Jasyamatang tasya matang, matang jasya na veda sa|
Abigyatang Bijanatang Bigyatambijantam||

Only that person comes to learn universal consciousness, to whom the universal consciousness wants to unfold in an unexpressive manner; however, that person, to whom it comes as a subject of knowledge, cannot state what it is. Those who have seen and felt it could never be consciously aware that they have realized it, but those who think that they have felt it have never learned what it is.

4 Fractal Mechanics Is Not Quantum but Original—Geometric Algebra for a Dodecanion Brain

4.1 REVISITING THE BASIC CONCEPTS OF QUANTUM MECHANICS USING CLOCKS

If today, geometric musical language (GML) is the language of the universe, then: "Tomorrow we will have learned to understand and express all of physics in the language of information" (Wheeler, 1990). If one has understood the right information theory of the universe would be, "at that point ready to revalue $h = 2.612 \times 10^{-66}$ cm^2—as we downgrade $c = 3 \times 10^{10}$ cm/s today—from constant of nature to an artifact of history, and from the foundation of truth to the enemy of understanding." The quest for a unified language for physics and mathematics is long (Hestenes, 1986). The message is clear. Explain the origin of fundamental constants, learn what existence is. Only acceptable proof that the true language of nature is invented, is the derivation of all fundamental constants from "no law." He envisioned "the world as system self-synthesized by quantum networking" (Wheeler, 1988). When there are plenty of observers, how the information structure changes? It is said that every measurement changes the source. It is very exciting. The photon that started from a distant star Billions of years back, when we measure it in the planet earth, by looking at that star, in our naked eye, the atoms in our eyes collapse the state, the entangled photon may be traveling to a very different direction, finds its state fixed. Across cosmos, zillions of atoms which are observing a single star would even change the star (Super Copernicus principle).

Nanobrain is a nano-sized black hole: Wonderful entropy of Bekenstein: We revisit quantum mechanics by writing all its basic knowledge gathered and optimized in the last century in terms of geometric musical language (GML) developed recently. We find that the basic unit of information, a clocking Bloch sphere holding a geometric shape that we introduced in the second chapter, could pictorially present all derivations of quantum mechanics. We have not tried to derive quantum mechanics, we consider it a phenomenon that has only one property, "***collect the singularity points and clock them in a single circle***" (Wheeler, 1968; Hartle, 2005; Hawking, 1982; Vilenkin, 1982). The singular property is essential and a sufficient condition to generate a wavefunction (Hartle and Hawking, 1983), thus, all of the quantum using GML. See how measurement is a fusion of two clocks in Figure 4.1a. In fact, the very foundation of GML is quantum, with a difference that its Bloch sphere has no classical point. The interesting feature of a self-assembled Bloch sphere is that apart from being a time crystal, the whole information architecture, whether it represents a human brain or a single protein molecule, it is similar to a nano black hole. Its only constituent is singularity points. Bekenstein found that the surface area of the horizon of a black hole, rotating or not, measures the entropy of the black hole, it is 2.77 times the plank area (Bekenstein, 1973, 1980; Penrose, 1969). A composite time crystal representing the information architecture of a complex system is filled with clocking singularity points, hence the surface geometry of silence accounts for an entropy. We do not need to count the Bekenstein number. ***The complex surface area of a time crystal is proportional to its entropy***. Since we use fourth-circuit element, Hinductor for implementing phase prime metric (PPM) and the GML, which increases magnetic flux linearly as a function of charge, such a scenario is valid even for a charged black hole (Zurek and Thome, 1985). It was argued that to address the complexity of the level of universe or brain we need an information metric (Zurek, 1989), we have it now as PPM, that does not grow or lose its complexity remains fixed everywhere.

Feynman's singularity bridge (Cao et al., 1993; Feynman, 1949)**:** The worldview breaks the fundamentals of the information science that has been successful for over a century. The reasons are the following. First, the observer dilemma is that already it is putting its bias into the system by choosing when to see, wherefrom to see, how much to see in the output. Then, the observer should not make a black box to fit nature blindly. Second, quantum fails to probe singularity. When one considers events inside an event inside an event in an infinite network, then it takes us back to the deadlock of the 1930s. Then, Feynman bypassed the singularity to save the quantum deadlock (Reddy et al., 2018). Bridging singularity saved them. However, the journey they avoided is what makes nature beautiful. One should not bypass but explore it (Mallat and Hwang, 1992). Third, logic and the fitting tools of AI are blamed for being a product of human imagination for creating the abstract black box. It is far beyond reality, only to fit certain observations. Then, one should not avoid singularity, do not use an "educated guess."

It is the purity of time that demands a new mechanics: Time travels both ways in quantum, to the past and to the future, just like all other physics laws, so the quantum is natural. However, the classical world where time travels in one direction is shocking, surprising (Price, 1996). In classical wisdom, time does not divide like cells, it does not intersect with another flow of time, it does not return or suddenly die out, or disappear forever. Time has no beginning or end, be it flows linearly or in a circle (time asymmetry). Here we envision a world where time is an architecture of phase following the symmetry of primes. Quantum is its local view, classical is a point on this structure. On a circle where the phase is changing 0°–360°, on its perimeter a pixel cannot be a complete event, as no event is before itself, else "the world recurs infinitely many times" (eternal recurrence; Nietzsche, 1967). Thus, we sense the need for new mechanics. Even quantum has evolved so much. Earlier it was proposed that multiple classical worlds interact in parallel to create a quantum world (Poirier, 2010), and now it is more clearly argued that all classical world's work deterministically, since we are ignorant about their motion, we see the unpredictability (Hall et al., 2014). Ehrenfest's theorem, wave packet spreading, barrier tunneling, and zero-point energy have been mathematically created using repulsions among these deterministic classical worlds. The journey between classical to quantum and quantum to classical has seen many adventures, but the journey through imaginary worlds remained unhonored.

A journey from qudit to fractal mechanics: an undefined network of actions *hc* (Plank constant × velocity of light): We consider quantum mechanics as a fundamental property of the universe that couples the vibrational systems in the time domain, independent of space, the connection is made by a wave function. Two particles at the extreme ends of the universes could be part of a single wave function. Quantum mechanics is said to be incomplete; a wave function should include an observer (Wheeler, 1977), but if there are classical points on the Bloch sphere, this won't be possible. As outlined in Figure 4.1a, an observer could be a pixel of the object to be observed or vice versa, when clocks depict wave–particle duality (pixel or perimeter that's the uncertainty), the relative size of clocks would matter. If the worldview is sequential, then one imaginary world of quantum mechanics is enough. However, when we explore "within and above" assembly of events, a large number of imaginary worlds would coexist. Thus far, quantum mechanics used octonions only to define multi-dimensional dynamics of one imaginary world, never explored, how multiple imaginary world could coexist. That takes us to a new mechanics, namely fractal mechanics (FM).

Ten principles of fractal mechanics: Thus far several attempts were made to put multiple classical points on the surface of a Bloch sphere. The attempt curves the Bloch sphere and we need to go to a higher dimension. Instead, when we built the foundation of GML (Chapter 2), we inserted new Bloch spheres at the singularity points. Instead of Bloch sphere we use the term phase sphere, because no real point exists on the Bloch sphere. The particular step drastically reduces the computational complexity for theoretically estimating the efficiency of the information architecture. Moreover, the mechanics driven by bursts from singularity alone requires multiple changes as outlined below:

1. We do not need to go to a higher dimension, 3D representation of phase spheres is sufficient to process higher dynamics. One can enter inside the singularity points 10 or 11 times, as soon as a system point crosses 10 layers or singularity points one inside another, in reality the complexity of 10 dimensions is addressed.
2. $\hbar$ maps the horizon area as information lost, it reveals the wave number of light as photon momentum and considers field flux similar to a bit-registered fringe shift. Therefore, GML derived time crystals that we built for operating the fourth-circuit elements (Chapter 8), we get momentum as typical geometric features of time crystal at various layers. In the conventional quantum mechanics, one layer or one imaginary universe is enough. Here at each layer, we get a set of momentum space made of layers below and contributes to defining the momentum above. When we rewrite basic quantum interference and quantum beating in terms of nested clocks or circles, we see the need for at least two nested imaginary layers (Figure 4.1b).
3. Product of plank constant and velocity is defined as action $(A = hc = hv)$. In the conventional quantum mechanics action is always hc, here in some layers it is hc and somewhere it is $hv(v = \text{velocity})$. Most importantly, hc is the flux of the most fundamental ring, it is magnetic. Information architecture is now an infinite network of various kinds of actions that is undefined everywhere. Projection of an observer's time crystal on the measuring time crystal to the infinity reflects back to the observer. The feedback from infinity on the observer is the reality. For this reason, we cannot even use the term classical-like or quantum-like. Of course, an entangled quantum system or free-to-edit classical system are both not essential to operate a PPM.
4. Bell's theorem is a proposal to measure the action at a distance; it is a bridge between the special theory of relativity and quantum mechanics. For entanglement

we need a hidden variable common to both the systems (Bohm, 1952). When we introduce PPM, there is a composition of symmetries linking observer and the system to be observed doing the measurement, the system and the environment are connected by clocks. Thus, it is not just one but an intricate map of geometric variables acting on the measurement. Therefore, a measurement following fractal mechanics would deliver a set of observations, not one, one just requires proper sensors to sense them in a non-demolition manner.

