - the stationary condition not contributing to any phenomenon.)

Intermediate vector boson elemental objects, like all elemental objects, are ultimately packets of information carried by OBV during transformation form one infon to the next. **What distinguishes bosons from other elemental objects is their proposed *"filtration"* out of OBV into more than one infon domain simultaneously.** Infons of the normal space domain, in a sense, filter out of the information sea of OBV specific mode patterns or shapes which correspond to elemental objects. So that observed characteristics of the standard model remain consistent with this developing theory, it is most likely that bosons filter out of OBV into multiple force domains (see Figure 37) in addition to the normal space domain:

1. Because the appearance of a particular boson (elemental object) *in the normal space domain* equates to the manifestation of a particular force in the standard model, a boson in this paradigm must filter out of OBV into at *least two* infon domains simultaneously - into the normal space domain since bosons have been directly or indirectly observed in experiments and into the proposed, associated force domain to actualize the force.

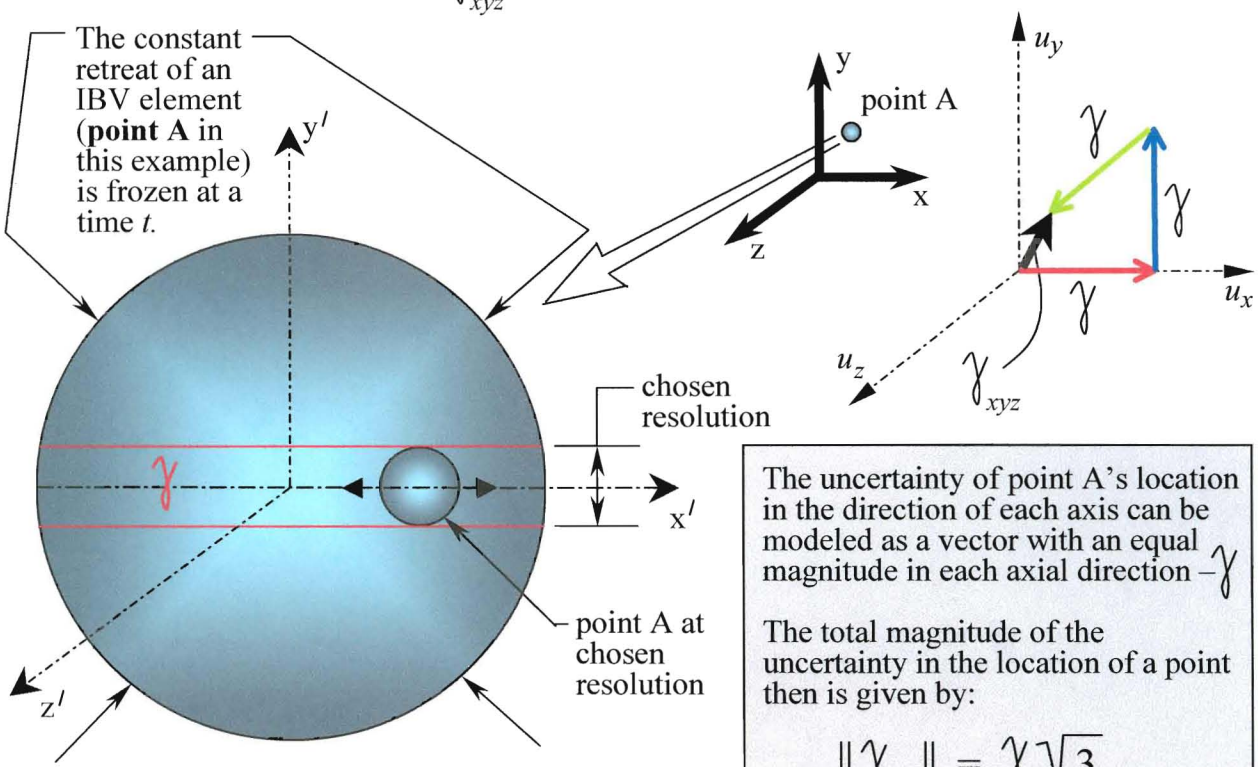
2. As seen in Figure 37, it is theorized that bosons can filter out of OBV into any domain between the normal space domain and their associated force domain. If bosons can appear in the normal space domain and in their associated force domains simultaneously, then they should be able to disrupt or affect all force domains concurrently that "lie" in between separated again in terms of u_r. (The degree to which bosons may affect non associated force domains remains a question for experimentation. Some evidence for this phenomena already exists.)

A quantitative derivation of the relative uncertainty in location, u_r, that exists between elements of IBV that define nested infon domains follows below. This relative uncertainty drives and naturally defines the emergence of an infinite number of three dimensional, hyper or hypo dimensional realms (infon domains).

As mentioned before, at any instant of retreat into the very small, an IBV geometrical abstraction has a fuzziness in position that never goes away at any magnification. See Figure 38 for the discussion which follows. Therefore, in order to make this situation tractable for analysis, an observer must pick any convenient time, t, and "freeze the picture" of the abstractional retreat of the IBV element - point A in this example. Once the action of IBV has been for the moment suspended, an uncertainty in point A's location, γ, becomes apparent at any chosen resolution in dimensions x, y, and z. A rectangular (Cartesian) coordinate system set of axes establishes the directions of the

Figure 38

The Derivation of Uncertainty in the Location of a Point in a Cartesian Coordinate System - γ_{xyz}

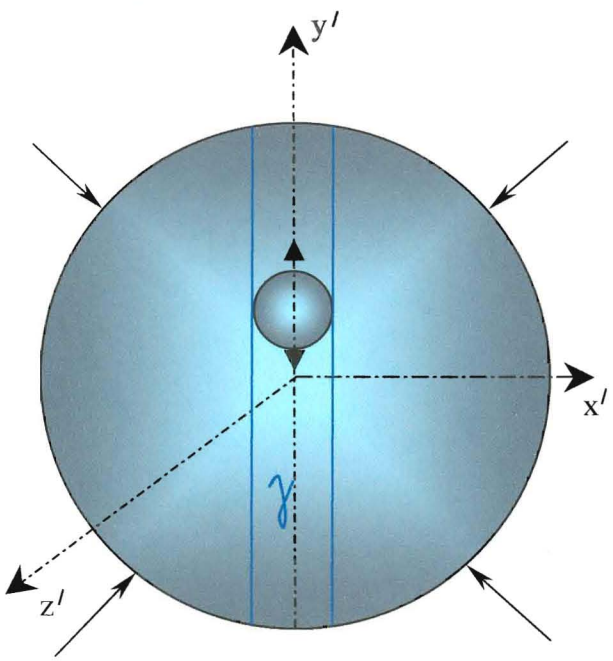


The uncertainty of point A's location in the direction of each axis can be modeled as a vector with an equal magnitude in each axial direction – γ

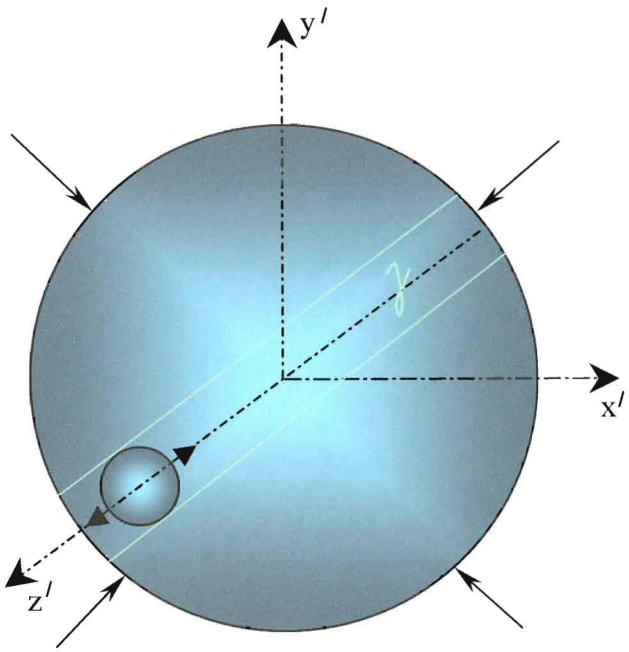
The total magnitude of the uncertainty in the location of a point then is given by:

$$\|\gamma_{xyz}\| = \gamma\sqrt{3}$$

uncertainty in location of point A in direction of x-axis: γ



uncertainty in location of point A in direction of y-axis: γ



uncertainty in location of point A in direction of z-axis: γ

three dimensions shown. Although the origin of this coordinate system is shown located away from point A's center, an auxiliary or "x, y, z, prime" coordinate system in the "center" of point A enables better visualization of γ. Given this scenario, there is a non determined, generic uncertainty in the location of point A in each dimension of the figure (γ):

1. γ is given structure and **direction** by virtue of the definition of dimension.
2. γ has an unspecified **magnitude** *identical* in each dimension (x, y, z).

Concentrating for the moment on the uncertainty in position of the point A in the direction of the x-axis, it is clear that point A can exist anywhere within the x-axis zone of uncertainty defined by dimension x and the action of IBV. One way of viewing this situation native to geometry and discussed previously is to say that a point at a particular resolution can exist at any possible location within an axial zone of uncertainty at a particular instant. This condition effectively "smears" the whereabouts of point A at this moment, creating an uncertainty in its location (γ) and at the same time allowing for its existence. Interestingly, by freezing the retreat of point A, another dynamic embodied by γ is created; it seems that geometric abstractions, when viewed realistically and in detail, always seek to preserve some innate facet of motion.

Statement number one above establishes that γ has a *direction* in each dimension (x, y, z), and statement number two emphasizes that γ has an unknown, but equal *magnitude* in each dimension (x, y, z). Therefore, γ can be defined as an always positive **vector quantity** plotted on its own axes of uncertainty (u_x, u_y, u_z) since it has both a magnitude and a direction of action. Although it is not possible to calculate a value for the magnitude of γ, this "unit" uncertainty is best understood as being representative of an abstractional "geometric velocity" imparted to all elements of IBV that reduces the probability of finding point A at a specific "spot" in each axial zone of uncertainty. Then from the above discussion:

$$\gamma = \gamma_x = \gamma_y = \gamma_z$$

Thus, the uncertainty vector in three dimensions is given by:

$$\gamma_{xyz} = \gamma_x + \gamma_y + \gamma_z$$

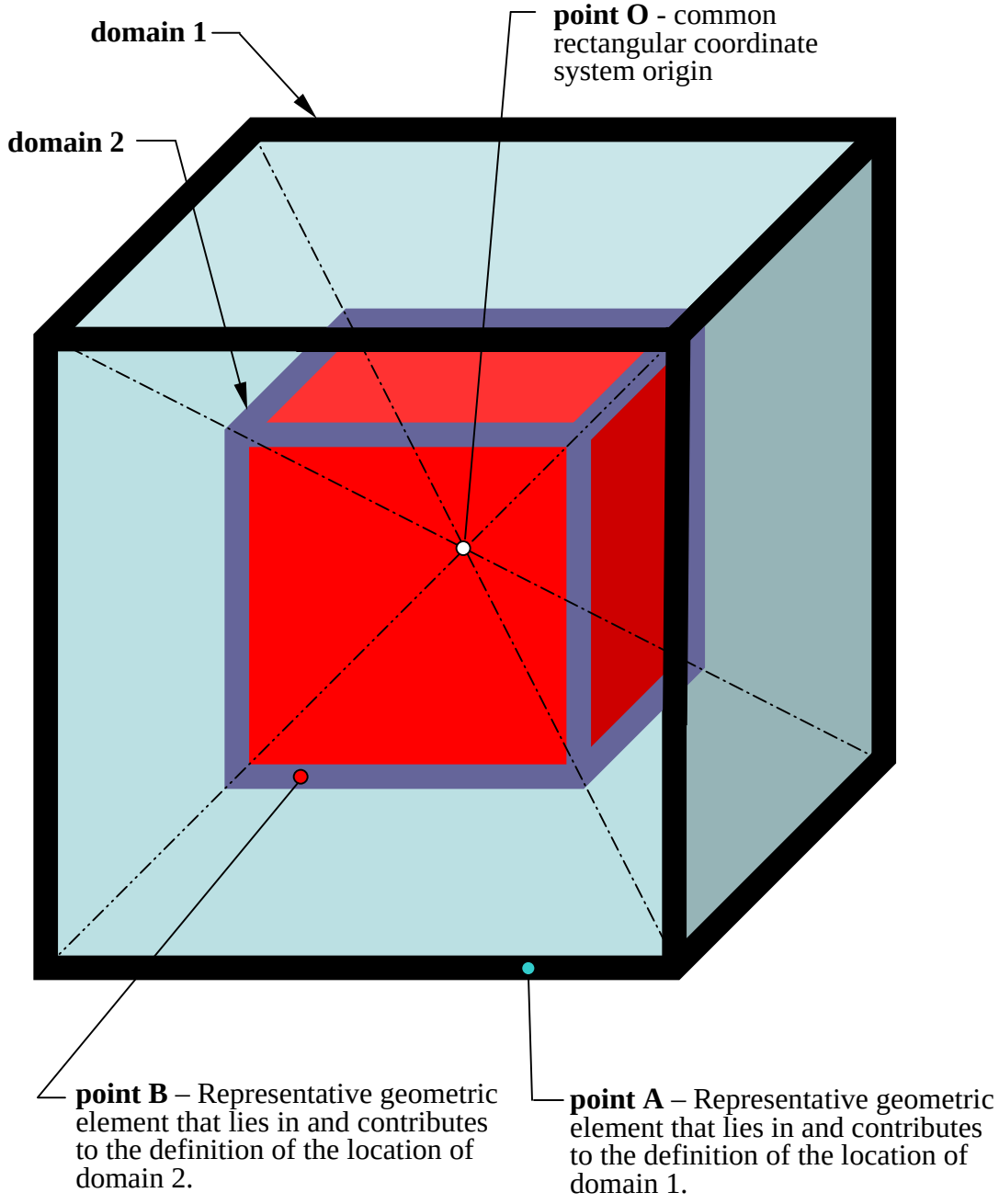
The magnitude of the 3-D uncertainty vector is:

$$\left\| \gamma_{xyz} \right\| = \sqrt{\gamma_x^2 + \gamma_y^2 + \gamma_z^2} = \gamma\sqrt{3}$$

Now that a relation has been derived in terms of γ that gives the magnitude of the uncertainty of a point's location in a three dimensional, rectangular, coordinate system, calculating the relative uncertainty, u_r, that isolates nested infon domains becomes possible. Figure 39 depicts two representative, consecutive, nested infon domains centered at point O, the origin of a rectangular

Figure 39

Relative Uncertainty in Position Between Geometric Elements that Define and Lie in Any Two, Consecutive, Nested Infon Domains - u_r



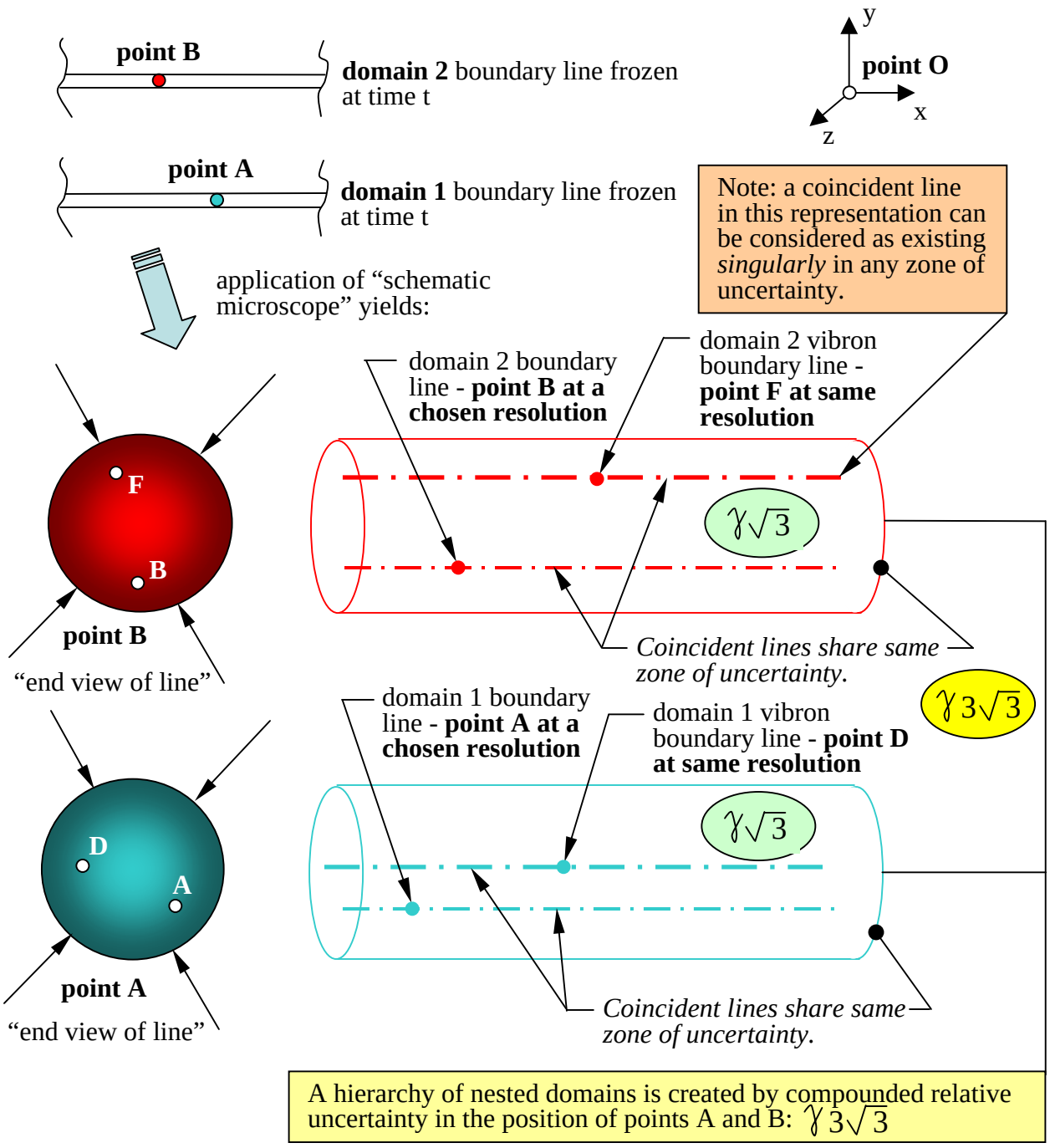
$$u_r = u_{A/B} = \underline{u}_{A/O} + \underline{u}_{B/O} + \underline{u}_{O}$$

$$u = \gamma\sqrt{3} + \gamma\sqrt{3} + \gamma\sqrt{3} = \gamma 3\sqrt{3}$$

Where $\underline{u}$ *is the magnitude of the uncertainty in the location of a point relative to a Cartesian coordinate system origin* - $\| \gamma_{xyz} \|$

Figure 39 (continued)

Detail of Domain Boundaries and Associated Relative Uncertainty: u_r



Points A & D and points B & F lie on coincident lines within the same *zones* of uncertainty. As was mentioned above, these lines individually can be considered as the "sole occupants" of their respective zones of uncertainty. This construct is parallel with the traditional meaning of a "coincident line." The derivation of the uncertainty in *the location of a point* in a Cartesian coordinate system ignores the inherent uncertainty of the coordinate system itself (represented by the uncertainty in position of point O). This is because coordinate system uncertainty is already accounted for in the stipulated axial zones of uncertainty, γ. Therefore, points in any IBV domain boundary that lie on coincident lines have as their magnitude of uncertainty in position: $\gamma\sqrt{3}$

coordinate system. Both domain A and domain B have associated points A and B which are typical of the geometric elements that define the location of domains A and B.

Because these geometric elements, along with other similar ones, define domain boundaries, their relative uncertainty in position is exactly equivalent to the relative uncertainty in the position of the domains themselves - u_r. With this stipulation, u_r can readily be calculated as the uncertainty in the location of point A relative to the location of point B. This uncertainty in these points' relative position equals the cumulative uncertainty in position of point A relative to point O (the common origin), plus the uncertainty in position of point B relative to point O, plus the inherent uncertainty in the position of point O itself:

$$u_r = u_{A/B} = u_{A/O} + u_{B/O} + u_O$$

$$u_r = \gamma\sqrt{3} + \gamma\sqrt{3} + \gamma\sqrt{3}$$

$$u_r = 3\gamma\sqrt{3}$$

Consequently, the relative uncertainty in location between consecutive domains (u_r) is γ multiplied by a factor of 3 times the square root of 3. **The concept of relative uncertainty in the location of nested (infon) domains powerfully establishes in a natural manner the basis of a multidimensional universe.** Infons *completely isolated* by u_r can express information in a multitude of independent, *discrete*, three dimensional realms (domains) with all information content preserved in outwardly bound void, OBV, a singular geometrical "essence" of complete *continuity*.

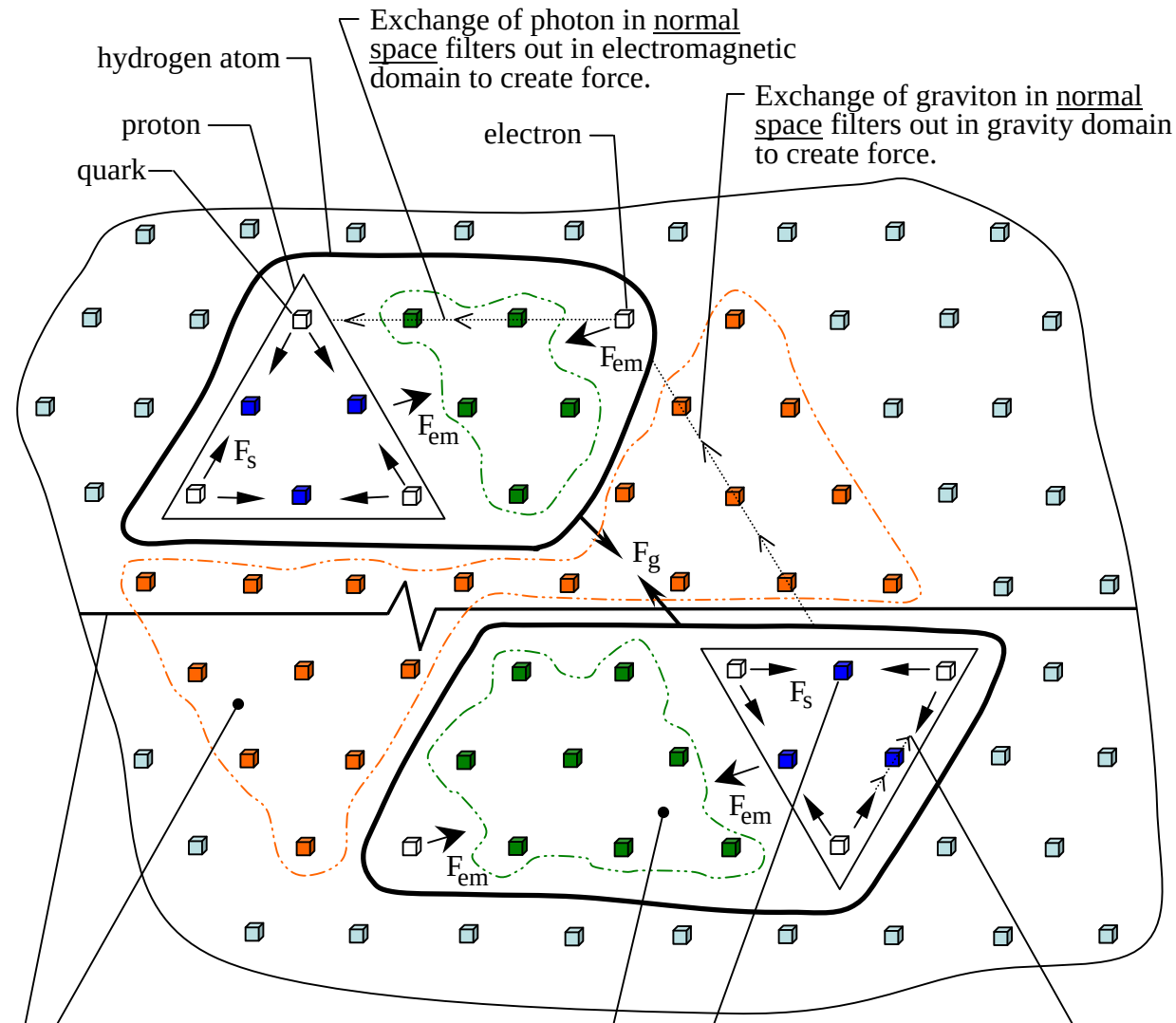
If, as proposed, forces most likely originate in other than the normal space domain and vector bosons are *filtered out* of OBV into different domains simultaneously, then aspects (features) of a multidimensional universe dramatically and continually affect our normal space domain every moment. These instances of multidimensional influence (forces) are directly observable but presently not understood as extradimensional in origin.

Figure 40 shows two schematic hydrogen atoms and typical force interactions both inside and between them on the array. Infons of the normal space domain filter matter elemental objects out of OBV to create the hydrogen atoms. At the same time, vector bosons of the strong, electromagnetic, and gravitational forces manifest from OBV in their associated force domains to create force.

By geometry-motion reflexive equivalence, the existence of vibration patterns (forms - infon mode shapes) in each force domain creates force. The uniqueness of each force is hypothesized to be in part the result of each force originating in its own isolated, three dimensional realm or domain. Continuity during transformation of both matter and vector gauge boson objects is preserved in OBV.

Since the geometry of the array is predicated on the clustering of transformation cells, and the dynamics of transformation of information can only be expressed at transformation cell locations, readily recognizable pathways of information exchange or flow between infons become apparent. These more familiar, basic avenues of array expression will be called "geopaths." In Figure 41, four, simple, core geopaths are highlighted in individual transformation cells. **Although the hexaform, pentaform, tetrahedral, and right pyramidal geopaths represent a small fraction of possible information flow paths between infons, these geometries would perhaps be the most**

Figure 40
Force as a Result of Form (Infon Mode Shapes) in Different Domains



Gravitational Force – Fg

Gravitons primarily filter out of OBV into gravity infon domain to create force.

Electromagnetic Force – Fem

Photons primarily filter out of OBV into electromagnetic infon domain to create force.

Exchange of gluon in normal space filters out in strong domain to create force.

Strong Force – Fs

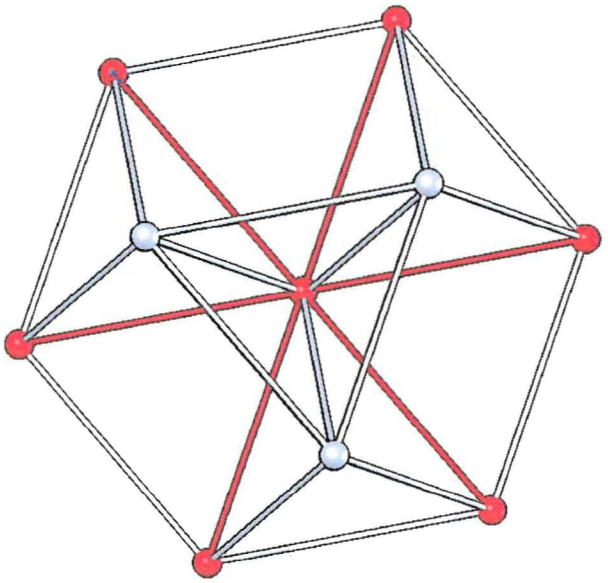
Gluons primarily filter out of OBV into strong infon domain to create force.

Note: Break line indicates that the two hydrogen atoms depicted would in actuality be much further apart.

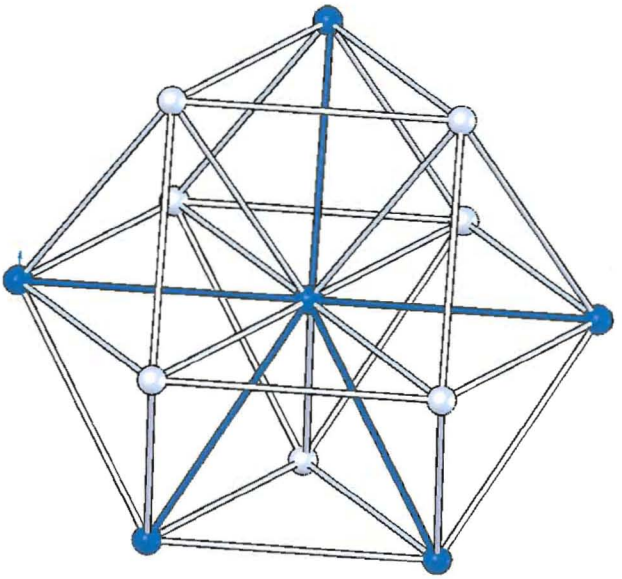
Note: Elemental objects are most likely composed of large numbers of infons. Elemental objects shown above are strictly illustrative in nature.

View looking normal to "hexagonal plane" defined by transformation cell cluster in space. (2-D lattice) Only two dimensional aspect of array shown for clarity.

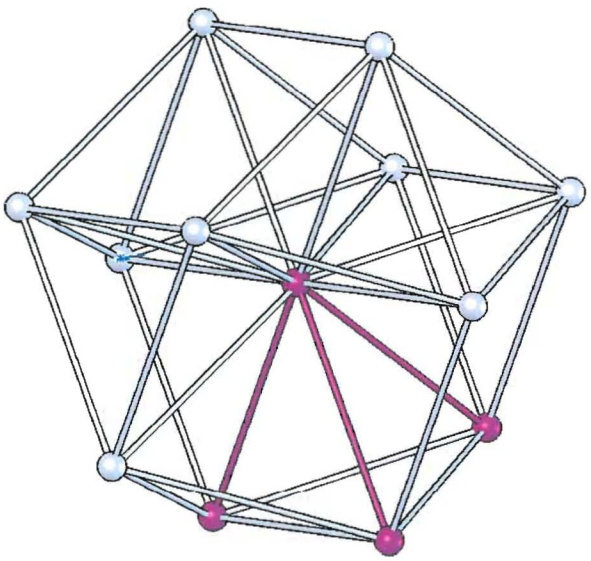
Figure 41
Basic Information Geopaths



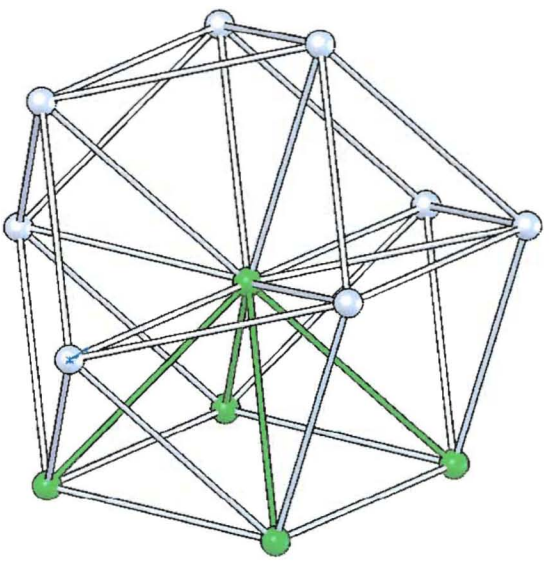
Hexaform Geopath



Pentaform Geopath



Tetrahedral Geopath



Right Pyramidal Geopath

easily recognized, macro signatures of the array and of The Discrete Motion Paradigm itself.

In the molecular realm, there are many examples of pentagonal, hexagonal, tetrahedral, and right pyramidal shaped molecules as seen in Figure 42. **While current ideas on why these particular molecular geometries proliferate are quite reasonable, the most comprehensive and simple explanation for these forms appearing over and over is that *observed* nature echos the transformation pathways that are fundamental to its manifestation on the infon array.**

Frozen water offers beautiful testimony to this idea in the formation of snowflakes. The water crystals depicted in Figure 43, Plates 1 and 2, embody a relatively complex creation dynamic that results in visually lavish hexagonal structures. As the various forces acted on the elemental objects that would become snowflakes, a fundamental pattern of those interactions, the hexaform geopath, will remain as a visible trace of basic array structure and heritage.

Moving up in size and complexity, many viruses exhibit spectacular pentaform and hexaform geopath architecture in their capsids or shells. See Figure 44, Plates 1-5. Although viruses are classified as being somewhere between living organisms and inanimate molecules, the molecule that is basis of all life, DNA, is entirely composed of pentaform and hexaform elements as seen in Figure 45.

Vast numbers of plants express geopath geometry in their flowers, leaves, and fruit. Several examples of blooming geopaths are shown in Figure 46, Plates 1-3. A forest floor when viewed from this perspective becomes a geopath collage in Figure 47, Plate 1. The face of a cut banana can be easily recognized as a pentaform geopath. These are just a few representative geopaths that proliferate in the plant kingdom.

A very early, primitive, life form, the starfish, displays pentaform geometry in Figure 48, Plates 1 and 2, most likely as a result of its ultimate genealogy - being born on the array. At the opposite end of the evolutionary scale, possibly representing millions of years of further transformation history on the array, a human body in plan view can be seen as being a pentaform geopath as shown in Figure 49, Plate 1. Additionally, a human being having five fingers and toes per appendage, along with five sensory pathways to the brain (the senses), further correlates our human genesis with a basic information pathway of the transformation cell, the pentaform geopath.

Vortices of the electromagnetic force in superconductors as seen through various visualization techniques are always arranged in a hexaform lattice. See Figure 50, Plates 1 and 2. The "geometric" dynamics of many forces acting on a greater scale become visible in recent hurricane eye satellite imagery. The hurricane eye in Figure 51, Plate 1 has a pentaform character most likely reflective of the highly intense, array transformation dynamic embodied by the collective action of forces native to the storm.

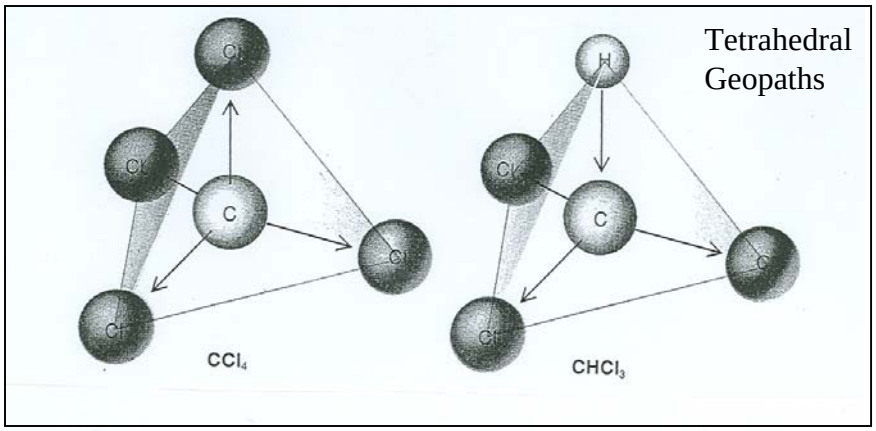
Much grander atmospheric dynamics in the clouds of the north pole of the planet Saturn echo both pentaform and hexaform patterns simultaneously - a visual intersection of two, prime array geopaths. See Figure 52, Plate 1.

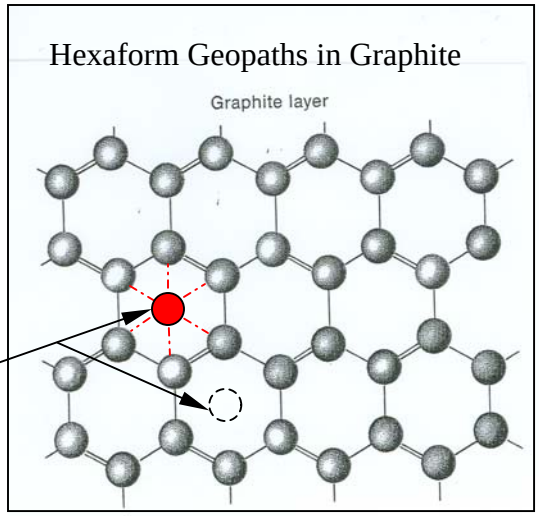
In a speculative sequence in Figure 53 (backdrop images provided by NASA), even larger scale, astronomical phenomena, when viewed from this new perspective, could reflect basic geopath geometries of the array in their structure. The largest scale image to date of the universe (WMAP satellite data) hints at such possibilities in Figure 54.