5. There is no collapse of the wave function by measurement, it is a redistribution of the clocks, restructuring the topology of symmetries that link two spatially distant, temporally non-separated systems. It is nearly impossible to destroy or delink all clocks, a measurement acts only on a few clocks. A clock forms when a phase loop traps a clock smaller than its pixel, then a new pixel is born in the host clock's perimeter. The creation of a system point is adding a pixel with a physical identity (Figure 4.1c).
6. Fractal mechanics is based on three fundamentals, singularity, the multi-layered architecture of clocks and the symmetry of primes. The architecture of clocks is similar to a generalized version of time

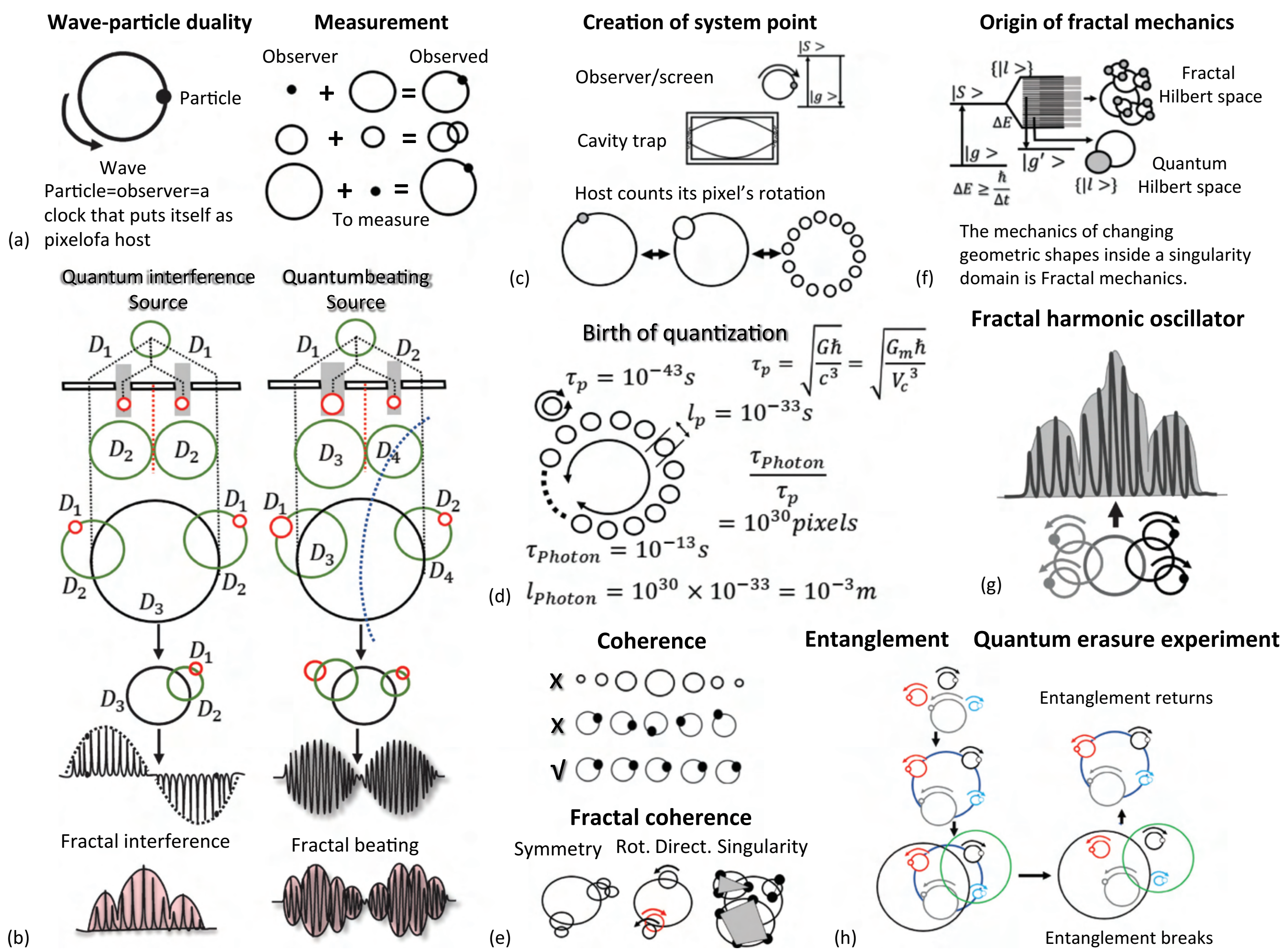


FIGURE 4.1 Using geometric musical language (GML) we revisit quantum mechanics. (a) No wave flows without a counter. Using a circle and a dot the philosophy of quantum mechanics is explained. The observer could be a dot, a circle or even bigger than the host. When a circle or a clock is measured it is a particle and when observed it is a wave. (b) Quantum interference and quantum beating shown with circles as light. Quantum is about one imaginary world. Fractal mechanics is about n number of imaginary worlds. Below the interference pattern and beating pattern, a simple case of fractal version is presented with one additional imaginary world. (c) Three routes of creating system points. (d) How smallest circles presenting time and thence distance quantizes space and time in a given system. (e) Three ways of quantum coherence, top two rows show multiple signals which are not coherent, the bottom one shows the coherent signals. The bottom panel we see three cases of fractal coherence. The left panel shows symmetry matching, central panel shows rotational direction matching, the rightmost panel shows matching in the geometric shapes stored by the singularity points. (f) Fractal mechanics is defined. In the higher excited state, within a small energy gap a large number of states reside. The same system would have two distinct clock representation for two kinds of mechanics. (g) Nested clocks add superposition of multiple periodicities in the energy spectrum, thus defined fractal harmonic oscillator. (h) Explanation of quantum erasure experiment using nested circles.

crystals, not a single clock with a single singularity points as advocated by Winfree or Wilczek.

7. Fractal mechanics do not have "A causes B," no one observes independently, no one measures as an outside system, no collapse is ever complete (Dummett, 1954). Triangular systems, the observer, measuring system and the environment are part of a single network of phase or architecture of clocks that has guidance following PPM.
8. The origin of unpredictability in the universe is one and only one source, the number of primes required to cover 100% of all possible composition of symmetries is not fixed. It is the reason, some systems reach saturation at 12 number of primes, some at 13, some at 14. A system could decide to stop at 99%, or 99.99% or 99.99999%, above first 12 primes, a system could stop anywhere. It stops constructing a pure mathematical universe or artificial brain or a self-operational system, then starts growing again, from a single unit.
9. No need to save locality in the future and in the past. No need to artificially link causal asymmetry with the physical asymmetry, the map is part of "advanced action" (Price, 1996) embedded in PPM.
10. In quantum, no one dares to picturize the origin of quantization, coherence and entanglement. In fractal mechanics, the smallest pixel that makes a circle or loop perimeter is a natural choice for quantization (Figure 4.1d). Distance between two pixels is inevitable. Geometric similarity, rotational directional similarity and a similarity in the arrangement of clocks determine the fractal coherence (Figure 4.1e). A fractal coherence means a map of coherent systems spread over several imaginary worlds. Since quantum has only one, such maps are non-existent. Fractal mechanics could explore the architecture of clocks in the superposed Hilbert space of quantum mechanics (Figure 4.1f). Since all clocks are connected, fractal harmonic oscillators show a complex hierarchical pattern of resonance peaks (Figure 4.1g), and retrieves the entanglement like responses since, it is all about rebuilding the missing clock (Figure 4.1h).

4.1.1 Wave–Particle Duality, Beating, Interference, Entanglement, and Harmonic Oscillator

The birth of a system point: In GML, every event is a clock with a few singularity points constituting a geometric shape, and a singularity point or a pixel often has a topology inside. When all the singularity points in the internal topology of the guest clocks synchronize to activate an entire loop at a time, effectively it becomes a single system point for the higher topology and could move along the higher topological structure, i.e., available above. Thus, a system point is born at the event point (Figure 4.1c). Energy burst from a singularity is how a system operating GML carries out a conversation.

Measuring and editing a time crystal: Pump-probe experiments work on an internally linear structure, for a time crystal, we need a similar structure to sync with the time crystal that we want to measure and in return let the singularity points bursts signals. It would be a non-demolition type measurement where we try to change probing time crystal continuously keeping both measuring and to be measured time crystals side by side until there is a match. As soon as they match two types of signals emit. The first stream of waveforms of different frequencies with changing phase values and the second stream of complex waveforms where different waves are fused together. We have studied a large number of proteins and their complexes and these two types of signals generate continuously, from which we identified the time crystal. Measurement is morphing between two geometries whose corner points are made of singularities. Time of measurement is the time of the slowest clock, not linear. So, in a time crystal computer the computing time is fixed by the slowest clock in operation. **During measurement, can we sync with a part of time crystal?** We can if the part's complexity has reached beyond a certain level. If 12 or more clocking units are there we get $2 \times 2 \times 3$, $2 \times 3 \times 2$, $3 \times 2 \times 2$, three points that generate a higher-level topology. Now, there are integers for which we may get geometric shapes and in the corner of the geometric shapes we get new structures within. When geometric structures seeded within corners they are separately measurable. By bringing a time crystal of similar symmetry composition we can measure the time crystal. But still there is no gradual synchronization. We have to redefine our concept on the gradual sync, it's either the whole part at once, or no interaction at all, time is fractal here. It is morphing between two geometries.

4.1.2 Multiple Imaginary Worlds Operating at a Time Need Fractal Mechanics

When a person moves around a circular path, after reaching the starting point, no evidence is retained anywhere that he rotated along the circular path at all. It is a classical view, how could we describe motion or dynamics in the quantum world? Pancharatnam came up with an idea of an infinite cylinder, where one sees the cylinder classically along the length, only the circle is visible, classically, but for quantum, one sees from the side, the moving point follows a spiral path, each rotation acquires a geometric phase. When we move to multilayered imaginary universes, the first major change in the Pancharatnam's idea would be twisting the cylinder into a cylinder shape (Pancharatnam, 1956). If we have clocks in the geometric phase of quantum, or the first imaginary world, then it would be sufficient to roll the Pancharatnam's cylinder into a circle, but then we would have the same problem that Pancharatnam had with quantum mechanics. How do we measure the phase change for the second imaginary world, beyond quantum. So, we twist the cylinder into a spiral form, get a higher-level infinite cylinder for the second imaginary world. The journey continues here, for 11 times, we say spiral of the spiral of a spiral….11 times, it's a cylinder made of a spiral made of a cylinder made of a spiral…. So, fractal mechanics is the mechanics of interactive imaginary layers, that interaction is not random, governed by multinion tensors, in the real physical space, minor changes would dramatically change the phase space.