Summary of Theoretical Presentation

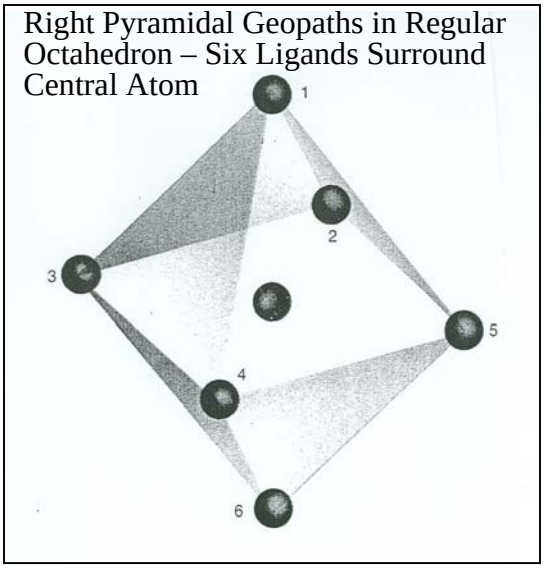
A closer examination of the true character of geometric elements and of geometrical abstraction has enabled the establishment of a consistent methodology to use in viewing the seemingly

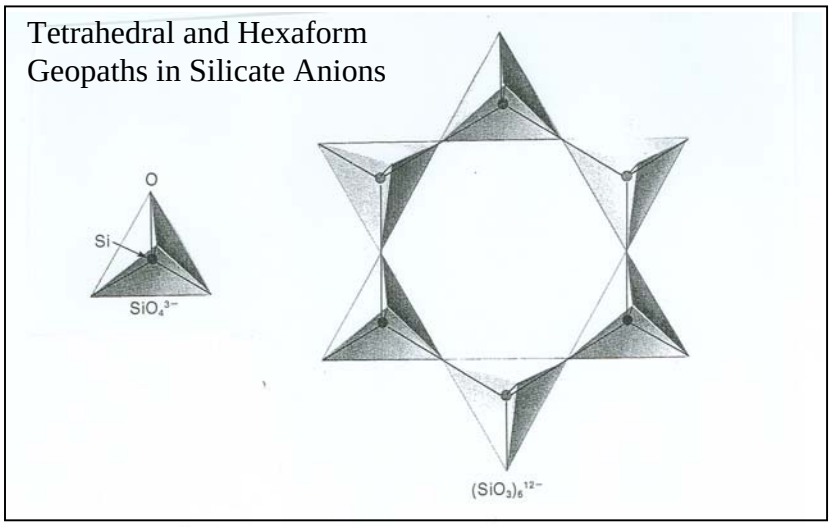
Figure 42 Geopaths in Molecules





Note: Central node may or *may not be* evident in macro, geopath geometry.





All illustrations from Masterton and Slowinski, *Chemical Principles* 4th Edition

Figure 43 The Hexaform Snowflake

Hexaform geopath found in ice crystals (snow).

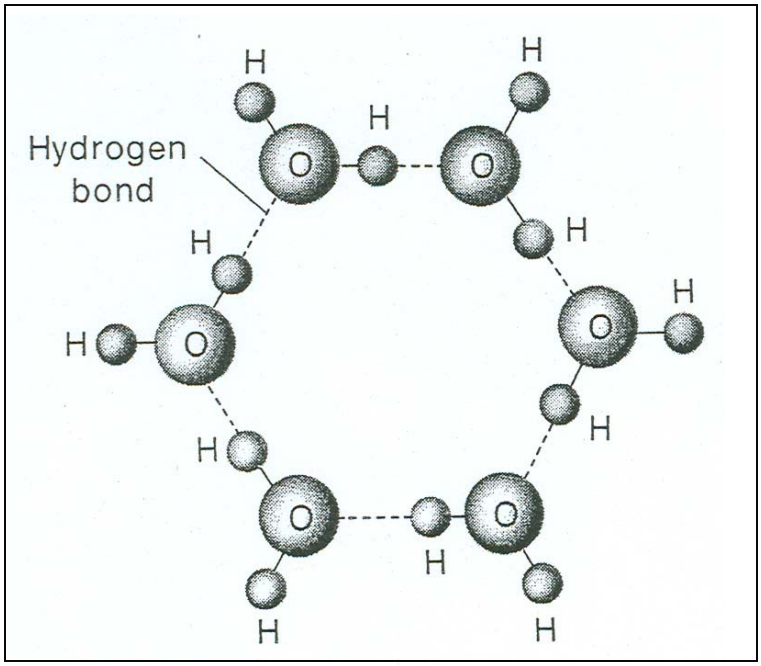
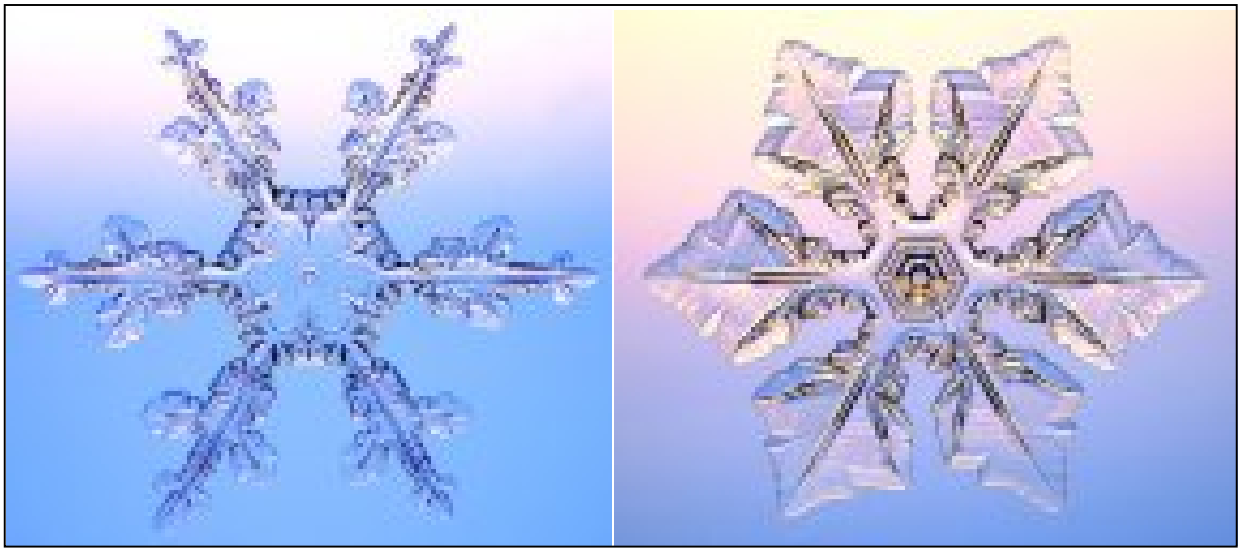


Illustration from Masterton and Slowinski, *Chemical Principles* 4th Edition

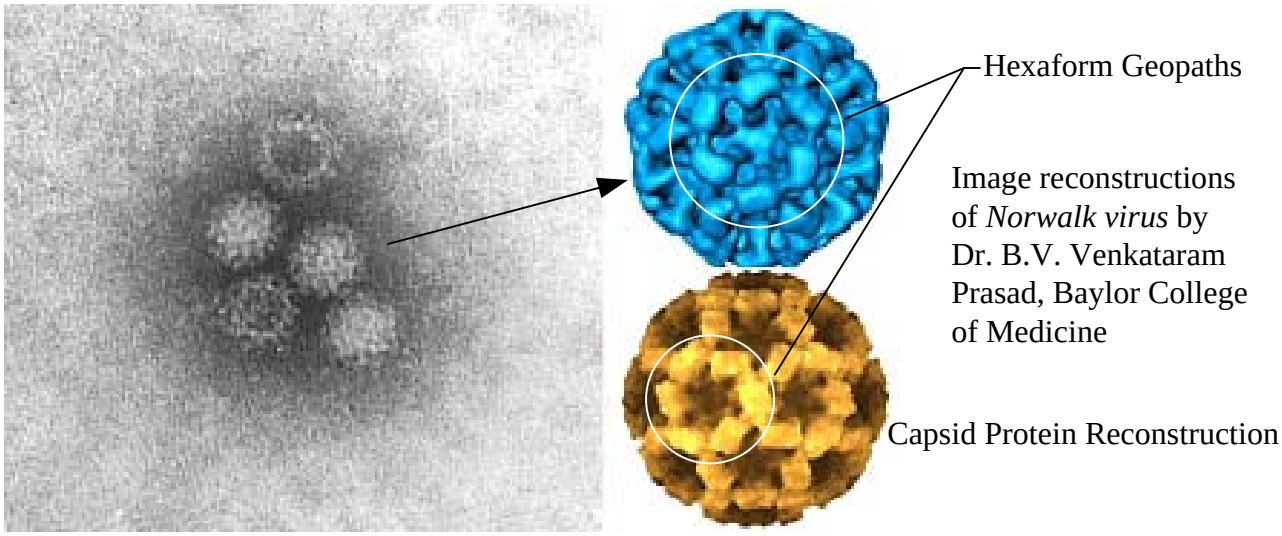
Plate 1 Plate 2



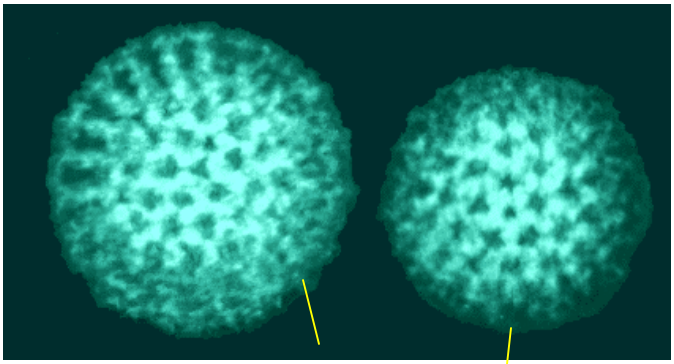
Snowflake photographs by Kenneth G. Libbrecht, Caltech

Please note that although these particular snowflake images show almost perfect symmetry, the hexaform geopath, or any other recognizable geopath for that matter that is *echoed* from the array, does not have to exhibit such geometric perfection. Repeated occurrences of macro, *basic geopath* geometry in nature are sufficient for the purpose of possible evidence of transformation on the proposed array. A *basic geopath* form preserves the total number of nodes and approximate shape of an array geopath without necessarily maintaining the absolute symmetry found on the array.

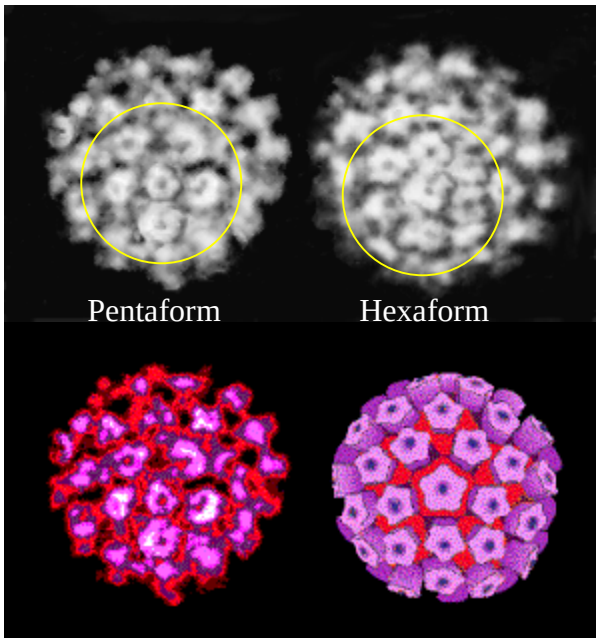
Figure 44 The Virus, A Visual Display of Hexaform and Pentaform Geopaths



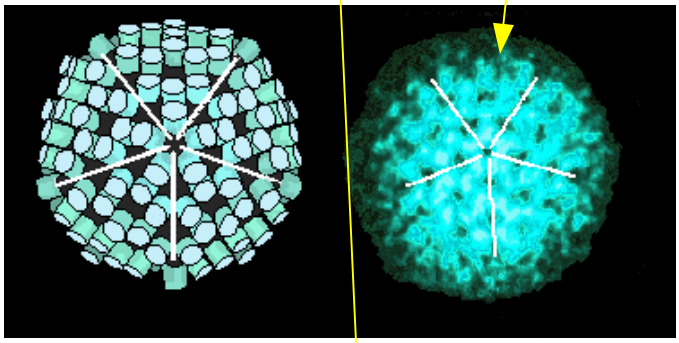
(Plate 1) *Norwalk Virus*: Electron Micrograph
by C. Büchen-Osmond, Columbia University



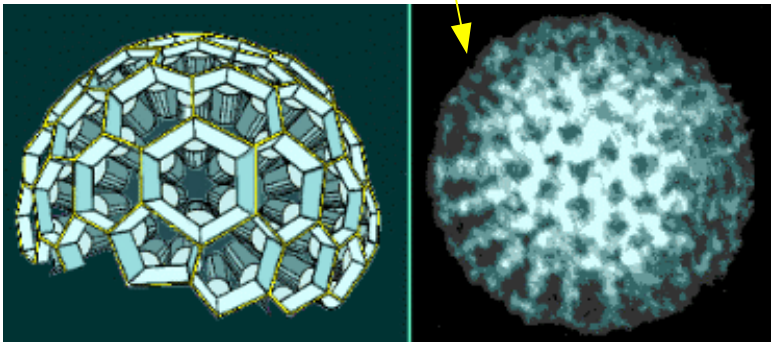
(Plate 2) Double Capsid *Rotavirus*



(Plate 5) A model of the *papillomavirus* capsid is shown below original EM images and beside a computer colorized EM image. Note capsid hexaform and pentaform geopaths.

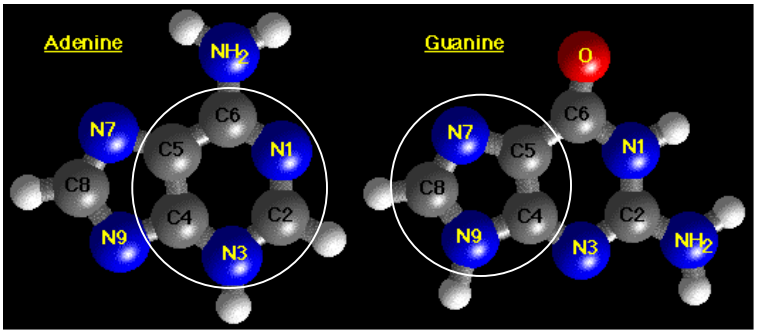


(Plate 3) Inner capsid displays pentaform geopath structure.

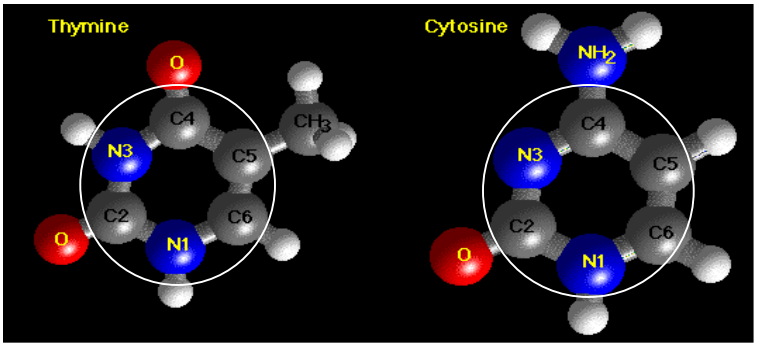


(Plate 4) Outer capsid shows hexaform geopath structure.

Plates 2-5 by Linda Stannard, University of Cape Town Dept. of Medical Microbiology



Purine Bases embody hexaform and pentaform geometry.



Pyrimidine Bases exhibit obvious hexaform geometry.

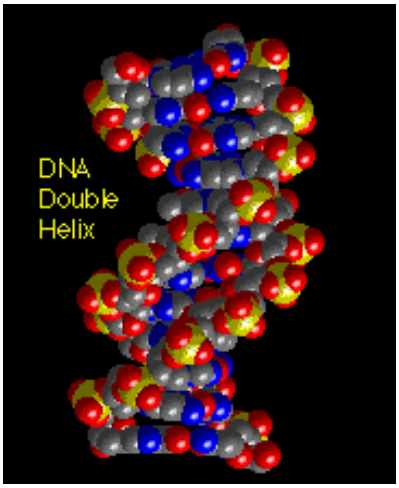
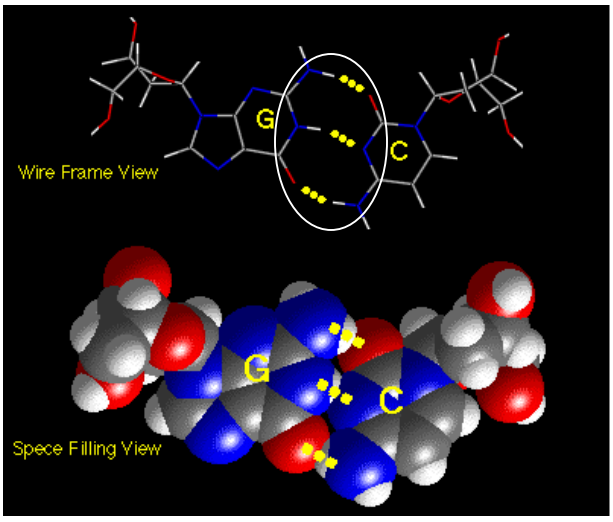
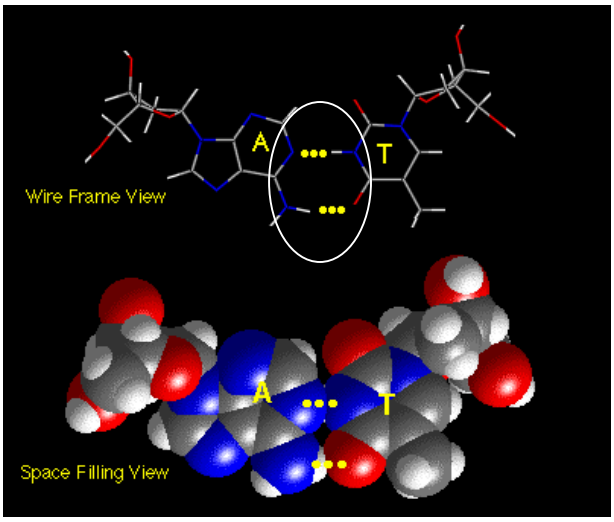


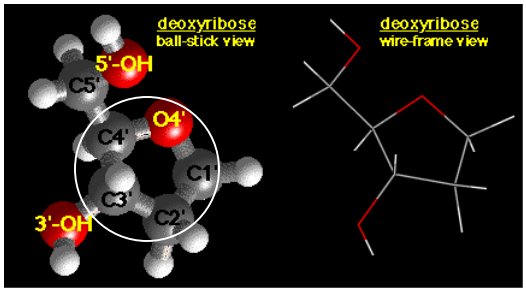
Figure 45 Hexaform and Pentaform Structure of DNA

(All images: Richard B. Hallick, University of Arizona)





Nucleotide base pairings bonded by hexaform geometry.



Deoxyribose sugar (Backbone) of double helix is a repeated pentaform.

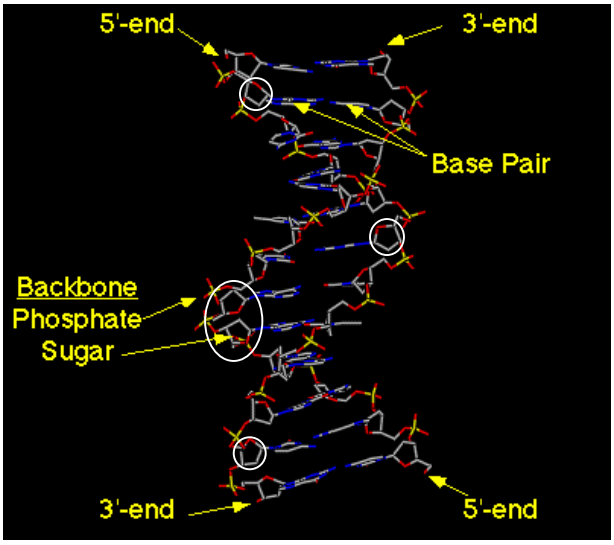


Figure 46
Geopaths in Flowering Plants

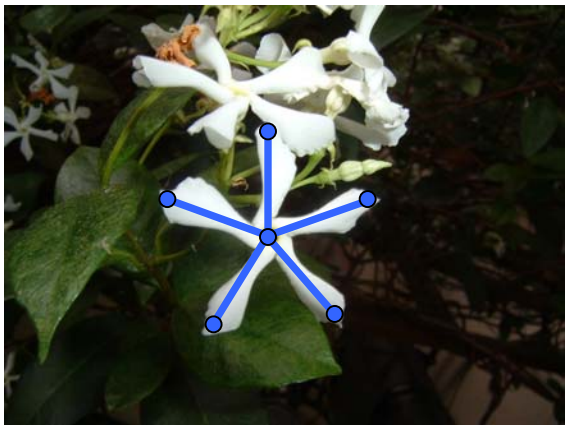


Plate 1

Pentaform

Plate 2

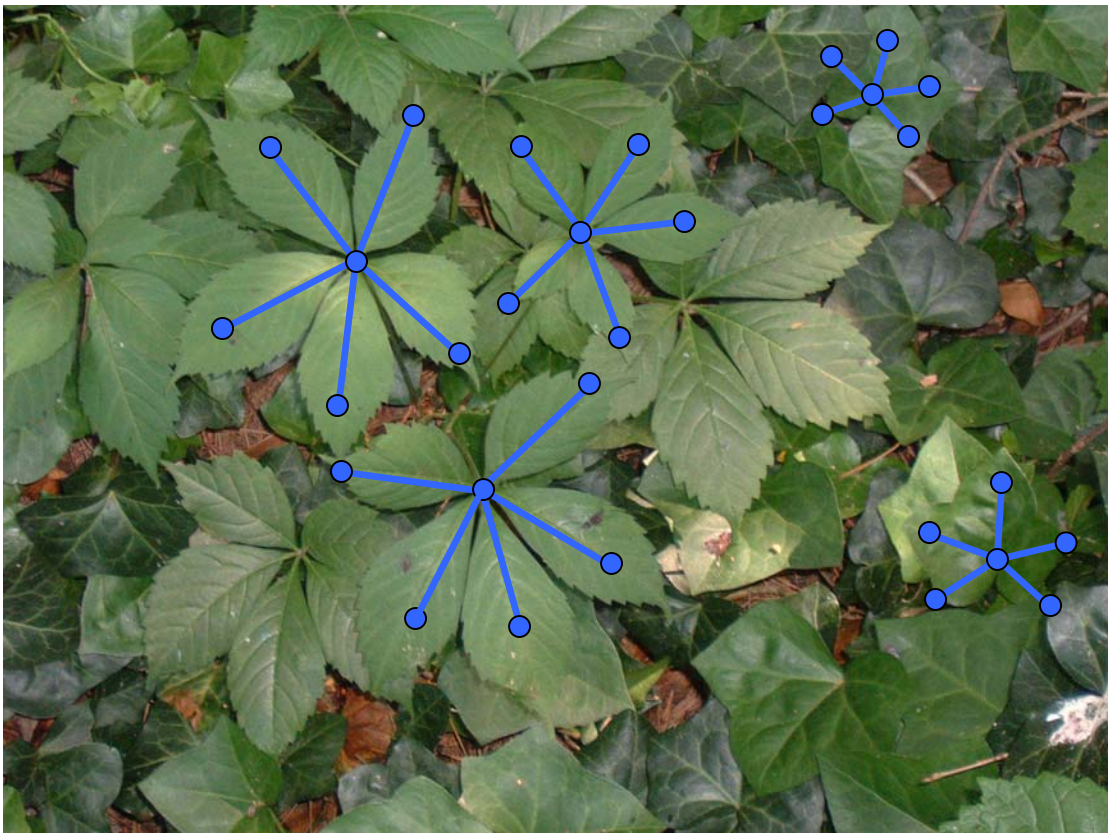
Hexaform

Plate 3

Tetrahedral Form

Figure 47 Forest Floor Echoes Hidden Structure

Plate 1



Pentaform geopaths found in abundance.

Figure 48 The Starfish Pentaform

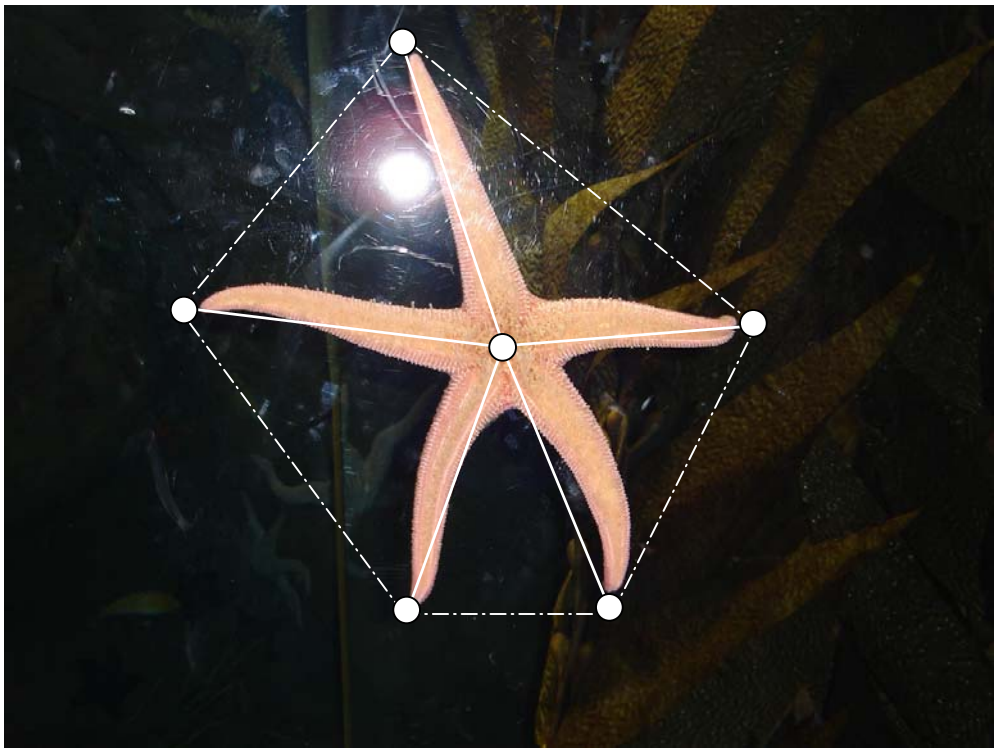


Plate 1 Early life form most likely *echos* array heritage in pentaform geopath design.

Plate 2 A more symmetrical resting position in another starfish better displays pentaform geopath.

Figure 49 Non Vitruvian Woman

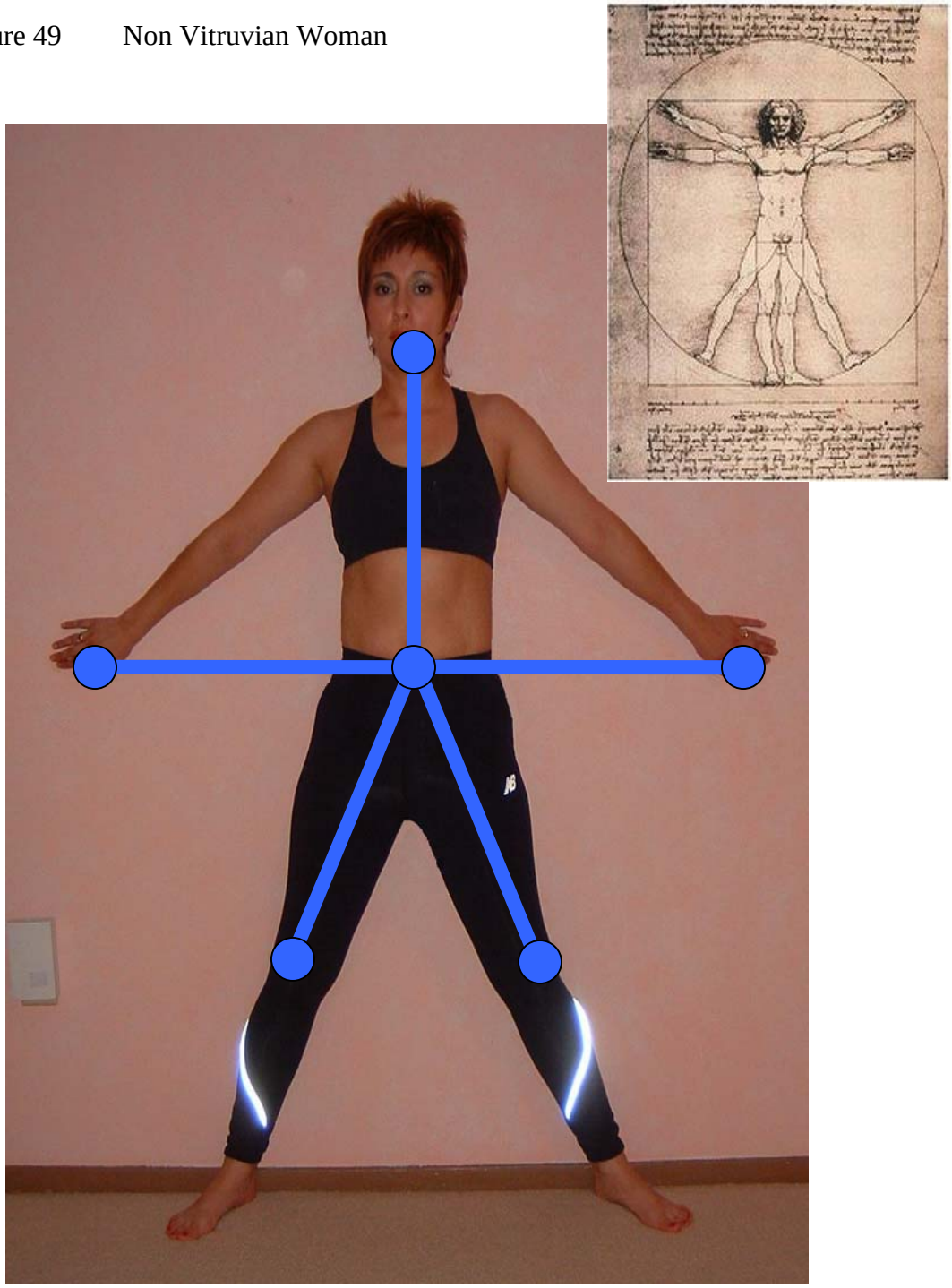
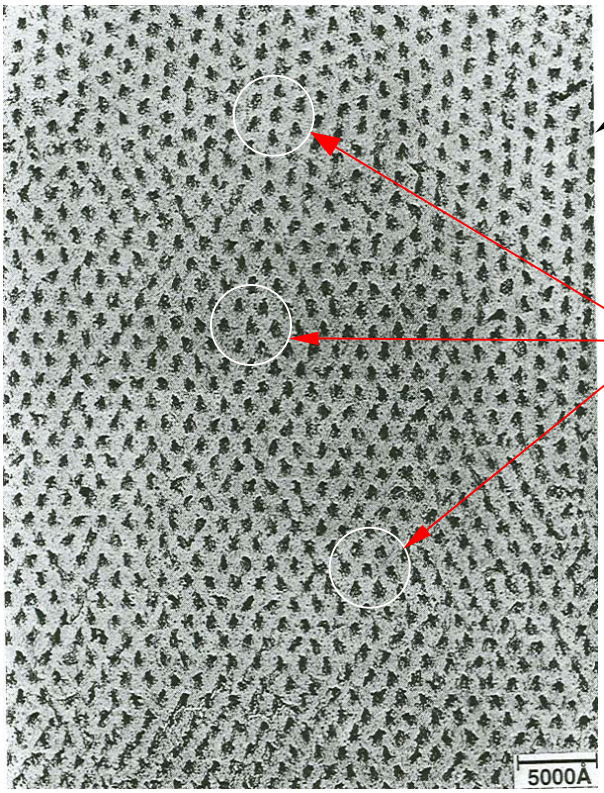


Plate 1

A pentaform geopath familiar to all of us. Leonardo Da Vinci had the right idea but probably the wrong geometry in mind.

Figure 50 The Hexaform Geopath Inherent to Electromagnetic Force Vortices in Superconductors



A "Bitter" pattern of EM vortices penetrating superconducting niobium.

A hexaform geopath that is repeated in a lattice arrangement.

A Lorentz micrograph of an EM vortex lattice in a superconducting niobium film.

Plate 1 Image courtesy of U. Essmann

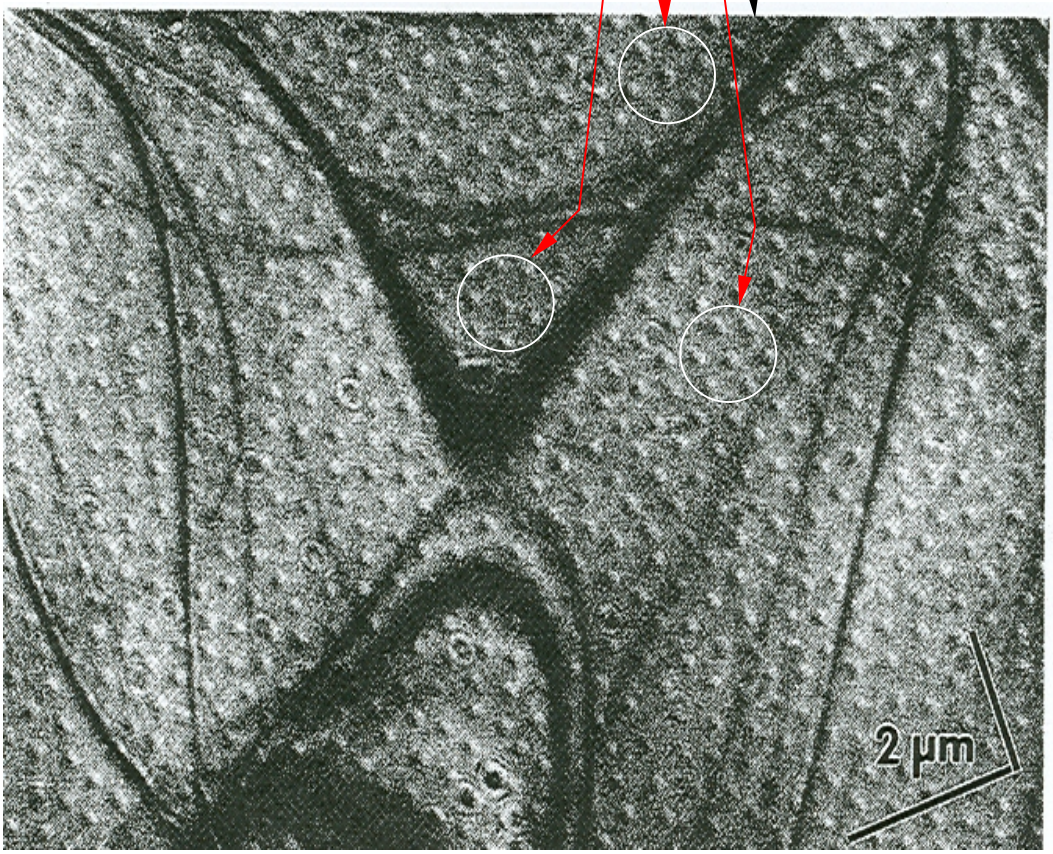


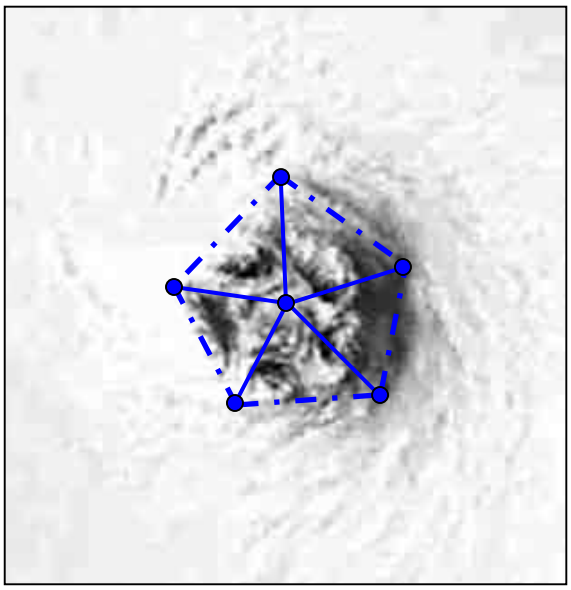
Plate 2 Image from Akira Tonomura, *The Quantum World Unveiled by Electron Waves*

Figure 51 Hurricane Eye Goes Pentaform

Hurrican Isabel at category 5 strength.