4.2 FRACTAL MECHANICS ACTS IN THE PHASE SPACE CONNECTING SINGULARITY POINTS

Ten foundations of the Fractal mechanics (FM)

1. Any point in space is a ***superposition of at least three imaginary "time" worlds forming a time crystal*** while there is only one imaginary world in QM. ***Supplement to a fractal state is contextual or non-contextual, if contextual then what would be its nature is decided by observer's coupling with the three or more imaginary time cycles***. Here, the study is limited to 12 imaginary worlds (dodecanion or icosanion).
2. ***Time gets a complex composition of rotations or spins as soon as information is encoded and that direction is purely based on the 3 to 12 imaginary worlds***. The 3D orientation of three or more imaginary time cycle planes changes with time, as information exchange between time crystals. Sometimes exchange means bonding or breaking of time cycles, often it changes the relative orientation of the planes. Hence, the same system is measured differently by a different observer, differently by the same observer from different directions. ***Measurement is a match between common nested cycles between the observer and that of the two imaginary worlds, the matched nested cycles create a domain on the phase space which is the "reality sphere." Oscillation of unit time means a change in the diameters of the local guest time cycles embedded sequentially in the singularity domains of the host giant time cycle***.
3. **Ten fundamental properties of wave function in Fractal mechanics (FM) that differs than the quantum mechanics:** Wave function ψ is a time crystal or a deconstructed topological architecture in the Fractal mechanics (FM), while it is the fundamental unit in quantum mechanics: (i) ψ is not a wave function, in FM it is a projection P of the imaginary triplet worlds of the observed on the imaginary triplet world of an observer (we call it "reality sphere"; $\varnothing$ is a point on this sphere). Note that we described in Chapter 2 that be it a quaternion, or octonion, or dodecanion tensor, all could be represented by a quaternion, wave function in FM is a tensor product Ж of the observer, observed and the environment. In other words, $\langle\varnothing\rangle = P\{f(z_1)+f(z_2)+f(z_3)\}$. (ii) Probability does not exist, $\varnothing^2$ takes a few common clock based architecture or time crystals of the imaginary part of the wave function and returns to a real entity in QM, we cannot do this in FM here $\varnothing\varnothing^* = \sum_i f(z_i) f(z_i{*})$. (iii) The wave function $\{\varnothing\}$ does not have a stationary state, the observed value is a set of output crystals by Ж operation which is a function of time. The "singularities" containing time crystals on the "reality sphere" changes with the observers time crystal. (iv) The wave function $\{\varnothing\}$ does not require additional normalization or renormalization as the projection of a structured system's charge and mass, i.e., all divergent parameters are always finite, w.r.t. observer. (v) The wave function $\{\varnothing\}$ grows and does not remain as an isolated packet, edit cycles phase to make a virtual sphere/hyperboloid unlike QM, hence, not only Fractal mechanics (FM) details the skeleton of $\{\varnothing\}$, it maps $\{\varnothing\}$'s evolution. (vi) The wave function $\{\varnothing\}$ self-assembles following ordered factor metric or prime number symmetry in the number system, i.e., there is a universal frequency chain or resonance chain that governs self-assembly. (vii) Bra-ket algebra does not work here, continued fraction algebra that processes infinite series in the finite domain is applicable, the mathematical operator Ж works here, we would detail this operator in the Chapter, a bit later. (viii) The wave function $\{\varnothing\}$ is a multinion tensor follows an unique multinion algebra, but normally we think tensor means a spatial direction, here it is a temporal direction, imagine 11D orientation of clocks in a manifold. (ix) The wave function $\{\varnothing\}$ is mass and length independent, no distinction, hence, it can hold infinite mass or length to the smallest mass or distance possible. Thus, the observer decides the magnitudes of the observed. (x) The wave function $\{\varnothing\}$ holds information as geometric distribution of frequencies in the time crystal.
4. **Zero-point energy and minima of QHO does not arise:** Quantum field theory (QFT) suggests that every point in a vacuum is quantum harmonic oscillator (QHO), so every point has finite energy, providing zero-point energy. For fractal mechanics (FM), every point is a fractal harmonic oscillator, due to fractal nature there is no limit, and minimum energy for FM is determined by observer unlike QM or QFT. If we resolve the energy minima, we get something else, a composition of time crystals within. As a result as ***empty space is an infinite volume fractal, mathematically undefined and is truly a superposition of fluctuating oscillator network***.
5. **Ten basic principles of Fractal mechanics (FM) are:** (a) ***Quantum superposition*** is simple addition of wave functions, $\psi = c1\psi 1 + c2\psi 2 + ...$ however in fractal mechanics (FM) there is no addition or subtraction or division or multiplication. Those are the entities of sequential world. All wave functions that

superimpose are connected by nested cycles, its projection, $f(z)$ = Sum $f(zi)$, which is regulated by multinion algebra and Ж operator, product is not sum of wave function. Superposition is different at different location of the nested cycle structure, or time crystal. (b) ***Entanglement*** in QM is a definite operation, if one entity is changed the other entangled entity changes to a given state. For FM, two entangled objects are part of a single cycle or multiple cycles. Therefore, the output of measurement could deliver more than one values at a time, and or as a function of time, not just one. (c) ***The elementary composition of an observer has defined*** QM observer's treatment has a long history of algebraic, contextuality, etc., it is debated, FM does deconstruct observer with strictly defined rules. (d) **Measurement** in QM gives a probability distribution of values, in FM a measurement gives a time crystal, ψ is always an output of a measurement which is observer and environment-dependent. The ψ does not exist without measurement, since there is no projection, a projection from infinity is required for the existence. (e) **The measurement complexity:** In FM ψ is $\{\varnothing\}$, a time crystal, looks different from a different direction. For a single observer, a 3D measurement around ψ creates a time crystal architecture of measurement this is the projected matrix. Since two identical observers observing the same ψ simultaneously cannot occupy the same position hence would measure different parts of the observed entity, or fractional part of a time crystal. The output cannot be taken from one sphere of a time crystal because two observers will influence each other, hence a new combined time crystal needs to be created. (f) **Variable system points:** Since variable system points are included in the nested cycles, how many system points need to be considered depends on the observer's nested cycle too ($D2<<D1$, as explained above). (g) **Fractal harmonic oscillator:** unlike QM where the quantum harmonic oscillator is used, the fractal harmonic oscillator is not singular entity. Here an oscillator is made of another kind of oscillator inside and is itself a guest inside a host oscillator above. (h) **Twelve, instead of one imaginary world:** In QM, the state of a system is undefined, its burst on a circle perimeter of a sphere or time crystal. In FM, multiple imaginary axes orthogonal to each other builds 11D architecture of ψ. (i) **Infinite resolution is achieved comprehensively:** QM can have a fractal clock in one imaginary world, even in 11D dynamics. Here, in FM the wave functions have infinite resolution that cascades through 11 imaginary worlds one inside another. (j) **Treating mass and space separately:** In QM, mass is a matter wave, similar to a wave function but still mass is used in the Schrödinger equation as a distinct entity. ***Fractal space-time tried to resolve this configuration by considering mass = a 12 clock based nested rhythm or time crystal with a particular topology***. Since FM considers time as a singular variable in its metric, space to be replaced by phase governing evolution of time, here ***mass = unresolved nested cycles made of frequencies when an observer interacts with a high density nested cycles***. Thus, FM's version of Schrödinger's equation could have a time crystal for mass. Entanglement, duality and superposition are peculiarities of three nested imaginary worlds in FM. ***Entanglement primarily originates in the imaginary world above, the wave–particle duality comes from the world present and within, Superposition originates in the imaginary world below, and collapse does not occur,*** there is no reduction, only one event happens, that is synchronization and de-synchronization of nested time cycles between the three imaginary worlds.

6. **Time-based dimensional analysis unravels a unique physical picture: What is space? What is mass? What is the time?:** In FM it is considered $M = L = T$, mass = length = time = phase, all three parameters are represented as time crystal, distinct architecture of phase. All parameters in the universe should have dimensions, related to, phase alone, if one converts to time then $1/T^4$, $1/T^3$, $1/T^2$, $1/T$, 1, T, T^2, T^3, T^4…. Since mass and length or space are nested time cycles, hence, every single fundamental constant and all parameters turn to the power of T or phase. The power of time dimension determines the weight of a parameter, Plank's constant is T^2, velocity is 0, etc., the infinite series is converted into nested cycles. It is interesting because from a time cycle, we can get $2\pi R = h$ (h = Plank's constant), h should be the smallest distance, and a series of existing scientific dimension now gets a geometric perspective.
7. **Equivalence principle changes fundamentally: now all parameters and fundamental constants turn geometric:** Time is a cyclic motion of phase. The unresolved energy packet with the simultaneous coexistence of all points on the loop perimeter, when an observer resolves the energy packet it detects the change in phase or time. Stereographic projection of the imaginary planes deliver several fundamental constants. The simultaneous phase change decreases to velocity c when two cycles assemble one perpendicular to another making a sphere, as π decreases due to a nonlinear surface (then we get $\pi = C$, the velocity of light). Note that the value of π is changed on a Euclidean surface (π increases due to nonlinearity then we get $2\pi \sim h$, G, Avogadro). Josephson constant $\sim 3/2\pi$; $Mu \sim 4\pi$; $F(\text{faraday, or electron mass}) \sim 3\pi$, $Vk = 8\pi$ (von Klitzing constant), $\pi/2 \sim e$ (an electronic charge, atomic mass constant), $\pi/4 = \text{Cosmological constant}$ (dimension $1/L^2$, for the fractal information processing $1/T^2$, =energy density of vacuum). ***It seems all fundamental constants originate from e, π, and ϕ (Golden ratio) due to the non-linear surface or Euclidian geometry, they***