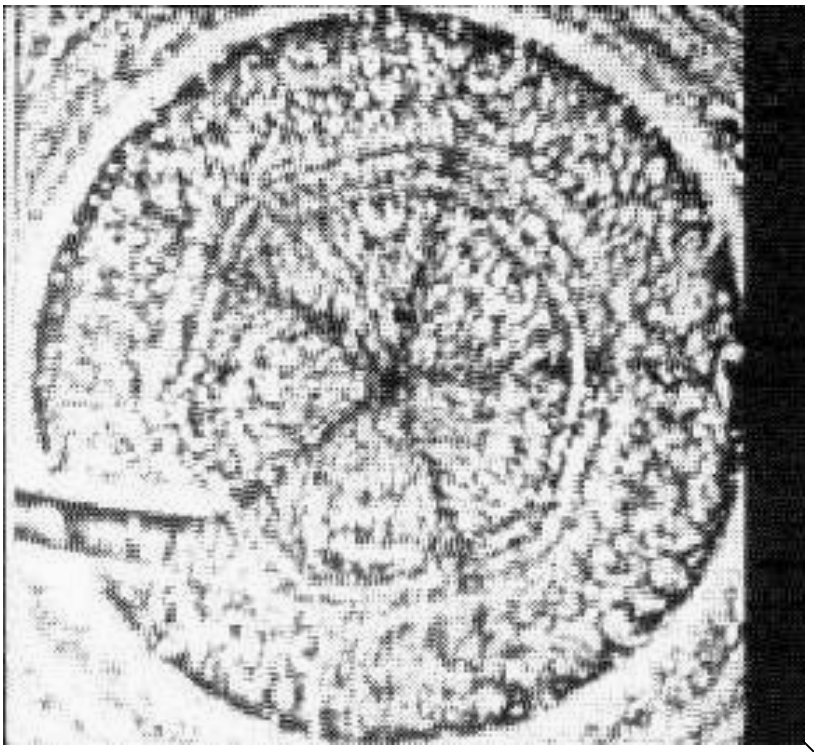
Plate 1 GOES 12 Rapid Scans, 12:45-17:45 UTC on 12 September, 2003

Storm Eye – Close up



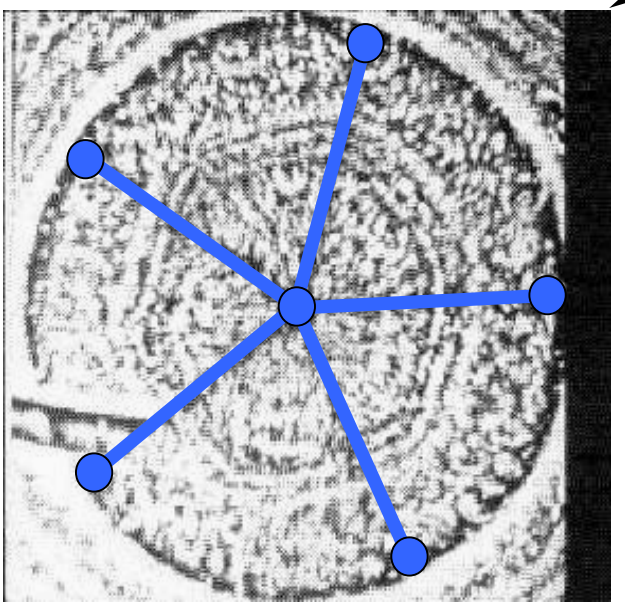
Possible Pentaform Geopath
in Eye Geometry

Figure 52 Hexaform and Pentaform Geopaths on Saturn

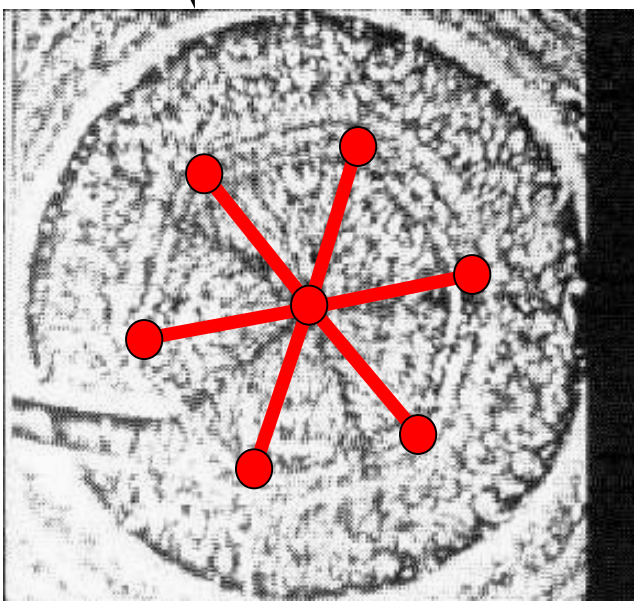


This image was originally published in 1988 by D.A. Godfrey from a series of computer-rectified, oblique Voyager images of the polar regions of Saturn. The title of his work is *A Hexagonal Feature around Saturn's North Pole.*

Plate 1 Pentaform and hexaform geopaths appear on Saturn simultaneously.

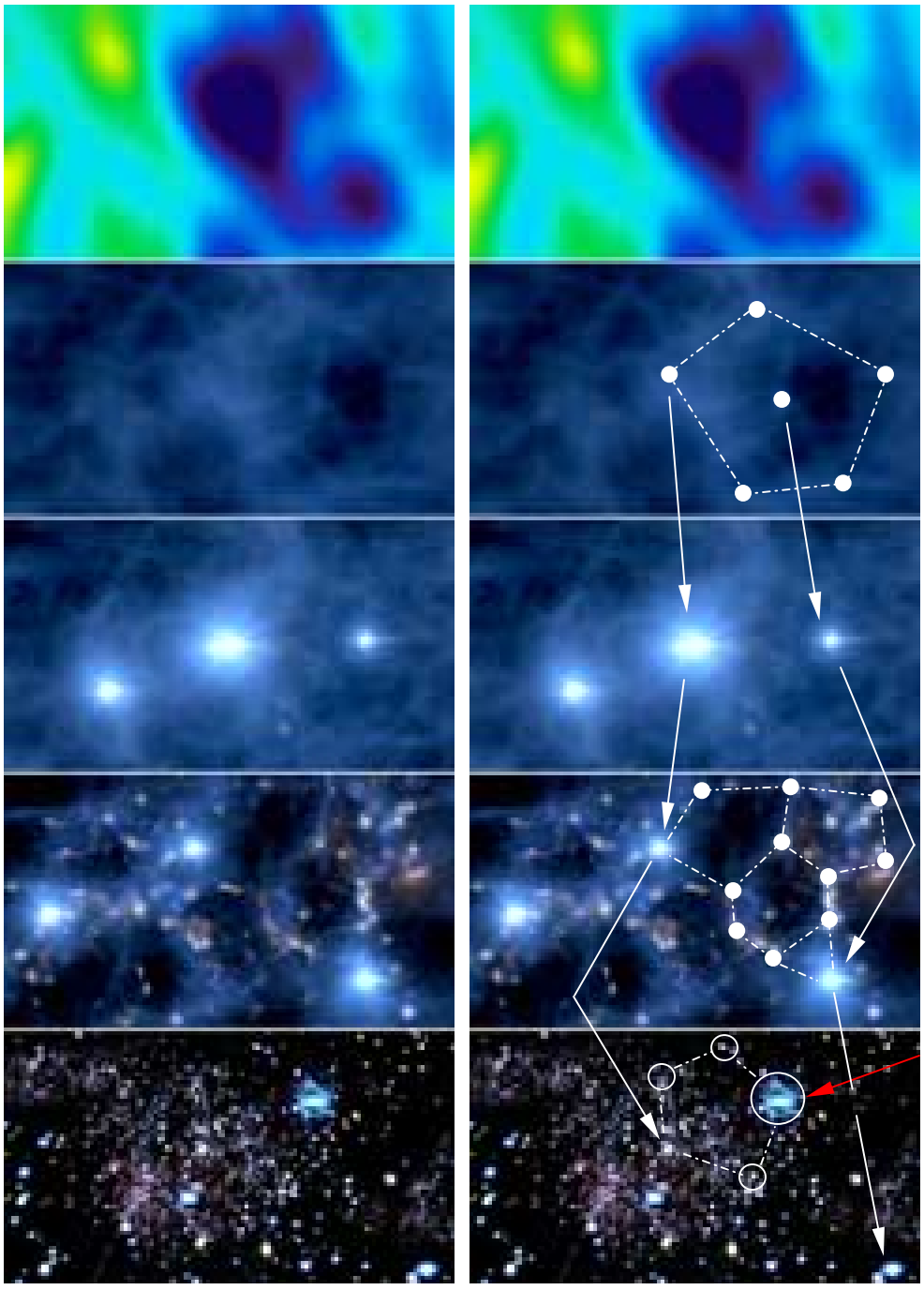


Pentaform Geopath



Hexaform Geopath

Figure 53 The Geometry of the Array May Drive Large Scale Structure of the Evolving Universe



Early Universe (WMAP image)

Matter begins to condense. Traces of initial pentaform geopath are visible.

Initial pentaform geopath becomes obscured by the ignition of stars in new galaxies and by the dynamics of their collective interactions. *Notice that two galaxies have formed on nodes of the hidden pentaform geopath.*

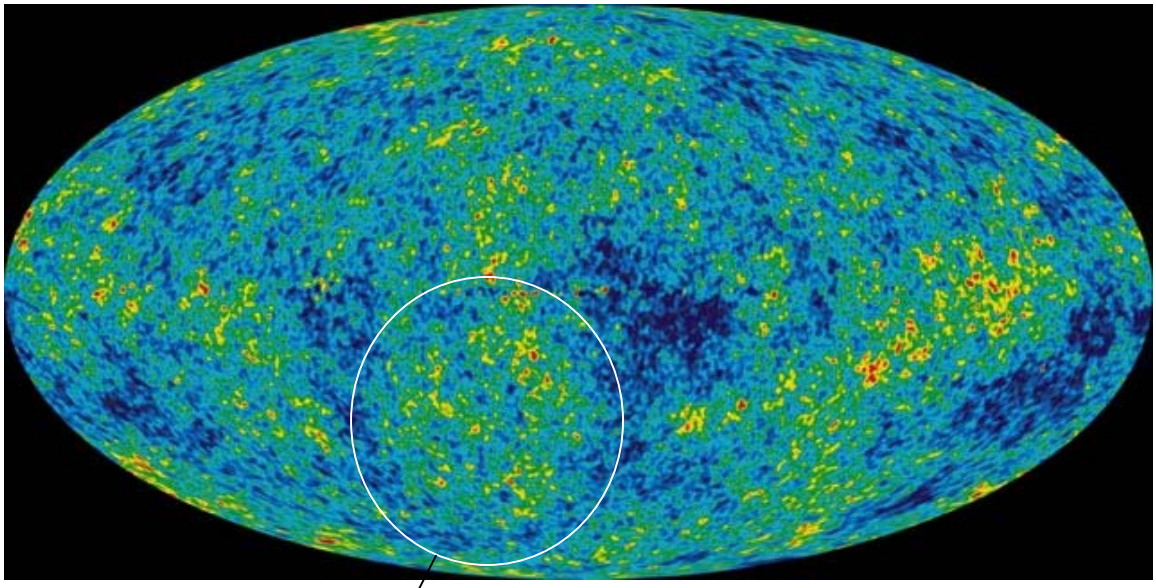
As time passes, the mature dynamics of the galaxies' mutual interactions echo *new* array geopaths in nearby interstellar gas.

Present day image of the aging galaxy cluster shows further activity on the nodes of one of the evolving, younger, pentaform geopaths. The other geopaths from the previous frame have dissipated.

Base Image Sequence by NASA

The Direction of Time

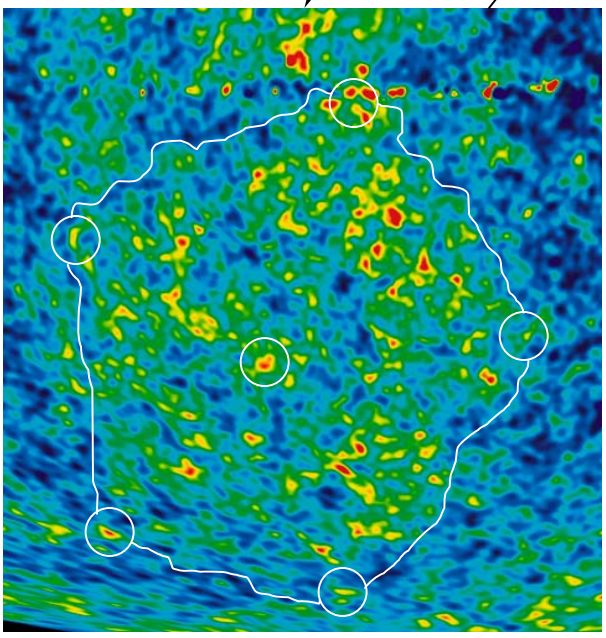
Figure 54 Possible Pentaform Structure Seen in Early Universe



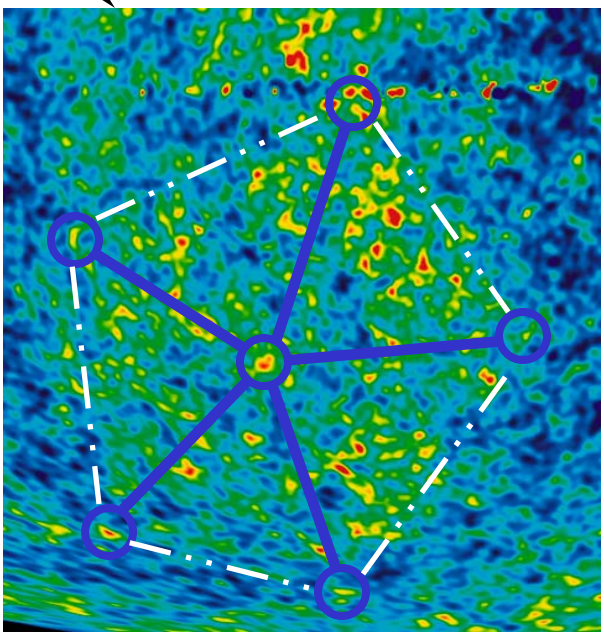
(NASA Image)

WMAP image of early universe showing distribution of energy by means of intensity of microwave energy released.

Red indicates warmer spots and blue indicates cooler areas.



Close-up of portion of image shows potentially the largest pentaform ever seen in the universe. White, irregular lines separate a *generally* warmer, greenish area from the cooler background of blue, and circles demarcate hot spots of activity.



Once again, the dynamics of information transfer on the array *may* have bled through at an exceptionally large scale creating a geometric resonance of a basic pathway.

disparate micro and macro observables found in nature. Qualities of Euclidean geometry (Non-Euclidean descriptions are not required or necessary.) find themselves embedded in a derived description of the dynamics of the universe and in the creation of information (*elemental objects*). Additionally, the genesis of unique form (geometry) intrinsically and seamlessly connects the behaviors of observed nature with the awareness mechanism of the observer – *secondary associations* predicated on discrete motion.

Discrete motion, the incorporation of infinity, and the inclusion of uncertainty as a fundamental process are all native to geometrical abstraction and have been labeled as three major themes of this investigation. *The Discrete Motion Paradigm* is central to the generation of abstraction in general (how humans create information i.e. secondary associations), and collectively, these themes contribute to the idea that all "things" are best envisioned as being parcels of information composed of "infons." Derived from the considerations of the three major themes, the modality of the infon is that of a fundamental, geometric, information generator that manifests the elemental objects that yield the material and motivation of the cosmos.

The *Circle of Logic* creates and links the theoretical infon to abstraction (information generation by means of discrete motion) and to geometry by means of a major postulate: *Geometry – Motion Reflexive Equivalence*. The realization that form (geometry) and discrete motion cannot exist without one another forever couples movement to form and requires that the quantum elemental objects responsible for force be composed of infons of a particular mode shape or vibration pattern. Thus, in order for all other elemental objects to retain their unique, "informational" properties or characteristics, they are conjectured to originate from infon sources as well.

Quantification of the *node behavior* of all elemental objects from *the universal perspective*, led to the definition of *complexity*. The complexity calculation sums the discrete, energy exchanges across nodes of elemental objects in the form of an index that spans a time interval from the *primal node* to the present. A composite object's complexity is the sum of the complexities or work histories of the elemental objects composing it. Increasing complexity was suggested as the mechanism of quantum decoherence. All material objects or forms come into being as an accumulation of elemental object, discrete motion activity *across* nodes. The node was shown to be a fundamental feature or aspect of nature.

Geometrical abstraction is more clearly defined as originating from two basic categories: inwardly bound void (IBV) and outwardly bound void (OBV). Inwardly bound void shrinks forever with no end or limit, while outwardly bound void expands indefinitely "towards" inwardly bound void. This fundamental dualism characteristic of geometry allows for modeling the theoretical, multidimensional transformation of information.

The Transformation Theory of information transmission on *the array* was born by understanding and combining two key concepts: First, in the reality of non-limited geometric abstraction, an infinite distance separates any two geometric points (elements of IBV). Second, physical observational limits of the very small allow for the necessary, Planck length "fine graining" of elemental object movement between *nodes*. The natural integration of the hypothesized *dwell cycle period* (required for noncontinuous motion) with the node behavior of all objects (The Discrete Motion Paradigm) mandated the array concept. The array defines a pattern of nodes separated by the Planck length, a fundamental, *geometric neighborhood*.

At each node of the array lies an infon as a means of discrete, information expression. Outwardly bound void carries information between infons on the array and is modeled as being unlimited information – complete geometric uncertainty and ultimate continuity. Infons being defined by inwardly bound void can be viewed as "broadcasting" local expressions of state (elemental objects)

from outwardly bound void at a given time. Information is envisioned to flow from higher to lower areas of uncertainty (from OBV to IBV).

The uncertainty in the location of the defining geometric elements of the infon gives the infon *vibron* its proposed means of motion (vibration). An infon's vibron vibration pattern or *mode shape* represents a dynamic, theoretical geometry (form). A mode shape exhibits a particular, *instantaneous, broken symmetry* of the infon at a given time. Once again, a feature of Euclidean geometry, uncertainty, arises naturally to create and to link together different aspects of this theoretical model in a totally coherent manner.

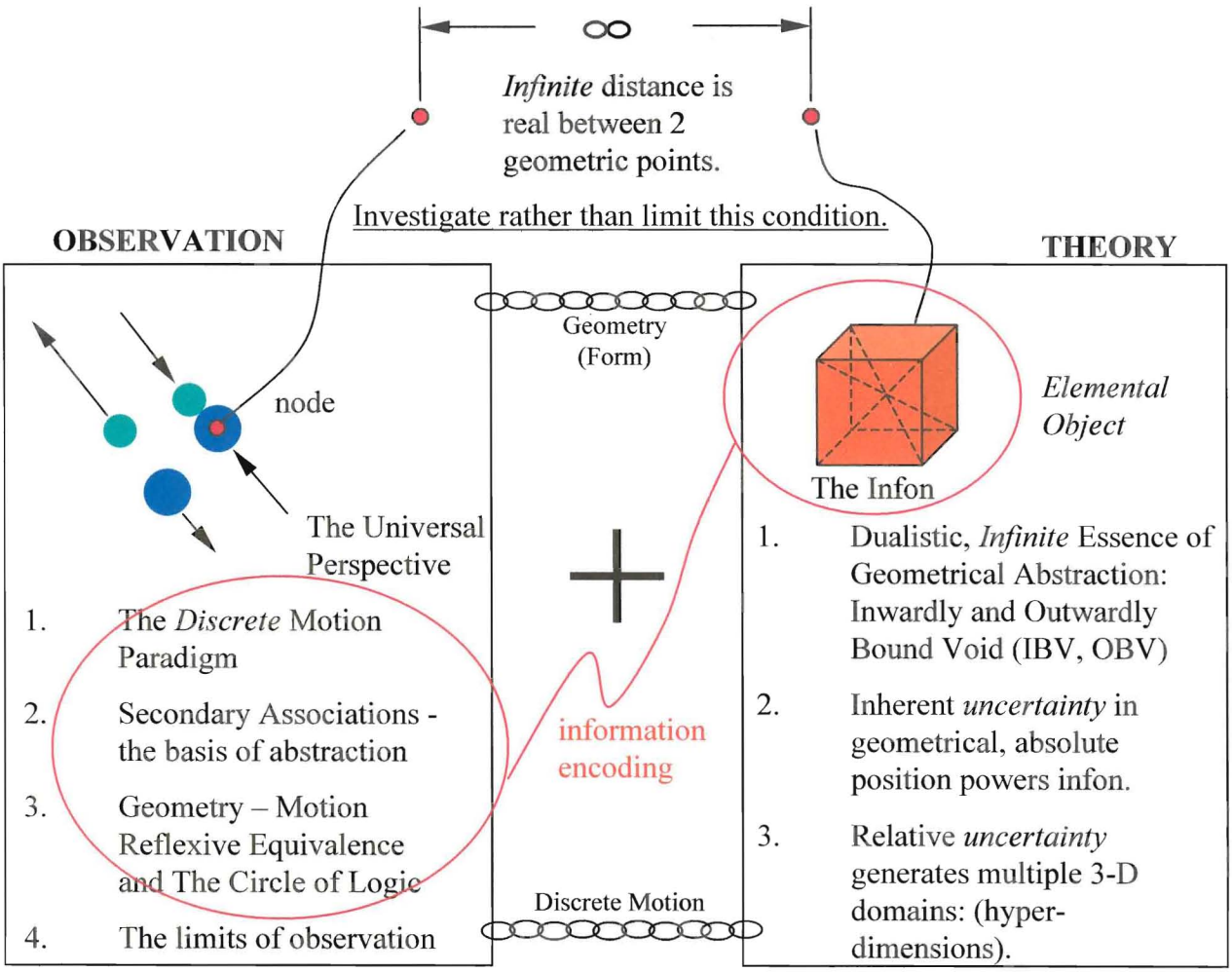
Similarly, the *relative uncertainty* of *nested infon domains*, which logically gives rise to a consistent definition of isolated hyper or hypo three-dimensional realms, is only made possible by the uncertainty characteristic of geometrical abstraction. An expression was derived for the magnitude of this relative uncertainty between nested infon domains in a Cartesian coordinate system. In this model, the *normal space* infon domain of common experience is just one realm out of an unlimited set of coexisting spaces.

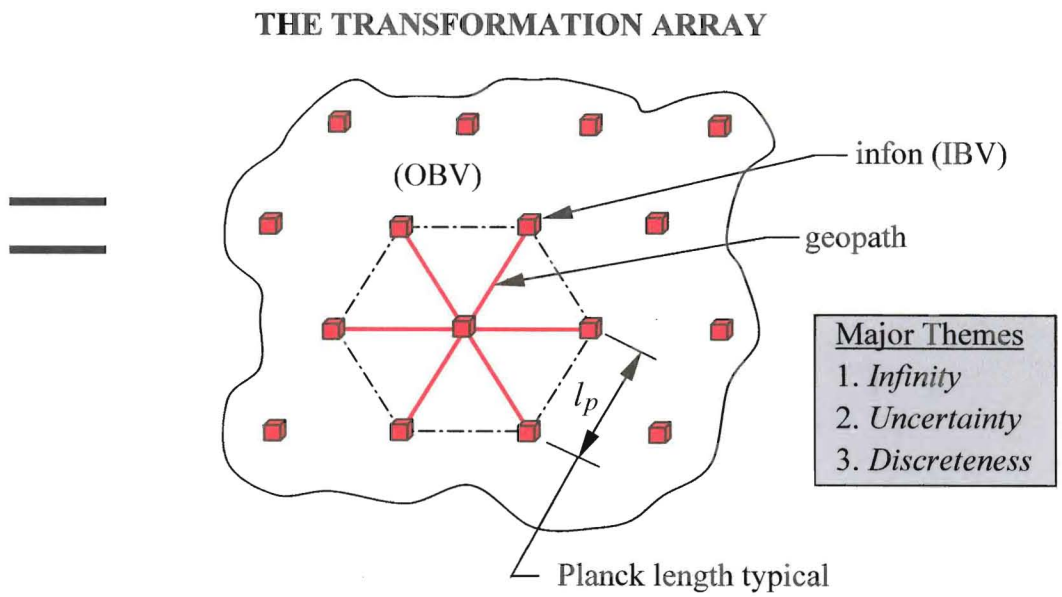
Additionally, the effect associated with intermediate vector bosons of the standard model (manifesting force) was better explained if they acted in other dimensional domains – their *associated force domains*. Outwardly bound void in the case of bosons should *filter out* into multiple infon domains, not just into the normal space infon domain to create force.

An infinite clustering of triangular orthobicupola transformation cells creates the structure for the array and represents the simplest arrangement of equally spaced points in space. Recognizable, fundamental paths of transformation and information flow between infons located at these points are called *geopaths*. Many examples of observed nature *echo* these basic geometries, and this phenomenon is to be expected *if* the transformation array and its associated dynamics underlie the physics of the universe.

While the *Transformation Hypothesis* has been described for the most part in terms of the quantum world, following chapters will show that these ideas, developed primarily in the arena of the very small, support key features of theories that attempt to define the very large. For a graphical summary of this theory see Figure 55.

Figure 55 Theoretical Overview of Transformation Hypothesis





A Larger Truth - The Remaining Bits

The Search for Consistency in Macro Observation, the Legacy of Albert Einstein

If a summary were to be made of the philosophy behind the generation of special and general relativity, it quite possibly could be encapsulated by this idea and core ethic: *All reference frames for observing natural phenomena should be equivalent with the discovery and stipulation of suitable transformation laws.* (Transformation in this sense pertains to mathematical functions that relate measurements from different reference frames – not the transformation of information as developed earlier.) In general, this equality of observation of nature demands that the universe and its recognized means of expression are ultimately invariant, no matter what one's state of motion may be at any time. Specifically, in special relativity, the task of novel discovery becomes one of finding the covariant relationships that link the seemingly disparate views generated by observers in constant velocity, relative motion.

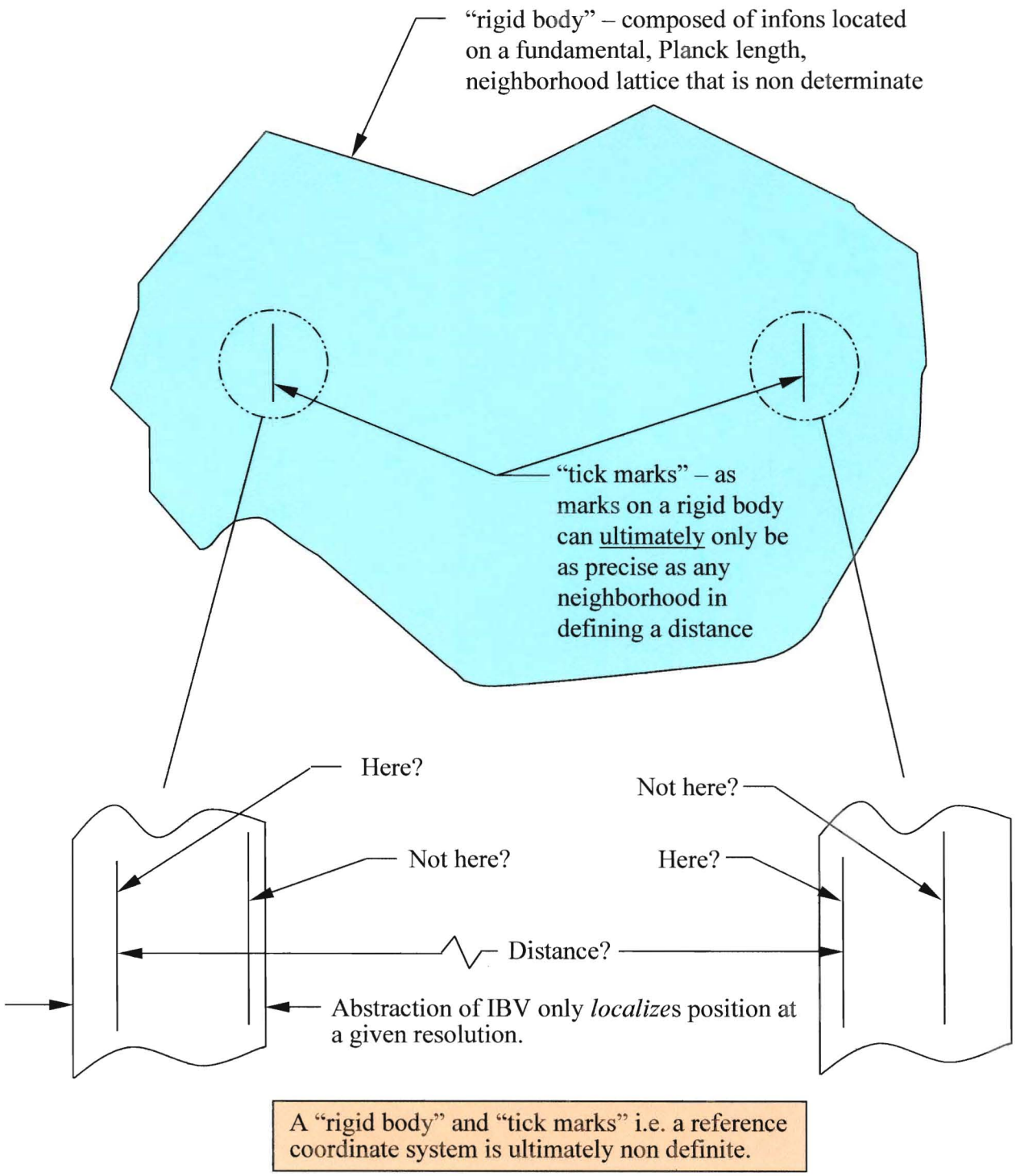
As a prelude to the thought process that led to the synthesis of special relativity (SR), Einstein in his book, *Relativity, The Special and General Theory,* discusses the "limited truth of geometrical propositions." Einstein invites his readers to question the absolute basis and meaning of distance, redefining distance more appropriately to his purpose as the linear space separating two tick marks on a rigid body. It follows then that all events occurring in space require a rigid body as a frame of reference.

While Einstein was on his way toward properly casting doubts on the previously presumed "absolutes" involved in observation, and specifically those pertaining to distance, he omitted, in this author's opinion, something more critical at this stage - an examination of the basis of abstraction in general and how, in particular, *geometrical abstraction in its fundamental precepts provides a natural pathway to the foundation of consistent observation in a nearly autonomous manner.* A closer look at those same tick marks would reveal that they are ultimately not absolute and only localize an inherent, non determined location. See Figure 56. Also of significance would be the means of making the tick marks - the node and coupled discrete motion essential to abstraction. In the preceding pages, the foundational concepts involved in geometric abstraction (those of uncertainty, infinity, and domain) when joined with the discrete motion paradigm drove a natural, unforced outcome: the existence of a "hidden reference frame" of matter, light, and force (information) *projection*, the array.

The array should not be confused with the "ether" of the Michelson-Morley experiment. The array is speculated to project or actualize deeper *currents* of information through a lattice of infons to create the observable universe. In an ether concept, bodies move through or against a "substance" that exists in the same domain (using the terminology developed here). Clearly, the array does not constitute an ether model because the array cannot project *itself* into observable reality as a "material" of any kind. The array provides the *platform* for and the means of object and force actualization, and in a sense, borrowing computing terminology, "runs in the background" invisible to the end users, its embedded observers. Objects and forces manifest on the array, but the array itself does not "interact" with them in any traditional sense. *For this reason, the array must be considered a theoretical point of view or reference frame quite different from those that are projected on it.*

In special relativity, there exists no primary or preferred frame of reference. Indeed, the theory is predicated on the absolute equality of the observations made in all (projected) reference frames moving relative to each other with a constant velocity. (This approach would be comprehensive in the *absence* of the considerations derived in this book, namely the concepts

Figure 56
Non Specific Nature of "Tick Marks"



A "rigid body" and "tick marks" i.e. a reference coordinate system is ultimately non definite.

brought forth by embracing the intrinsic *reality* of infinity in geometrical abstraction.) Special relativity stipulates as a founding principle that the speed of light, c, is a constant with respect to any moving or stationary frame of reference. The basis of this assertion lies in two observations:

1. Maxwell's equations of electromagnetism and his derivation of the invariance of the speed of light from those relations:

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} \qquad \textit{where}$$

ϵ_0 *is the permittivity constant* $= 8.85 \times 10^{-12}$ *F/m and*

μ_0 *is the permeability constant* $= 1.26 \times 10^{-6}$ *H/m*

2. The absence of an *ether* from which the speed of light can be measured: (With no ether, in reference to what is the speed of light measured? One way of going forward is to speculate that the speed of light is measured the same in all inertial reference frames.)

With this logic as part of its genesis, the Lorentz transformation makes equivalent the disparate observations made by observers in non accelerated, relative motion. Another way of expressing the same idea is to say that the laws of physics are co-variant with respect to the Lorentz transformation. Deriving the Lorentz transformation begins with a sketch of two reference frames (K and K′) where one is moving at a constant velocity, v, relative to the other. At $t = t' = 0$, the two system origins (0,0′) coincide. See Figure 57. Observers in each reference frame witness the same event and assign to that event position and time values (x, y, z, t and x', y', z', t'). The two coordinates systems are then found to be related by the *Lorentz transformation equations*:

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$y' = y$$

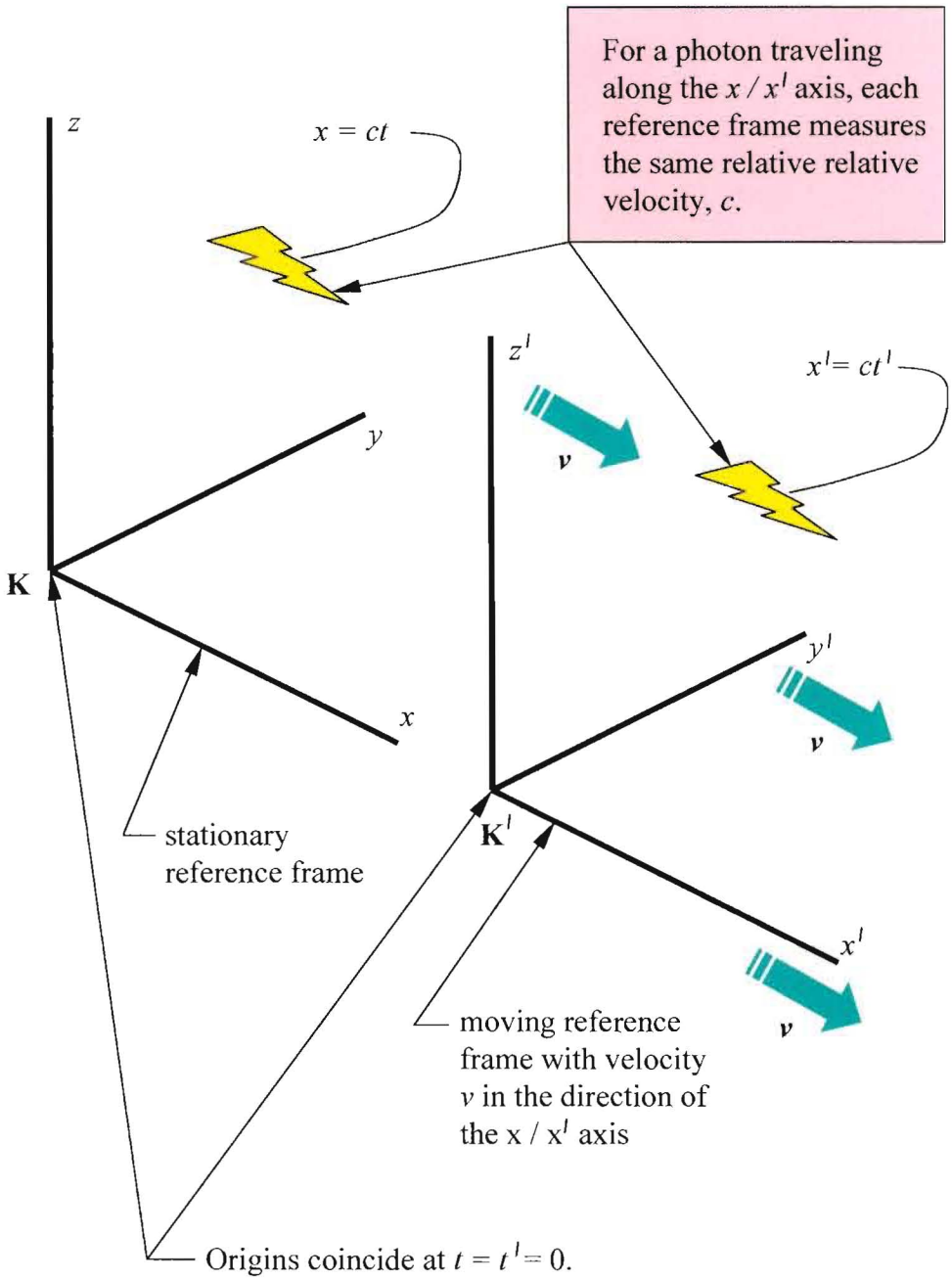
$$z' = z$$

$$t' = \frac{t - \left(\frac{v}{c^2}\right)x}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Ultimately, the reconciliation of the disparities in observation between K and K' created by

Figure 57

The Lorentz Transformation: Reference Frames



constant velocity, relative motion requires that time become mutable by consideration of the above relations. If K observes two events separated by a time, Δt, and K′ observes those same events in a time interval, $\Delta t'$, then the relationship between the two, measured, elapsed times is given by:

$$\Delta t = \frac{\Delta t'}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Therefore, an observer in reference frame K′ measures less time passing than does an observer in reference frame K for the same phenomenon. *Thus, a moving clock will always run slower than one that is at rest relative to it.* This result, in combination with a similarly derived, relative length, contraction of a body along the x′ axis of K′ observed by K, forms the core of SR.