change due to the topological constraints of different embedded imaginary worlds (we neglect the order or power). The hyperbolic surface has $\pi > 3.14$ and the spherical surface has $\pi < 3.14$; there are multiple geometric spaces across the imaginary manifolds of 11D on which the physical constants get created. On a sphere, some sets of from e, π, and ϕ values are stereographically projected on a hyperbolic surface. ***Hence, the geometric shape that nested cycles want to create is not just a sphere rather a 3D dual conical shape, sometimes it's a sphere and sometimes it's a hyperboloid. Why π values form manifold/fraction in an integral way, who quantizes the constants?*** The answer is the number of loops allowed in the ordered factor metric. There is no space, a nested time cycle has upper and lower detection resolution, the lower resolution creates the boundary of a particle and beyond the upper resolution it's an open space. Mass comes from the transition of elliptic to ellipsoid cavity resonator rhythms, nested cycle rotation is felt like gravity, so there is no need to consider a separate mass, a typical 12 clock structure based time crystal is sufficient to represent mass. Momentum is a property that varies with the square of the time-lapse in a system, it means a time crystal is sufficient to represent momentum. The Kinetic, Potential and total energy is simply "time." In QM an operator executes a defined transformation, gives the expectation values, in FM we have a protocol. The observer's time cycle continuously checks the tape's cells and integrates, disintegrates (clocking together or in an isolated manner) the nested time cycle and that is synced with the observer. This continues time and again to deliver different physical parameters that govern a system.

8. **Implications of the fractal clock: Fusion of special relativity, general relativity and Quantum mechanics: The fusion is not new, it has been realized with fractal clocks for over a decade now:** G. N. Ord, Laurent Nottale, and M. L. Naschie are a few among recent proponents of fractal time. The strongest and direct argument for such a fractal clock universe has been put forth by Ord (1983, 2011, 2012). Already G. N. Ord showed in a fractal clock system special relativity emerges at different continuum limit. Since FM takes out the mass from the equations, it is possible to estimate the laws of gravitation from the nested cycles simply by using the ordered factor metric (teardrop to ellipsoid transition in ordered factor metric delivers the laws of gravitation) one might connect both quantum mechanics and the general theory of relativity. There is no velocity, no distance, only phase that we have to change in the time cycle, not in the distance parameter to generate cause-effect. Since distance does not exist in reality, it is a particular topological feature of a time crystal, the extreme velocity c and entanglement induced collapse are not contradictory. No one measures velocity, actually measures "relative clock diameters," and entanglement for the fractal clock as explained earlier is all about creating two complementary guest nested cycles in a single host cycle of a much longer time scale.
9. **Fractal Interference and transition to classical mechanics and beyond FM:** With the fractal harmonic oscillator the interference images appear a bit different. We have generated wide ranges of interference patterns for the fractal interference in microtubule and Sahu et al. study suggests that if a part of the pattern is zoomed then a new pattern appears.
10. **Ripple effects in the information science due to three imaginary worlds: Uncertainty principle:** The uncertainty principle that is frequently used as a certainty limit, even school textbooks give problems where one finds "time" from "energy" and momentum from the position is not a logical approach. Fractal information estimates the uncertainty from detailed time cycle maps between the observer and the observed, i.e., cells of the fractal tape map each other.

4.2.1 Multilevel Geometric Architecture of the Hilbert Space

A Bloch sphere with multiple singularity points: Bloch sphere (Poincaré sphere in optics) is a geometrical representation of a 2-level quantum system, this concept was introduced in 1946 (Bloch, 1946); since then, several attempts were made to modify it. One critical problem is the generalization of the Bloch sphere to include n level quantum mechanical system (Kimura, 2003). The surface of the Bloch sphere is made of pure states, $|\psi\rangle = \cos\theta|0\rangle + ei\phi\sin\theta|1\rangle$ with $-\pi 2 \le \theta < \pi 2, 0 \le \phi < 2\pi$ is also called Hilbert space. In order to increase the number of classical poles n ($n \ge 2$, $SU(n)$ Lie group) on the surface (a transition from Qubit to Qudit), the Bloch vector (or coherence vector) does not trace a spherical surface. This is very difficult to imagine, so we built an analogy. When we have two classical poles A and B, if one puts a torchlight at pole A pointing to the other pole B, the projection on the back of the pole would be a circle, and vice versa. However, when, there are three poles (Qutrit, $SU(3)$), we can do a darkroom experiment shining light to the center of a glass sphere from three points on its surface. Depending on the locations of three lights, the central region of the sphere would lit brightly, so much so that at certain locations, we might not see the origin of all light sources on the surface of the sphere (Goyal et al., 2011). Instead of three, if one detects only two light sources, then it is stated that there are only two pure states, the rest are mixed states. High-density light patterns would change dramatically inside the sphere as a function of the number of light sources and their location. The 3D pattern of bright light domain maps the complicated topology of coherent vector or Bloch vector, located much inside the Bloch sphere, a part of the map depicts separated states and the rest part depicts entangled states (Jakobczyk and Siennicki, 2001). At $n = 8(SU(8), E7)$, the coefficients of wave vectors distribute such that a fraction of total topology remains entangled, the rest turns separable, it is effectively a classical system (de Wit and Nicolai, 1982).

Vibrating clock: Why should the Bloch sphere expand and shrink? Geometric algebra addressing the Euclidean vector space often maps the logic gate operation. It requires a specific rotation across the trajectories on the topological space inside the fully deformed Bloch sphere (Havel and Doran, 2004). As the number of classical state n increases, the folds in the topology of Bloch sphere complicates. One such example is Hopf bifurcation in two Qubit system (Mosseri and Dandoloff, 2001), accessing the desired coherent vector during a measurement becomes critical. It is not possible to use the Bloch sphere as a structural unit in FM due to singularity. In the fractal mechanics the singularity points were embedded on the Bloch sphere and triggered in a loop to activate self-assembly of many information units (Figure 4.2a). The number of layers through the singularity point equals the level of the operational imaginary worlds. The loop is around the great circle, hence, the solid angle created by singularity points hold the geometric phase (Pancharatnam, 1956) while the topologically closed-loop tracks the dynamic phase of the quantum system. If Phase spheres (FM variant of Bloch sphere) are self-operating, it has to expand and shrink, so that the trajectories crossover, the geometric phase paths create a suitable network. In Figure 4.2a we have outlined two types of Phase spheres, one that changes its surface area to modulate the infinity, since projection from infinity is our key. The second is the counter Phase sphere with an indefinite diameter, or multiple diameters coexist. When diameter changes, it means, a change in the surface area, a single sphere coexists in three shapes means three imaginary worlds are processing similar geometric information. The concept of fusing dynamic and geometric phase in a solid cone is adopted from neutron interferometry results of A. G. Wagh and Rakhecha (1990). As n increases from 1 to 8, the number of singularity points also turns eight, increasing n further for useful topology is useless, and literature is rich in mapping such critical folds inside the Phase sphere. Total dynamic phase for $SU(8)$ would be $\exp\left(-i\sigma_n\alpha_n/2\right) \times \ldots \times \exp\left(-i\sigma_n\alpha_n/2\right) \exp\left(-i\sigma_n\alpha_n/2\right) = e^{i\varnothing}$, similarly we can extrapolate it for dodecanion, icosanion with a twist, there would be three such equations coexisting