Because the array actualizes portions of the larger information content of outwardly bound void (OBV), it is not unlike a movie screen that reveals the images of a film being projected in a cinema. If the movie in this analogy is taken to be the universe of all experience, then the reference frame of the screen is unknown to any of the film characters. Within the movie, there are many possible frames of reference portrayed on the screen, but the screen itself remains invisible to the actors, even though it is a more primary point of view and directly supports the showing of the film.

Special Relativity and any other classic theory in physics has been fashioned "in the movie" of this metaphor independently of any knowledge of the proposed "screen." Therefore, the following discussion of special relativity acknowledges that SR is a currently valid description of the "projection" of the universe and also addresses the point of view of the "screen" whose derivation has been a focus of this book.

Since the time dilation effect of special relativity has been extensively verified experimentally, any new, posited representation for the universe must generate or facilitate the same phenomenon. **The proposed array model inherently supports time dilation through the mechanism of transformation.**

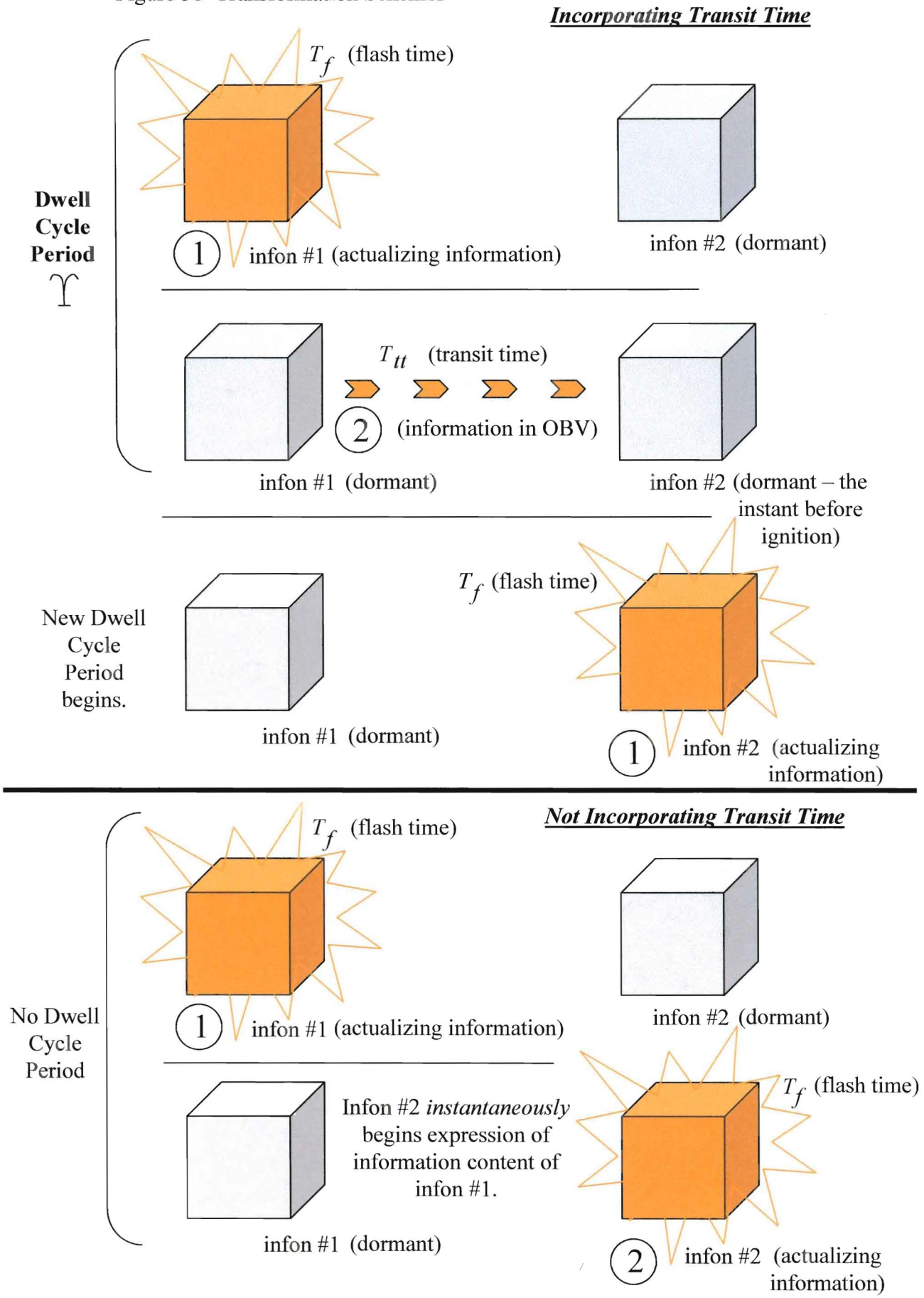
In the upper half of Figure 58 two, adjacent infons typical of the array are shown during a transformation dwell cycle period of $\Upsilon(t)$ seconds duration. Information (a basic object) expressed on infon #1 is being transformed to infon #2. The total time of information/object actualization or projection at infon #1 will be called the "flash" time (T_f). The time of transit of the information from infon #1 to infon #2, termed transit time (T_{tt}), is included as part of the dwell cycle period (Υ) so that:

$$\Upsilon = T_f + T_{tt}$$

It is important to remember that the elemental object in this discussion is fully non coherent; that is to say, its work history or complexity (See pages 25-27.) has a value that prohibits "quantum weirdness." In this transformation model, a non coherent, elemental object or generational object does not "skip" infons of the array as it moves, and it must experience flash time at every infon along its path - its motion is predictable as it transforms in Planck length increments.

Coherent objects, on the other hand, do not have to observe this proposed transformation formalism which allows for the multiple facets of quantum behavior observed thus far. In SR, the fact that light always "travels" at the same speed, c, relative to any *projected*, constant velocity frame of

Figure 58 Transformation Schemes



reference is but one example. The lower half of Figure 58 shows another possible mode of transformation in which an elemental object experiences no T_{tt} as it moves from one infon to another. Information in this example simultaneously leaves one infon and appears at another. This instantaneous transmission of information is allowed because of the nature of OBV being the sum total of all information at anytime, anywhere. However, information transforming in this way accumulates no T_{tt}, and thus, as will be shown, provides no basis for special relativity. Non coherent information (elemental objects) "moving" in this manner obviously experience time in an "alien" manner, not yet describable, but allowed for.

Because time is more properly an attribute of our projected universe (that which is manifested by the infon domain of experience), it is conjectured that objects (information) can only "experience time" while being actualized at an infon location. Therefore, a stationary object (or clock) **relative to the array** experiences time maximally. In contrast, a moving or transforming object (or clock) goes missing from its domain at regular intervals (T_{tt}) and as a result experiences less time in domain than its stationary counterpart *for a given time interval "ticked" by a stationary clock on the array*..

Cumulative transit time (T_{tt}) represents the amount of time that an object (information) spends *out of its domain of reference* while in motion during the period measured by the stationary clock. Cumulative transit time also can be viewed as the "time" spent by a moving object in outwardly bound void (OBV) between infons. As an object moves with higher and higher velocities relative to the array, its dwell cycle frequency (ξ) also increases, "exposing" the transforming object to less and less time relative to a static clock on the array. See Table 1 for a listing of dwell cycle frequencies at various velocities. (Table 1 assumes linear pathways through the array for the transformation of objects for illustrative purposes. Non linear paths of transformation embody the same concepts but prove more difficult to quantify in terms of velocity.)

Thus, a clock only ticks during the flash time (T_f) portion of each dwell cycle period (Υ), and a clock moving on the array does not "tick" during the transit time (T_{tt}) portion of each dwell cycle period (Υ). The relation that determines T_{tt} across all velocities is an embedded function of OBV, and logically, it should be a function of an object's dwell cycle frequency (ξ) on the array. In summary, an object transforming on the array experiences time passing more slowly than a stationary elemental object on the array by virtue of the following assertions:

If a stationary clock relative to the array ticks Δt_a *seconds ,*

then in that same interval a moving clock will tick $\Delta t'_a$ *seconds at a given* ξ.

The relation between the two rates is given by:

$$\Delta t_a - \Delta t'_a = \sum_{n=1}^{n} T_{tt_n}$$

with $\quad T_{tt} = f(\xi)$,

where n is the number of transformation dwell cycle periods (Υ) *occuring during* Δt_a.

Table 1
Transformation Dwell Cycle Frequencies and Dwell Cycle Periods for Various Velocities

Dwell Cycle Frequency (ξ): Transformations (τ) per second (s)		**Dwell Cycle Period (Υ):** (Υ) = 1/ τ
1 millimeter per 10,000 years	$1.98 \times 10^{20} \frac{\tau}{s}$	$5.05 \times 10^{-21} \frac{s}{\tau}$
1 millimeter per year	$1.98 \times 10^{24} \frac{\tau}{s}$	$5.05 \times 10^{-25} \frac{s}{\tau}$
1 millimeter per day	$7.23 \times 10^{26} \frac{\tau}{s}$	$1.39 \times 10^{-27} \frac{s}{\tau}$
1 millimeter per hour	$1.74 \times 10^{28} \frac{\tau}{s}$	$5.75 \times 10^{-29} \frac{s}{\tau}$
1 meter per hour	$1.74 \times 10^{31} \frac{\tau}{s}$	$5.75 \times 10^{-32} \frac{s}{\tau}$
Walking speed (3 km/h)	$5.21 \times 10^{34} \frac{\tau}{s}$	$1.92 \times 10^{-35} \frac{s}{\tau}$
Auto at highway speed (110 km/h)	$1.91 \times 10^{36} \frac{\tau}{s}$	$5.24 \times 10^{-37} \frac{s}{\tau}$
Speed of sound at standard temp. and press. (331.4 m/s)	$2.07 \times 10^{37} \frac{\tau}{s}$	$4.83 \times 10^{-38} \frac{s}{\tau}$
Earth's mean orbital speed (29,770 m/s)	$1.86 \times 10^{39} \frac{\tau}{s}$	$5.38 \times 10^{-40} \frac{s}{\tau}$
Speed of light *(c)* in vacuum (300,000,000 m/s)	$1.88 \times 10^{43} \frac{\tau}{s}$	$5.32 \times 10^{-44} \frac{s}{\tau}$

Since this derivation of time dilation for constant velocity, moving observers is accomplished with respect to the array, it can be considered a *more fundamental description* of the time dilation phenomenon than that derived from special relativity. Given previous discussions that highlight the fact that the universe of observation exists as a "projection" on the array, the time considerations of SR can be correlated with this deeper, possible truth. Thus, the measurements of transforming observers in relative motion are reconciled and made covariant ultimately as a result of variable transit time (Tit) accumulations.

From the point of view of the array, underlying and manifesting this entire process, the total symmetry of relative motion reference frames found in special relativity would be invalidated. In other words, the idea that an observer in relative motion can consider himself stationary with respect to any other constant velocity observer and vice versa loses validity with respect to the array.

This result, however, is not "binding" because *the observers in any discussion of SR are fundamentally projected ones,* and as such, cannot detect the array. Therefore, each projected observer can claim that he is "stationary" with the other observer doing the moving or transforming "past" him. Since no projected observer can determine a state of absolute rest relative to the array, the symmetry of relative motion reference frames is preserved for the *"actors" on the screen.* Finally then, objects transforming at a constant velocity relative to each other on the array must have their accumulating, mutual transit times (Tit) adjusted in outwardly bound void (OBV) to reflect their projected relative motion.

Because all constant velocity reference frames are considered equivalent and the speed of light invariant relative to all of them in SR, observers in two different reference frames watching the same event cannot agree on what "actions" occur at the "same" time. Simultaneity, according to special relativity, cannot be a valid concept between observers in relative motion. Parallel to the thoughts already developed with the *hidden* point of view of the array being primary, the "stationary clock" with respect to the array is the ultimate arbiter of what is truly simultaneous in the *projected* reference frames of our experience.

In conclusion, any "classic" or novel theory in physics must be reconciled in some manner with the projection of information that is the observable universe. *The array of infons serving as the screen of this paradigm was born of necessity;* the infinities of geometric abstraction in combination with the overwhelming signature of discrete action in all aspects of nature and ultimately consciousness drove its conception. The observables of special relativity can be supported under this umbrella of projection, and the enigmatic time effects of SR have hopefully been shown to be "less mysterious" with this perspective.

Einstein's Theory of Gravity

Because special relativity cannot generate frame covariant equations for observers in accelerated motion, Einstein sought out the formulation of a more general relativity theory. Insights gained from special relativity were combined with observations on the nature of acceleration and gravity to synthesize what became to be known as "general relativity" (GR). Commentators over the years since general relativity's development have argued that GR is not really a statement of physical relativity but more a requirement put on physical equations that describe mechanics. In any event, general relativity ultimately describes gravity as a "geometrical entity," which to some degree *echoes* the gist of the arguments found in this book that force (motion) requires coupled form.

The road to general relativity begins by realizing that inertial and gravitational mass can be considered equivalent by the following argument:

By Newton's third law of motion:

$$F = ma$$

where F = *force* ,

m_i = *inertial mass* , *and*

a = *acceleration* .

In a gravitational field:

$$F = m_g G_i$$

where F = *force* ,

m_g = *gravitational mass* , *and*

G_i = *gravitational field intensity* .

Combining these two relations yields:

$$a = \frac{m_g}{m_i} G_i$$

Because a body's acceleration in a given gravitational field is constant and independent of any other characteristic ascribed to it, then in consideration of the above equation:

$$\frac{m_g}{m_i} = 1 \quad or$$

$$m_g = m_i$$

Therefore, the gravitational mass of a body is identical to its inertial mass. "It is true that this important law had hitherto been recorded in mechanics, but it had not been "interpreted." A satisfactory interpretation can be obtained only if we recognise the following fact: *the same* quality of a body manifests itself according to circumstances as 'inertia' or 'weight.'"[24]

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[24]Albert Einstein, *Relativity, The Special and General Theory*, p. 74.

Mass in general may be regarded as a quantitative measure of inertia, but its origins are currently considered a mystery. The Austrian physicist, Ernst Mach, best known for his work on sound waves (Mach number) proposed that the distant stars "pull" on a body thus producing inertia and related centrifugal forces. Known as Mach's principle, this conjecture influenced Einstein during the development of GR.

Armed with the proposed Discrete Motion Paradigm and the related transformation of information hypothesis, *inertia can be defined as an object's intrinsic resistance to transformation.* Because the "physical" transformation of objects (mass) can be viewed as requiring "calculation" (information handling) by OBV between infons, a change of direction, a change in velocity, or any combination of the these two factors in an object's motion increases the computational difficulty of a given physical transformation. Similarly, a massive object has more information associated with its definition than a less massive object and therefore, requires a more intense computational environment in OBV between infons for any given change in motion.

Given the lack of distinction between inertial and gravitational mass, Einstein proposed that a uniformly accelerating reference frame is essentially equivalent to a frame of reference experiencing a uniform gravitational field. This idea, known as "The Principal of Equivalence," is foundational to general relativity because the results of special relativity can then be applied to a case of centripetal acceleration to generate a curved *space-time* description of gravity.

If an observer is placed on a spinning, rigid disk, then the measurements he makes on the disk while it is in motion define a *space-time* that is very different from that experienced by a stationary observer. See Figure 59. As shown in the figure, the observer on the spinning disk has his time and distance measurements warped (relative to the stationary observer) by special relativity considerations:

1. All measurements of length are shortened if they are taken in the direction of rotation.
2. All clocks run more slowly the farther out on the disk they are situated.

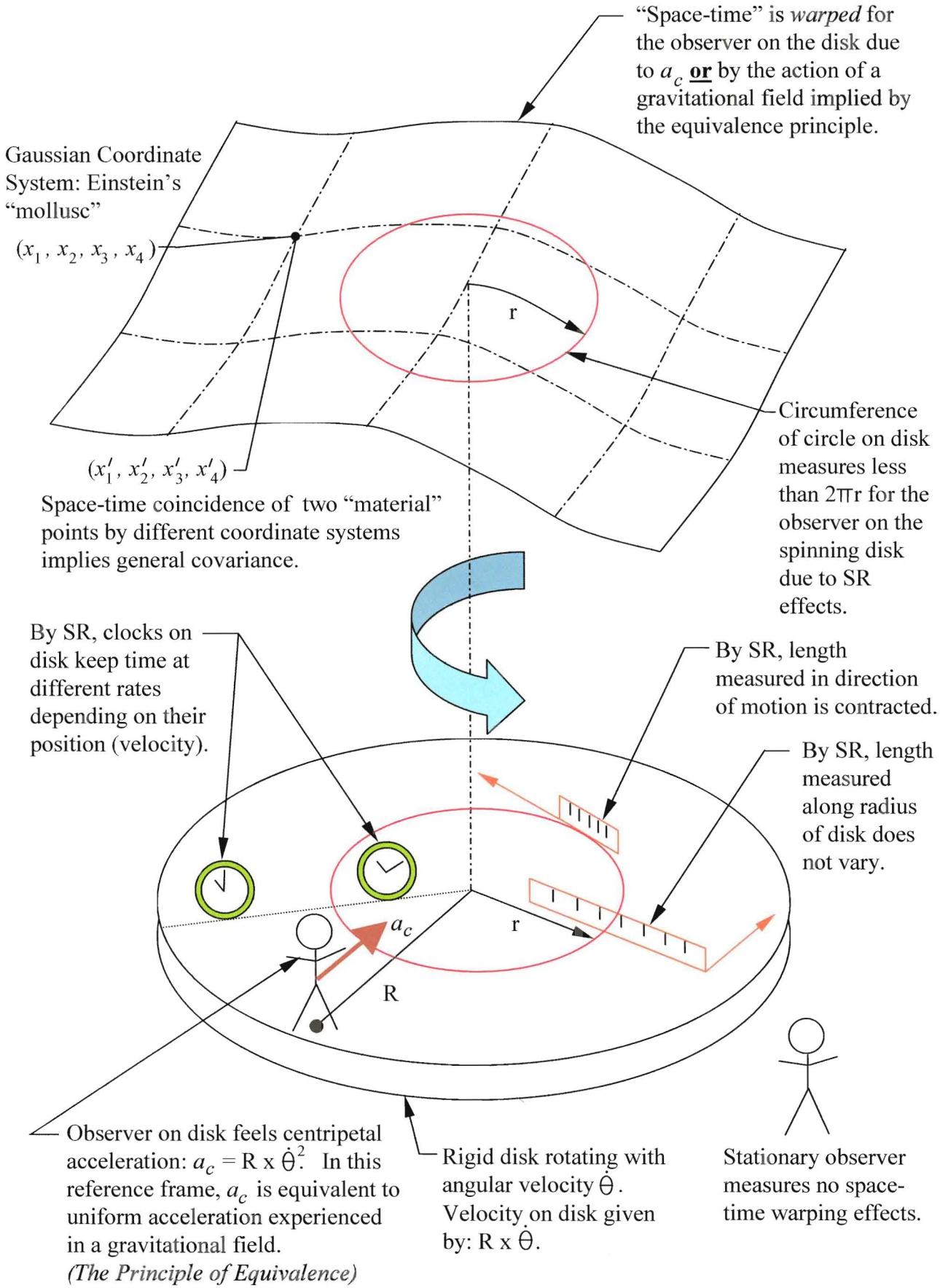
Due to the above considerations, Einstein realized that a Gaussian coordinate system had to take the place of a rigid body as a frame of reference in space-time description. Therefore, the fundamental precept of the general principle of relativity is that all Gaussian coordinate systems are essentially equivalent for formulating the general laws of nature.[25]

"According to the special theory of relativity, the equations which express the general laws of nature pass over into equations of the same form when, by making use of the Lorentz transformation, we replace the space-time variables, x, y, z, t, of a (Galileian) reference-body K by the space-time variables x', y', z', t', of a new reference-body K'. According to the general theory of relativity, on the other hand, by the application of arbitrary substitutions of the Gauss variables x_1, x_2, x_3, x_4, the equations must pass over into equations of the same form; for every (mathematical) transformation (not only the Lorentz transformation) corresponds to the transition of one Gauss co-ordinate system to another."[26] Thus, the equations which describe nature must be generally frame

[25] *Ibid.*, p. 108.