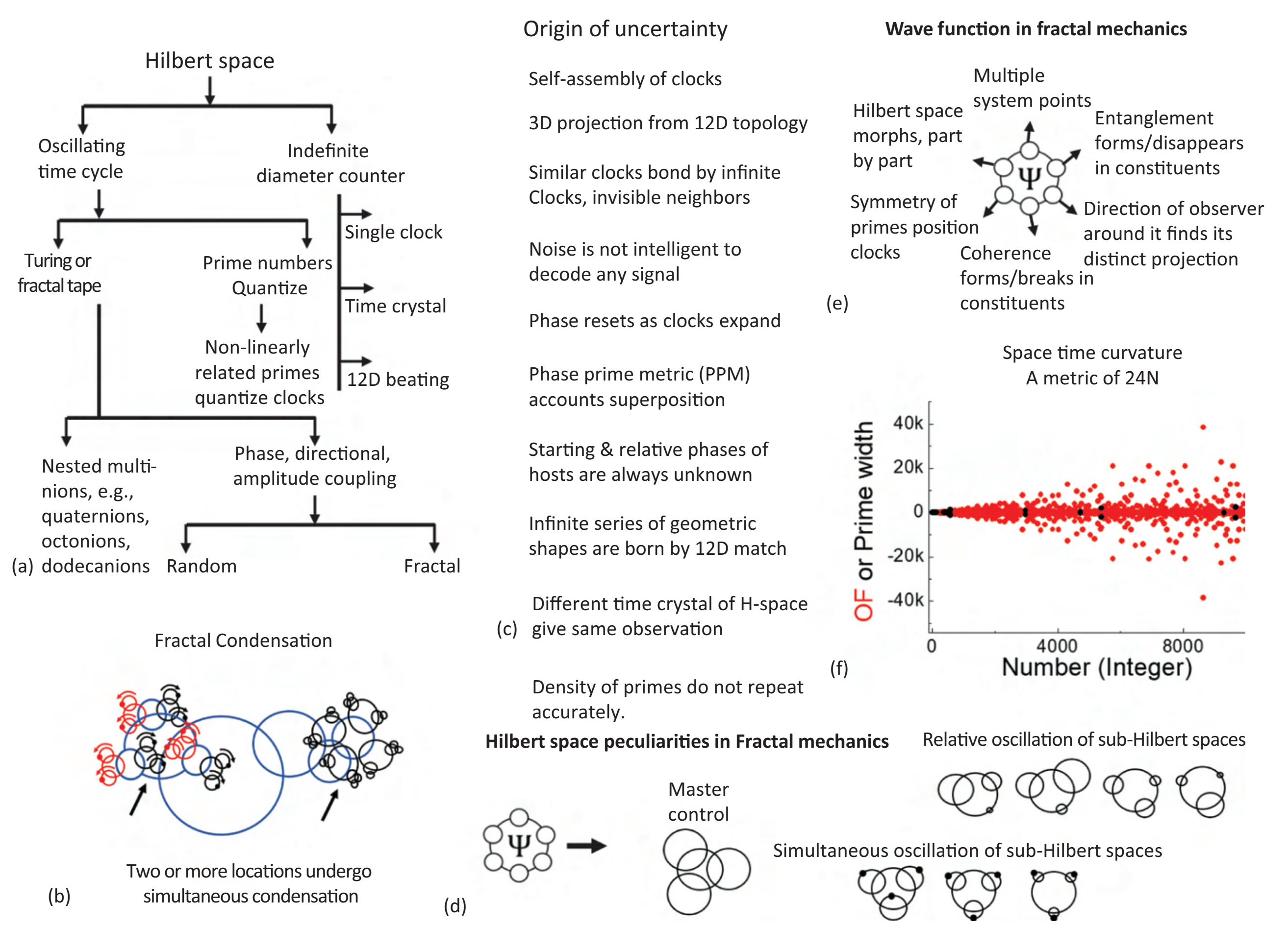


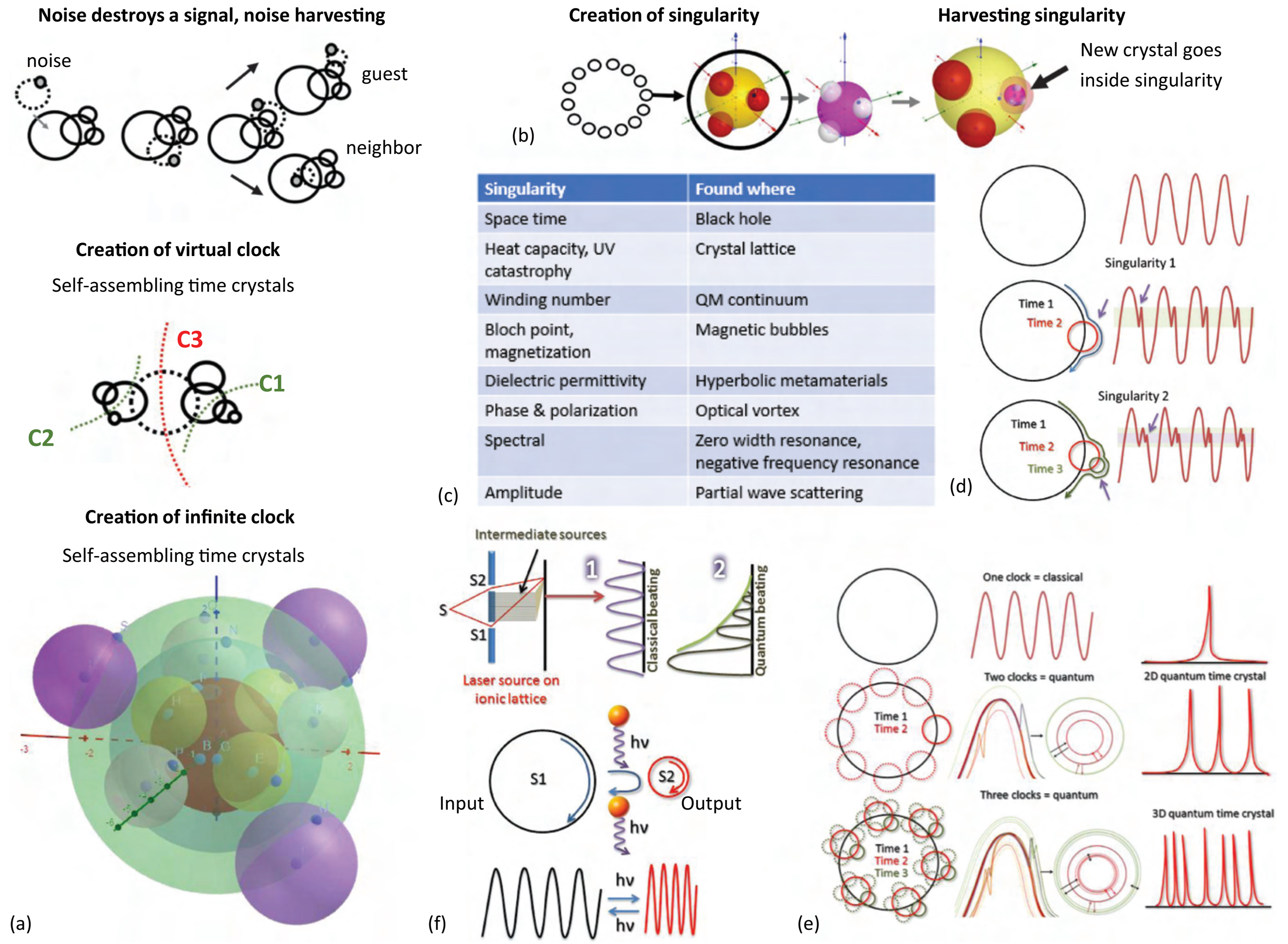
FIGURE 4.2 (a) Different classes of Hilbert space to be found in the fractal mechanics. (b) Condensation in fractal mechanics happens in different imaginary worlds at a time. (c) A list of geometric fluctuations that naturally causes uncertainties in the system that operates using the geometry of clocks. (d) Three incredible features of the Hilbert space when mechanics are driven by geometry of clocks. (e) Comparative wave functions in fractal mechanics and in the quantum mechanics. (f) Space-time curvature of quantum mechanics is replaced by a metric of symmetries that maps the symmetry breaking possibilities as a function of available choices (integer).

simultaneously. To engineer singularity, the diameter of the clocks should vibrate along with the rotation of the system point.

Bypassing the complex manifolds and adopting the pattern of primes: As said above, when classical point increases on a Phase sphere, the surface gets folded in a complex manner. So, an assembly of spheres reduce the complexity, adds manifold controls which were otherwise not possible to encode. The replacement of a complex architecture using a group of small spheres (thanks to singularity points) paves the way to implement the pattern of primes. Now we suggest a point that absorbs light, say, like a black hole, neutralizing the complex folds in topology. One could edit electron spin by shining light, i.e., geometric phase could be precisely chosen by driving photons in multiple cycles (Kim et al., 2010) and Cn coefficients that map the topology. The center of Bloch sphere makes a phase with the topological path between two singularity points, a set of such angles completing the loop represents the geometric shape made of singularity points. Thus, the geometric phase that could be used to run a clock (Badurek et al., 1986) is interpreted as a measurement of time. Quantifying time as geometric phase (Wagh and Rakhecha, 1990), store memory and even decision-making, the solid angular projection through the geometric phase loop from the center of Bloch sphere is the basis of replacing curvature on Bloch sphere with another small sphere. Let us put it in another language. Inserting a time cycle or time ring using an additional sphere, holding the geometric information would be compensating the topological deformation. It would increase the probability of accessing the separable and entangled states would make computing more feasible. Geometric phase is an integral part of the Bloch sphere or Phase sphere. However, for quantum computing one needs to switch On and off the motion of geometric phase through its trajectory. For PPM-GML-H triad computing that we are exploring in this book, several system points holding different local clusters of the geometric phases, covering a wide range of imaginary worlds (from 1 to 12, it could be anything), carry out complex tasks. First, new paths condense at various local regions of the unified time crystal representing the entire information content (Figure 4.2b). These independent local regions contribute to ten different ways to create uncertainty (Figure 4.2c). The wave function, a clock-structure representation of matter, would have a complex geometric architecture, it would be a time crystal as shown in Figure 4.2d. A simple wave function, which was otherwise thought to be a single, mysterious wave-like entity following Schrödinger's equation, would now be complex life-like object performing PPM (Figure 4.2e). For quantum, Bloch spheres infinite solutions are called Hilbert space. For FM, the Hilbert space analog is fundamentally different. Two fundamental processes govern the relative oscillations of the sub-Hilbert spaces. Either they follow a periodic expansion and contraction; or, all sub-Hilbert spaces would expand and shrink together like one unit (Figure 4.2d, right). The simultaneous dual-mode is fundamental to find symmetry in a complex ordered factor metric. Superposition of OF-metric and PG-metric as described in Figure 3.16 is superimposed in Figure 4.2f, to show how the prime gaps are located in the key locations on the OF metric. Doing mathematics is not easy for a wave function following Fractal Mechanics, formulation needs noise, to explore all possible choices of clock-geometric path and a noise assists in finding the right choice (Figure 4.3a).

The ultimate engineering of Singularity: an experimental perspective: Whenever a fractal wave function described above is less than the pixel size (the longest clock is less than the host, but the host-guest geometry matches), the guest goes to the imaginary world and a singularity point is created (Figure 4.3b). Singularities are everywhere in nature, depending on the type of singularity, and the system the architecture of wave function changes, it may be a quantum or classical but it has an additional feature of exploring the engineering of multiple worlds (Figure 4.3c). We do not carry out proper experiments to see them. One possible experimental path is fractal interference using polarized light as shown in Figure 4.3d–f. Singularity is a time lost in the flipping direction of spin if we cook a spin-based quantum system, but this particular physical significance is an extremely useful tool. One can insert a complete-time loop or a clock inside a singularity (Kim et al., 2010) as shown in Figure 4.3d. Unfortunately, the power of drawing geometry on a Bloch sphere was never harnessed, though very recently, its potential is getting recognized (Oh et al., 2016). The singularity points are not actually a point, rather, it is a sphere (diameter is set by Rabi Frequency damping, i.e., flipping time for the quantum state) represented by a function that is non-holonomic, but switches to a holonomic one as soon as it acquires another time ring of singularities along its closed-loop trajectory. See the generalized version in Figure 4.3d. Essentially we get, $\theta_{TotalN} = \theta_{Geo(N-1)} + \theta_{Dyn(N-1)}$ and $\theta_{Dyn(N-1)} = \theta_{Geo(N-2)} + \theta_{Dyn(N-2)}$, if the replacement continues, $N \to \infty$, we get pure geometric phase regulating the system. In case pure geometric phase regulates the entire system we get a quantum time crystal and the output differs between a classical and a quantum experiment (Figure 4.3d, e). Eliminating the dynamic phase to create a pure geometric phase is not new, and the most remarkable advantage is "passage of vibration to the higher level" (Far off-resonant trap or FORT; Joshi and Xiao, 2006). Joshi et al. beautiful description of bypassing the core shells ionic vibration to the outer optical cavity nicely fits with Reddy et al. self-similar or fractal network. The wave function of the system is $\psi_{\text{system}} = \prod_n e^{-i\theta_n}$, apparently unitary feature is broken, but if we do numerical simulation relative intensity of the signal is $\text{Sin}\, n\pi/n$, which would be a binary stream of pulses in an experiment like the one shown in Figure 4.3f. When we consider the geometric phase, it is independent of the parameters that govern the path of the projective Hilbert space, thus, it is independent of the speed.

Why was it essential to introduce a singularity domain and reject any form of classicality from the Bloch sphere: We need the undefined singularity points and not classical that could be stated with an argument. Because (i) we wanted to use multiple clocks one inside another at various layers,



Singularity	Found where
Space time	Black hole
Heat capacity, UV catastrophy	Crystal lattice
Winding number	QM continuum
Bloch point, magnetization	Magnetic bubbles
Dielectric permittivity	Hyperbolic metamaterials
Phase & polarization	Optical vortex
Spectral	Zero width resonance, negative frequency resonance
Amplitude	Partial wave scattering

FIGURE 4.3 (a) Three panels depicting three basic features of fractal mechanics. Top panel shows how noise is harvested by absorbing its time crystal. The central panel shows how does the symmetry of the 3D arrangement of clocks determine which one to self-assemble and how. The bottom panel shows unique self-assembly of clocks, within and above. (b) A single pixel of a clock holds a 3D geometry of clocks. (c) A table of different sources of singularity. (d) Three rows show three types of nesting of clocks in classical mechanics. A circle represents a clock, a wave. In three rows, the number of clocks increases one by one that increases the ripples in the waveform. (e) Plots for panel d is repeated in the panel e, but for quantum mechanics. Guest clocks position is uncertain but time is certain so we expect three peaks for a guest. (f) A quantum interferometer showing the interference (1) and quantum beating (2).

to model Sahu et al. experimental finding of nested clocks in the protein complexes. (ii) Creating a fusion of adiabatic (clock inside singularity) and non-adiabatic system (clocks reside side by side) is essential to build a generic model where a sub-system retains virtual isolation from the environment. (iii) A burst from singularity could be a classical event born out of an undefined function, thus, making classicality an emergent phenomenon from the undefined world. (iv) We get a virtual spin or directionality, no real direction; even the direction would remain undefined. Guest Bloch spheres inside a host Bloch sphere could adopt a composition of various rotational directions, thus, the rotation of the host would always remain undefined. (v) When a Bloch sphere is defined in Quantum, a classical certainty is already included in its poles. Diminishing an essential form of classicality or certainty of the Bloch sphere in the form of 0 and 1 (poles) is required to make a version of Quantum that is purely uncertain. (vi) Singularity enables escape time fractal to be introduced, fractal clocks bring an imaginary time (fractal uses iota just like Quantum), and so we do not have to introduce imaginary space-time unexpectedly as we do it in the conventional Quantum mathematics. We could derive the emergence of the imaginary term from a special type of fractal nature in the information structure. (vii) When we introduce singularity entire Bloch sphere, and its self-assembled architecture becomes undefined. Therefore, it is not a Turing machine anymore, it represents the fractal tape that we proposed to replace "machine." (viii) When the entire system becomes a singularity, at a time, at any given part of the system, the available information is finite. Thus, unlike Quantum's Hilbert space, we get a finite projection. Singularity therefore serves as a route to reject "infinity" and "probability" in a single shot, as "infinity" gives inroads to the "probability" and "perturbation." (ix) Uncertainty of Quantum has been a mystery, and demystification was essential, an absolute singularity at all scales, everywhere in the system enables generating uncertainty in a logical way in any system (see ten different ways of generating uncertainty). (x) Geometry has a classical nature; corners are a certainty, which ensures incorporation of classical from the backdoor. Nested singularity enables varying the surface on which the geometric shape is drawn, so, the triangle is a certainty, but not the sides or its angles.

Conversion of a fractal Bloch sphere into a Quantum Bloch sphere and a classical state: The fractal Bloch sphere turns to a quantum Bloch sphere when the observer's resolution is less, so it sees the guest singularity spheres on the host Bloch sphere as the discrete single points (classical). Consequently, the clock line connecting the singularity points into a single loop disappears. If there is only a pair of singularity points on the great circle, then it's a Qubit (0 and 1). Even for more than two singularity points, since, the singularity domains turn to a point (Qudit), no geometric information exists. A fractal Bloch sphere, is itself a singularity sphere, when the entire Bloch sphere converts to a single point, it is classical. The disappearance of singularity leads to a classical or a defined state. The loop connecting the singularity points is not fixed, it connects two rotating system points of loops located in the neighboring singularity domains.

4.2.2 Fractal Harmonic Oscillator, Fractal Condensation, and Peculiarities

The maximum number of states a quantum system can process? A quantum rhythm and quantum time crystal: In a quantum system, the notion of distinct states is very well defined, two states are distinct if they are orthogonal. It has been shown mathematically that a quantum system with an average energy E could be made to oscillate between two orthogonal states with a frequency $4E/h$. Thus, even in the quantum scale we can get rhythm (Margolus and Levitin, 1998). It has also been noted that for very long evolutions that form a closed cycle, the maximum transition rate between orthogonal states is only half as great as it is for an oscillation between two states. A quantum system can run through a long sequence of mutually orthogonal states for a maximum time $\tau = N-1/N\left(h/2E\right)$. Interestingly, this is not only true for the quantum system, for any harmonic oscillator, it means even for the kind of time crystal, argued here, but the limits are also valid. One can run through a long sequence of nearly orthogonal states at a rate $Emax/h$ or $2E/h$, where E is the average energy of the microscopic system under interaction.

Morphogenesis of information in a time crystal is multi-layered or fractal condensation: Time crystals arriving through the sensors eventually fall on a resonance chain that operates following the guidance of a PPM. The resonance chain morphs the seed geometric shape in the time crystal that emulates an event happening in nature. The morphogenesis of events happens at every spatial and temporal scale, in the real human brain and in its analog brain jelly. Mimicking the frequency space of a 3D time crystal into a real physical structure or morphogenesis is amazing in the sense that communicating proteins or fourth-circuit elements H (Chapter 8) would undergo simultaneous changes only at those parts where minor changes would edit only a few clocks of the time crystal. Communication means an exchange of local parts of a time crystal. If one images the shape of those two proteins or H, apparently both would be silent as if there is no physical movement. If we could enter inside the structure, then we would find some other structures are changing quite fast. If we could take one, and enter inside, we would find a large number of extremely fast shape-changing materials. The journey reveals that two proteins or H devices exchange very little energy only where the changes should be made. In the Turing paradigm, one has to carry entire information content, not here. During the exchange, mismatched clocks are written, this is not new writing, many clocks are not linked, remain free in the hardware of a resonance chain. They condense to build a new clock. Therefore, the condensation of carriers in shape-changing material is a part of the information exchange.

Experimental evidence required to establish that fractal mechanics (FM), a generic form of quantum mechanics does really exist

1. **Fractal fringes:** If a system follows fractal mechanics (FM), then one could zoom any part of the quantum interference pattern, to discover that there are hidden fringes. QM has no such provision.
2. **Fractal Feynman diagram: superposition of multiple interference patterns:** If a system follows fractal mechanics (FM), then electromagnetic frequencies would be able to track the fractal gaps in the Feynman diagram and we would get multiple interference patterns for multiple resonance frequencies. QM does not allow many imaginary worlds to interact and generate superposition of superposed wave functions.
3. **Fractal condensation:** Condensation of the vibrational modes in Raman spectrum at the room temperature, one could see live the vibrations collapse at various frequencies so that peaks merge. It is simultaneous Frölich condensations at multiple singularities; singularity inside a singularity is a trademark of FM and does not exist in QM.
4. **Fractal coherence leads to the quartet:** When two spins are entangled, it means one wave function, both particles are actually one in reality and that is equal to a nested three time cycles. Therefore, a mother photon can produce a child, a granddaughter and a great-granddaughter, but the granddaughter's child will not be born (above quartet not possible), a single photon cannot produce infinite progeny in FM, there is no such restriction in QM.