[26] *Ibid.*, p. 109.

Figure 59 The Warping of Space and Time



covariant (tensor equations) to satisfy this argument, nothing more.

Making use of the equivalence principle and the idea that gravity represents the curvature of space-time as seen in Figure 59, Einstein developed the "Einstein Field Equations," a series of 10 expressions which describe gravity as curved space-time that results from the presence of matter. In symbolic form:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

where G is the gravitational constant , and

c is the speed of light .

Solutions to these equations are labeled metrics of space-time. The left side of the symbolic expression (Einstein tensor) represents the curvature of space-time as specified by the metric while the right side of the relation (stress-energy tensor + constants) indicates the matter/energy content of space-time. While noble in design and intent, exact solutions to these equations are exceptionally difficult to find.

> Einstein gave another argument for general covariance which John Stachel has conveniently labeled the 'point-coincidence argument,'
>
> > That this requirement of general co-variance, which takes away from space and time the last remnant of physical objectivity, is a natural one, will be seen from the following reflexion. All our space-time verifications invariably amount to a determination of space-time coincidences. If, for example, events consisted merely in the motion of material points, then ultimately nothing would be observable but the meetings of two or more of these points. Moreover, the results of our measurings are nothing but verifications of such meetings of the material points of our measuring instruments with other material points, coincidences between the hands of a clock and points on the clock dial, and observed point-events happening at the same place and the same time.
> >
> > The introduction of a system of reference serves no other purpose than to facilitate the description of the totality of such coincidences. We allot to the universe four space-time variables x_1, x_2, x_3, x_4, in such a way that for every point-event there is a corresponding system of values of the variables $x_1 \ldots x_4$. To two coincident point-events there corresponds one system of values of the variables $x_1 \ldots x_4$, i.e. coincidence is characterized by the identity of the co-ordinates. If, in the place of the variables $x_1 \ldots x_4$, we introduce the functions of them, x'_1, x'_2, x'_3, x'_4, as a new system of co-ordinates, so that the system of values are made to correspond to one another without ambiguity, the equality of all four co-ordinates in the new system will also serve as an expression for the space-time coincidence of the two point-events. As all our physical experience can be ultimately reduced to such coincidences, there is no immediate reason for preferring certain systems of co-ordinates to others; that

is to say, we arrive at the requirement of general covariance.[27]

Einstein in the point-coincidence argument for general covariance emphasizes the fact that all of experience can be reduced to the meeting of "material points." It is apparent that Einstein by using the term "material point" means a geometric/(mathematically limited) point "on the surface" of an object. Clearly from the discussions in this book, the ultimate, non definite reality of such geometric abstractions has been omitted from his analysis. *As addressed previously in this narrative, moving geometric points can never become coincident unless they are transformed into another inwardly bound locality.*

Thus, any mathematical theory based on such points and related reference coordinate systems represent at best an approximate description of reality. This neglect in analysis is not unique; the nature and traditional interpretation of our present abstractions limits more descriptive treatment. An acknowledgement and incorporation of the non limited nature of geometric entities into any new representations of nature may permit a better conceptual structure or strategy to emerge. The Planck length, neighborhood lattice as the foundation of "material" experience (information expression) could be one such example.

In spite of this oversight, the point-coincidence perspective on the machinations of the universe shares *some* similarity with the "node logic" of the Discrete Motion Paradigm. The difference however, is distinct in both interpretation and formulation. The aim of the point-coincidence argument was to cast measurable reality as a space-time coordinate system which then could be "fashioned" by covariant equations into a description of gravity as curved space. In other words, the intent was to make nature conform to mathematic treatment in which general covariance had been incorporated. According to Einstein's interpretation, general covariance equates to satisfying the conditions of general relativity.

Kretschmann (a contemporary critic of Einstein) stated that "...there must be something more to a relativity principle than covariance. For he (Kretschmann) argues that we can take any theory and reformulate it so that it is covariant under any group of transformations we pick; the problem is not physical, it is merely a challenge to our mathematical ingenuity. In brief, general covariance is physically vacuous...*if we accept the point coincidence argument, then any theory can be given a formulation of arbitrary covariance.*"[28]

By contrast, the Discrete Motion Paradigm's roots lay in observing and noting the very physical essence of the basic behavior of elemental physical objects: the repeated instance of zero relative velocity that occurs between their "mass centers" during a collision event. Although a mass center is a theoretical point, the fact that these elemental objects collide and then rebound or are absorbed is a *physical* fact. Therefore, an instance of zero relative velocity at their mass centers had to occur to support this behavior (an inflection). The exact location of each mass center is not required to be known at this instant, and will never be known. Geometric uncertainty insures this outcome. By embracing this uncertainty, the proposed transformation of information across geometric infinities then "fine grains" the limits of observation to a non specific, Planck length neighborhood. Einstein's "material points" can only have meaning relative to this structure. Geometric abstraction guarantees this result.

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[27] John D. Norton, *General Covariance and the Foundations of General Relativity: Eight Decades of Dispute*, p. 804.

[28] *Ibid.*, p. 818.

As in special relativity, any of the conclusions of general relativity *could* be projected on the array. These representations, according to The Discreteness Paradigm, are allowed, but do not follow directly from a consistent analysis of the basis of general abstraction. While Einstein's curved space embodies the phenomenon of gravity, the postulate of Geometry-Motion Reflexive Equivalence in conjunction with the infon concept describes gravity as a particular infon mode shape existing in another dimensional domain on the array. Incorporating the non definite nature of geometric abstraction along with similar ideas on the modality of awareness is a more consistent approach to take in characterizing gravity or any other natural phenomenon.

In fact, gravity's effect on time as predicted by GR, can be seen as a slowing of transit time (*Tt*) during transformation induced by *busy space*. See Figure 60. Matter by its very nature is held together and acted upon by forces. These forces are represented as infon mode shapes in domains other than the normal space domain in transformation theory. Therefore, any mass (and particularly a large, composite one) can cause the electromagnetic, strong, and weak force domains to be active in addition to the gravitational force domain. Thus, it is possible that time would slow more than expected for an object transforming near a large mass because *Tt* would increase over its "normal value." This phenomenon should occur as a result of the increased "information handling" activity of the array in the force domains in the vicinity of the moving object. Even a stationary clock relative to the array would be slowed (over a non force environment rate) by activity in the force domain(s) (gravity included) because all time devices require discrete movement (transformation of an object) in some aspect of their time keeping.

Concluding Remarks on the Evolution of Ideas

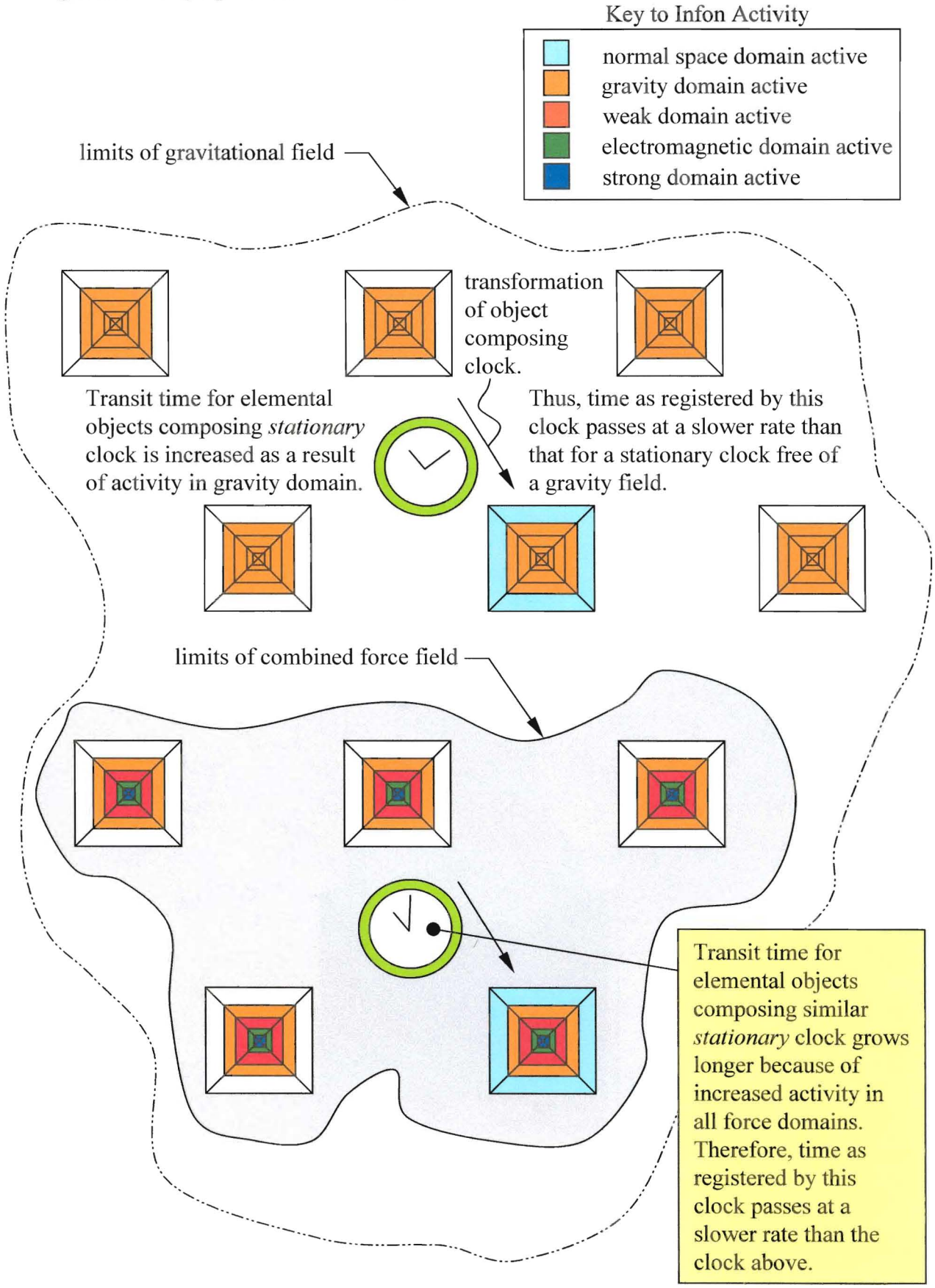
Science advances incrementally not unlike the process of natural selection described by the theory of evolution. Periodically, in the history of science, new representations of nature are created and put forth in the greater scientific community for comment and criticism. Those representations which survive this process by analogy should be more *fit* than their predecessors as descriptions of natural phenomena. Thus, the "genome" of contemporary paradigms contains the legacy of this *winnowing* process.

The habitat for new ideas can be a dangerous one; often, more mature content, due to its foothold on the landscape, limits the potential for the sustaining elements in the environment to promote new growth. Sometimes however, a novel *body* of thought exhibits characteristics that permit exploration of previously unknown features of a given locale without competing directly with the established order.

The representation of nature described in this book *fits* such a description by virtue of its non competition with current and acknowledged scientific thought. More importantly, the linkage of the mechanism responsible for the genesis of thought with the modality of the material of the observed universe creates a consistency in approach lacking at the present time. This very comprehensive synthesis, an umbrella of cause and effect, does not compete for the resources of the establishment, and thus, has the potential to seed the surroundings with new possibilities.

As, mentioned before, the observations of the worlds of the very large and the very small mesh with the modus operandi of those doing the observing from this new, encompassing perspective. The "excitations" of thought and the engine of information share discrete motion origins. The infinities and non determinism of geometric abstraction theoretically motivate the expression of information in the infon. Previous to this discussion, elemental matter and light had yet to be defined in a thorough manner; with this representation, a "thing" and a thought are discretely generated bits

Figure 60 Busy Space and Related Time Effects



of information. The Circle of Logic provides the rationale for these assertions.

A discussion of String Theory was purposely omitted from the arguments in this book precisely because of its neglect to specify what constitutes a "string." Other than being a vibrating, mathematical entity, no consistent logic of the means of its vibratory motion is offered... Also, strings apparently move continuously through space, a non sequitur in terms of The Discrete Motion Paradigm.

Another important feature in the new landscape of ideas embodied by Transformation Theory is the required existence of a *substrate* (outwardly bound void) from which the perceived universe emanates. The internal consistency of geometrical abstraction yields this result. Young's experiment, the delayed choice experiment of John Wheeler, and the possible non local description of nature resulting from the experimentation of Alain Aspect's group in Paris all reinforce the strangeness of the quantum realm and the need for this underlying continuity that is "sampled" or "projected" into the observable universe. As developed over the course of this investigation, the infon array provides the means of projection or actualization of this hidden "source."

Within the array model, the effects of general relativity are a *possible* projected reality. In other words, the observables of general relativity may have origins different from those of a warped space-time as outlined previously. However, cosmological models of open, closed, or flat universes based on general relativity's curved space are at a fundamental level inconsistent with the existence of an array embedded in an infinite, geometric continuum. As mentioned earlier, the WMAP spacecraft has found that the universe is flat. This result is entirely expected and parallel with the concept of an infon array situated in a three dimensional space.

By the strength of the arguments offered, the fine graining of observable reality becomes a requirement on all physical theories. A consistent description of the universe contains this background.

Glossary

Array - a developed, geometric, information network that projects quantum object reality.

Associated Force Domain - a domain which actualizes one of the four known forces by being a primary filter for a particular boson.

Circle of Logic - a visualization tool that demonstrates the interconnectivity and interdependence of geometry, discrete motion, and information. The infon concept results from these considerations.

Closed Neighborhood - a term given to a neighborhood defined by closed curve(s) in 2-d space and closed surface(s) in 3-d space.

Coherence - a state of quantum elemental objects in which wave properties of their description predominate over material particle description.

Complexity/Work History - an index which sums elemental and composite object energy changes across nodes from the Big Bang to present. The magnitude of this index could determine when an elemental object decoheres.

Discrete Motion Paradigm - the idea that the movement of all elemental objects is discrete in form from the universal perspective. There is no such thing as continuous movement from this vantage point.

Domain - a closed neighborhood existing in two or three dimensions.

Dwell Cycle Period -the total time required for a complete transformation cycle.

Elemental Object - a basic quantum of Transformation Theory envisioned by Geometry-Motion Reflexive Equivalence to be made of one or more infons.

Flash Time (Tf) - the amount of time that information is actualized at an infon location during transformation.

Frozen History - a term associated with object complexity calculation denoting that an object's work history is held static once it is absorbed by another object.

General Discrete Motion - a category of discrete movement encompassing the discrete motions of all elemental objects.

Geometry Motion Reflexive Equivalence - a postulate that states that geometry and motion are essentially different manifestations of the same phenomenon - it is impossible for one to exist without the other. Therefore, form in the quantum world motivates motion.

Geopath - a recurring, basic, geometric pattern of quantum object transformation pathways in a transformation cell. Four such patterns have been identified.

Infon - the fundamental, hyperdimensional, geometric, information generator made of vibrons that through mode variance (broken symmetry) manifests quanta.

Inwardly Bound Void (IBV) - a retreating infinite space typified by a geometric point in transformation theory.

Locality - an open (non closed) element of inwardly bound void that exists in OBV.

Neighborhood - the name given to two or more, distinct localities in OBV.

Node - the location at which two or more universal observers note the occurrence of zero relative velocity occurring between themselves.

Outwardly Bound Void (OBV) - an expanding infinite space surrounding IBV in transformation theory, that contains all information by means of its representation as complete uncertainty.

Relative Uncertainty (u_r) - the uncertainty which exists in the relative position of nested infon domain boundaries - responsible for generating hypo or hyper dimensional spaces.

Secondary Associations - abstractions that result from *special* discrete motion.

Special Discrete Motion - a category of discrete movement that includes only the discrete movements that accompany imaginary points on macro objects that are required in abstraction.

The Primary Association - recognition of the fact that the movements of all *elemental* objects are discrete from the universal perspective. A statement of *general* discrete motion.

Transformation Cell - the speculated arrangement of infon domains in OBV that determines geopaths and yields the observables in transformation theory.

Transformation Theory - the idea that quantum objects (information) must respect the inherent infinities in geometrical abstraction in order to be displaced. As a result, all quantum objects are hypothesized to move incrementally from one Planck length locality to another if perturbed. Continuous motion does not exist.

Transit Time (T_u) - the time required for transforming information to go from one infon to the next, forming the basis of the time dilation effects seen in special and general relativity.

Universal Observer - term given to a hypothetical observer located at the center of mass of any elemental object.

Vibron - a geometrically defined component of an infon that possesses *abstractional* energy which enables its vibration.

Void - the fundamental geometric abstraction that manifests as inwardly or outwardly bound infinite space.

Zone of Uncertainty - the inherent uncertainty in absolute position which accompanies the location of any IBV element.

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After graduating from The Georgia Institute of Technology with a BS in Aerospace Engineering in 1982, Doğan Gökçe subsequently developed a career as an Engineer/Scientist specializing in the design of high performance military aircraft with the former McDonnell Douglas Corp. and with the Lockheed Martin Corp. The Marines' AV-8B Harrier V/STOL attack aircraft as well as the Air Force's next generation air superiority fighter, the F-22 Raptor, have both directly benefited from his expertise. Exploring new ideas in science has been a passion over the years; this book was born as a result. He currently resides with his wife, Tatiana, in Atlanta, GA.