5. **Multiple clock entanglement: Entanglement without an identical point of origin:** Until now, it is believed in QM that entanglement happens only with photons from the same origin, i.e., among mirror photons, however if FM exists, then it can happen for photons from other sources too. Thus, suitably generated photons from different sources if entangles and generates interference then it would establish the existence of FM.
6. **Superposition is a function of time:** Time cycles join and disjoin spontaneously, thus, in a suitably designed fractal tape system, entanglement will be a function of time. With a suitably designed time resolution set up, an entanglement would appear and disappear, as one switch to a different time domain. Such a feature is feasible in FM, prohibited in QM.
7. **Quadrupolar moment changes as a function of time:** One essential outcome of converting all parameters, mass, length to nested time cycles in FM is that, all higher-order moments change as a function of time. It is observed in the frequency-time-intensity 3D spectrum during energy transmission between two objects. QM does not allow this.
8. **Frequency wheels of primes determine the system's nesting:** Every fractal tape system has its own frequency wheels of primes. QM has no provisions for nesting of waves.
9. **Fundamental constants emerge as infinite series like *e*, *π*, and *φ*:** The triangular geometric musical formulation of number system fractals generate all other fundamental constants as a single time cycle and several time cycles inside. QM is not geometric like FM, the fundamental nature inside of a wave-function is beyond the limit of QM.
10. **Live "beating" communication of three imaginary worlds:** One could experimentally verify three imaginary time worlds simply by experimenting on a nested quantum system like protein, which has three layers of quantum systems embedded. Such a nested QM would exhibit classical, Quantum and fractal beating simultaneously.

4.2.3 Harvesting Noise by Harvesting Singularity—PPM Replaces Statistical Mechanics

Space-time and path: From any given point in a spatial crystal, by moving toward any direction, one would get different kinds of the arrangement of atoms. By rotating 360°, one should find at least two distinct spatial symmetries. One cannot imagine a space in a set of time intervals, as one cannot state a "direction." If the phase oscillates one full swing 360°, it is equivalent to the concept of all directions in a spatial crystal. On the circular 360° path, if at least once the cycle hosts another small loop that shifts the rate of phase change, then one gets two time symmetries. A system point moving along the phase cycle perimeter would experience two different rates of time flow (Ord, 2012; Girelli et al., 2009). The large phase cycle which constitutes a "time" is called the host time cycle and on its path the local phase cycle is called guest time cycle. The guest-host phase assembly is called a time crystal (Winfree, 1977). Phase-shift is fundamental to both space and time, and it is abundant in nature (Chandrashekaran, 1974). Therefore, information structure, if it is a 3D phase sphere, could represent all existing physical parameters comprehensively.

Old schools of statistics to the statistics of primes: Events are not random, one can predict events with 99.99% accuracy: Maxwell Boltzmann (MB) statistics is applicable to identical, distinguishable classical particles with Non-quantized energy, with any type spin (gas molecules). **Bose-Einstein (BE)** statistics are applicable to the identical, *indistinguishable* particles of zero or integral spin (bosons, photon, He atom etc.), where any number of particles can occupy any level. **Fermi Dirac (FD)** statistics is applicable to the identical, indistinguishable particles of half-integral spin (Wu and Cai, 1999). Since only one particle can occupy any particular level, these particles obey **Pauli Exclusion** Principle (electron, proton, etc.). Imagine we have a network of cells, where a finite number of indistinguishable and distinguishable events are diffusing like particles, colliding randomly. Unlike spin half or integral spin or anyon, here, the repeating events with a particular symmetry are indistinguishable. As the symmetry breaks and a new symmetry starts contributing to the unfolding of the events, then the events are distinguishable. Conditional distinguishability was not part of FD, BE, MB, or anyon statistics. PPM is a 3D architecture where the symmetry of primes is mapped over the integer space. We define the event as clocking topology, it means we account for the symmetry of a repeating event and map the symmetry relation of the constituent events. Therefore, PPM is a grammar book, if the events change, how would it follow.

Statistical entropy is perpetually clocking: a matrix of past-present-future: At certain conditions, a physical system is bound to transit arbitrarily close to the initial state, even one with very low entropy (Poincare's recurrence theorem; Poincaré, 1890). Zermelo (1896) argued that the Poincaré recurrence theorem shows statistical entropy in a closed system must eventually be a periodic function; therefore, the mechanism to increase entropy, is unlikely to be statistical. At any moment we consider, entropy was more in the past, will be more in the future, no one answered why it is low now. Boltzman said, isolated systems are always at maximum entropy, but suddenly it switches to very low entropy, traps in a local minimum, so, both the time directions from the bottom now, go upwards. In other words, we take it for granted that the influences in the other direction, the minute influences that a system inevitably exerts on its environment, do not "go at haphazard." Demarcation of past present and future is a function of the architecture of the time, preferably a time crystal built using a PPM. The direction of time and entropy is not objective but an appearance, a product of neighboring clocks direction, a vector product.

The entropy of a series of clock outputs from a biological system $E = -(\ln T_{max})^{-1} \sum_{t=1}^{T_{max}} P(t) \ln P(t)$. The entropy is known as Recurrence period density entropy (RPDE) and used to find the degree of symmetry in a composition of deterministic and stochastic signals (Marwan et al., 2007).

The weakness of statistical methods: Principle of independence of incoming influences, PI^3: Time asymmetry does not emerge in statistical entropy. Using two criteria, it is assumed that even before the derivations of statistical principles. First, the output products of collisions are correlated with one another, even if they will never encounter in the future. Second, the incoming components of a collision are correlated, if they have never encountered in the past. Two assumptions make sure that the previous collisions will induce correlations between the participants in future collisions. The problem with statistics is that (i) every single entity and event is equally probable, (ii) an entity that participates in defining statistics is non-deductive, (iii) there is no emergent property for a given entity, (iv) environment and boundary properties are imaginary tools of humans like hidden layers in a deep learning network, (v) no distinction between past and future of an entity is considered, it involves only counting, the past is merely the mirror image of the future. In fact, "that previous collisions induce correlations between the participants in future collisions" (Zeh, 1989, 1992). Memory has no accountability, the past is an illusion (von Weizsacker, 1939)! (vi) The universe is made of fractal branches of systems one inside another, the direction of time should be in harmony and that communication of time is not understood (Sklar, 1992). Extreme parallelism and diversity of directions have no internal mechanism. (vii) All kinds of fundamental waves radiate outward, not inward in nature. No inward means no mechanism to set direction. Even if there is an unknown inward wave, radiating to the past and then the past contributing to the future to direct time and entropy in a particular direction (Wheeler Feynman absorber theory) is not possible because absorption is an irreversible process (Gleick, 1992). (viii) Quantum effect like "advance action" and "backward causation" defines the direction of time and entropy (Cramer, 1980). (ix) Two kinds of perturbation modes regulate the universe, one is clocking and the other static. Combination of various modes of perturbation expands and contracts phase and at both phases, the system grows, it defines the arrow of time and entropy only in one direction (Hawking, 1985, 1988, 1994). (x) Inhomogeneous anisotropic modes originate at the ground states itself (Halliwell, 1994), the path integral of the just born universe account for this confined, limited perturbation that keeps time and entropy to a minimum. Creatures living at that time and entropy followed that limit. A century-old effort to link life, time and symmetry are confined into two choices. Both are fatal. First, if we opt for low entropy choice, then we end up in Big Bang and Big crunch. Second, if we chose underlying physics of the universe is asymmetric in time, the symmetry of the physics laws that we are an illusion, then we need to find a missing link, a governing gene of codes running the universe (Penrose, 1979, 1989).

PPM-based temporal architecture as an alternative to statistical mechanics: Time asymmetry does not emerge in statistical entropy. Using, PPM, we map how prime symmetries interact, all possible compositions are mapped in this infinite 3D architectures. The advantages of this approach to constitute an alternative to statistical mechanics. (i) Time asymmetry in the universe is invisible until the architecture and intricate map of symmetry is understood, this is realized in PPM. (ii) The necessity of inward wave is satisfied by singularity points. Fourth-circuit element Hinductor is designed to produce vortex of light and knots of darkness at the same time, by harvesting singularity. (iii) Addition of a new symmetry in the metric increases or decreases the number of compositions. That changes the entropy. The universe is neither symmetric, nor asymmetric, it is an intricate map of symmetries, PPM. Since adding new symmetries enable a system to achieve 100% coverage of entire symmetric space and only 12 primes cover 99.99% symmetries, the entropy fluctuates in a non-repeating way. PPM pattern is infinite and never repeats. (iv) Future is the addition of symmetry, past is a subtraction of symmetry, and the present is clocking a single symmetry repeatedly. Evolution in the universe is making a journey from 0% to 100% symmetry structure of PPM by restructuring the system, repeatedly eon after eon, from the smallest to the largest. It is similar to the gold universe hypothesis, where at both ends the universe has minimum entropy (Gold, 1962, 1967). (v) PPM appears similar to Hawking's explanation where he argues that both at contraction and at expansion phase, the system grows in time and entropy (Hawking, 1985, 1988, 1994). There is a fundamental difference. In a PPM, it is an architecture of all possible symmetries, if we move toward zero or infinity, eventually, the system adds or subtracts symmetry. Therefore, quantum mechanics is confined within a local disc, a single plate in the infinite stack of discs in the 3D metric. The interaction between piles of discs create a beautiful surface gradient of the metric which describes a new mechanics, we named it fractal mechanics. Perturbation causes interference, which in turn generates singularities of various kinds. Fractal mechanics relies on engineering the singularity in a system. (vi) PPM does not have to ensure a low entropy of the big-bang or the growth of a conscious brain from a single zygote cell. It avoids two critical dilemmas. The infinite cycle of PPM, where we make a journey to cover the symmetry space 99.99999% by increasing the integer N to around 7.6 trillion, takes the final product and start recounting from 1 to 7.6 trillion again and again and again, we do not have any end anywhere. It is somewhat similar to Penrose's conformal cyclic universe where there is no end, but in his proposal, universe reaches to a finite topology which is retained as the remains for the next eon (Gurzadyan and Penrose, 2013). For PPM universe, at primes, entropy reaches minimum, even without a crunch, and follows a beautiful temple-like terrain, without a collapse, the system becomes a singularity point for the aeon above, because around 12 primes a system, say a universe or the brain cannot add a new dynamic to make a significant effect. (vii) A system is converted into a time crystal; constituent clocks rotate clockwise or anticlockwise. The architecture of time crystal's direction of time or direction of entropy is an irrelevant question. Depending on the set of clocks we chose, on the host Bloch sphere it is a local flow of time and entropy through the surface of the phase space. Sometimes, paths are closed (clocking) or even open. (viii) Penrose calculated that 1 of $10^{10^{123}}$ universes would have the right Big Bang. If PPM is considered, universes would be foolish to go beyond 7–8 trillion choices. If someone believes in parallel universes, currently at this moment there won't be more than 7–8 trillion of them. Around that number 100% symmetry saturation would be reached, and naturally a combination of 7–8 trillion universes would act like a single atom, but in that effort, would end up building a periodic table full of atoms. The second law of thermodynamics is a particular line drawn on a PPM's temple surface. (ix) PPM is an architecture which is primarily a superposition of 12–14 prime number related symmetries. That gives birth to Gauge invariance and several other conservation laws. (x) PPM's singularity engineering with GML breaks one old myth that anything emerges out of singularity should be random (Davies, 1974). That does not happen in a PPM universe, communication across the singularity points is the foundation of Fractal Information Theory, FIT and GML.

Lotus lotus everywhere, this could be a very nice caption of the nanobrain if we look at it from the entropy symmetry perspective. The entropy symmetry relationship of any system around us is a linear plot that we learn in the textbook. More is the number of distinct symmetries embedded in a system, more will be the disorder, and the degree of disorder is the entropy, so creating a mess increases the entropy of anything that is in perfect order. However, the picture changes completely when we think of a higher level of architecture. Say, we have a ten-storied building, and we are creating a mess in every single floor randomly, shall we plot entire mess up into one linear plot? Of course, we can do that if we are asked to provide an account of gross mess up, however, if every single floor has residents from different nations, different culture language habits, altogether the variation of the degree of the disorder will vary distinctly between the floors. Therefore, as soon as we are asked to provide a dynamic picture of the degree of the disorder instead of a static one, the entire game shifts to a different perspective.

4.2.4 What Is Energy in the Many Interacting Imaginary Worlds?

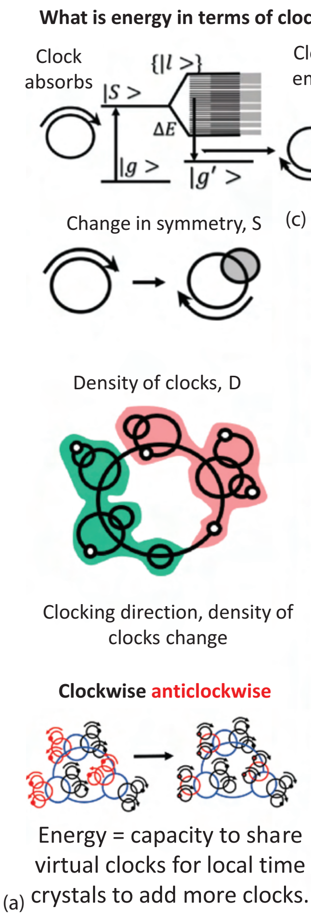
What would be the energy of the nested Hilbert spaces and how they would exchange energy: The energy in the classical and quantum world is a quantity that drives motion. Here in the universe of time crystals, a suitable analog of energy is an ability to add more clocks, just like molecular motors it is not about running but changing three parameters (Figure 4.4a). First, change in the symmetry, making a structure more and more asymmetric makes it hungry for adding new clocks and gaining symmetry. Second, the morphogenesis caused by changing the directions of the clocks. Even no clock is added or subtracted to a time crystal architecture, a change in the direction of rotation alone could generate an asymmetry. Finally, the third important parameter governing the density of clocks allowed in a host clock. No one ever tried to encode a geometric shape in a Bloch sphere, continuously. Since the addition of clock is made deep inside a singularity point, the shape of the singularity surface is not circular, it is determined by the geometry of clocks inside, which governs the critical parameter of energy burst from a singularity (Figure 4.4b). When a single time ring is played out, there is no logic gate, no reduction of choices, yet a decision will be made. When the energy is redefined, the correlation between the prime numbers governs the fractal mechanics and the differences between the classical, quantum and fractal mechanics explicitly reveal this feature (Figure 4.4c).

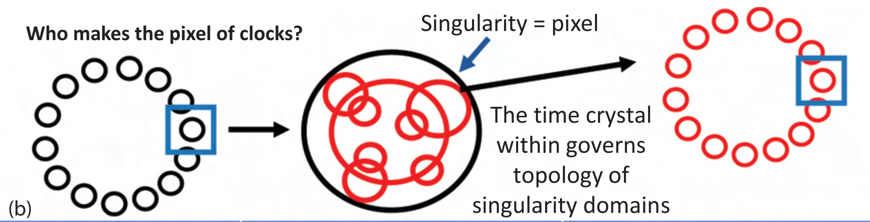
How entropy changes when universe is a linear chain of bits to the universe of singular assembly of clocks: In the language of the bits the entropy of the baby universe as big bang as deduced from the entropy of the present 2.735 K (uncertainty<0.05 K) microwave relict radiation totaled over a 3-sphere of radius 13.2×10^9 light-years (uncertainty <35%) or 1.25×10^{28} cm,

The number of

$$\begin{aligned}\text{bits} &= (\log 2e)\times(\text{number of nats})\\ &=(\log 2e)\times(\text{entropy/Boltzmann's constant, } k)\\ &=1.44\ldots x\left[(8\pi 4/45)(\text{radius}\cdot kT/\hbar c)3\right]=8\times 10^{88}\end{aligned}$$

When we switch to the PPM, the matters vibrate in a cyclic pattern to come to the same starting point, several such loops, while exchanging energy, a part of that energy is always neither found in any of the participating systems, we call it bond energy. It can happen at any scale. When a matter or system gets an energy packet, where does the energy go? It goes to the structural symmetry. The symmetry defining part always takes the energy to vibrate, so, replace every matter and simply consider the structural symmetry, now PPM is like a matrix of all symmetries of the universe. Every single system in the universe is a composition of multiple symmetries, each symmetry has characteristic vibrational frequencies and each object created in the universe has a personalized PPM. Among three particles, all or a can exchange energy and interact, see for example a new time crystal-based definition of mass (Figure 4.5a). If the exchange repeats periodically, then cyclic energy exchange arises and a periodic oscillation or rhythm is born, enriching its personalized PPM. In the universe or human brain the time crystal grows continuously following PPM and the number of symmetries, that change simultaneously edits the surface area of the time crystal, hence we see in real-time the change in entropy. Here the physical size of the universe does not matter, to find the boundary of the universe we do not need to carry out space travel, seed symmetry of a few galaxies would repeat, just like the symmetry of tubulin





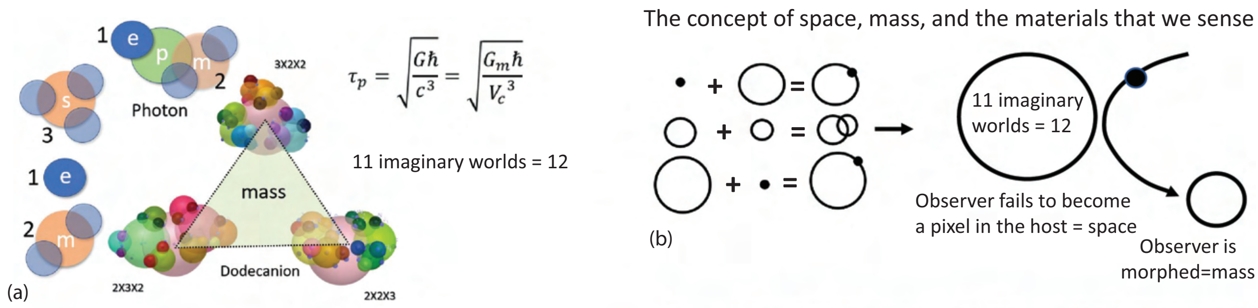
(c)

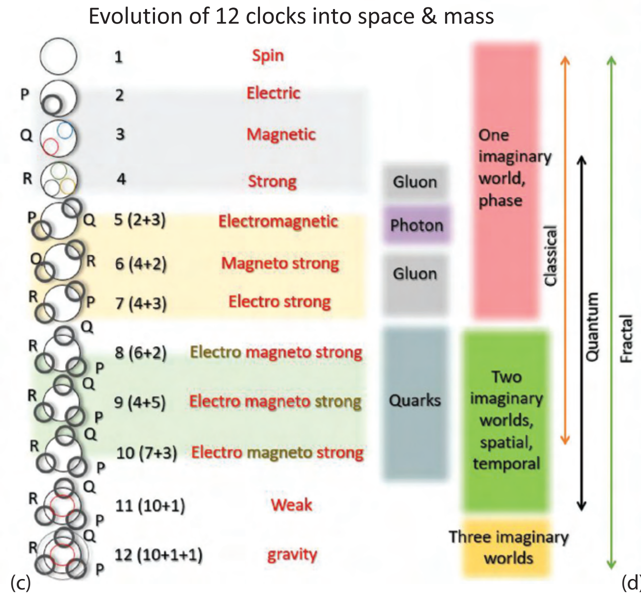
Classical mechanics	Quantum mechanics	Fractal mechanics
Imaginary world means phase part dominates reality	One imaginary world, time from that world acts on reality	11 imaginary worlds, topology of states of 11 worlds act.
No simultaneity	Superposition of infinite intermediate states	Topology of intermediate states govern superposition
No intermediate states	No control on the intermediate states.	Pattern of primes govern intermediate state geometry
No phase space	Phase space pathway exists, but no topological control	Self-assembly of Bloch spheres follow a geometric algebra
Information content is log(symmetry)	Content is source entropy – Tr(dlogd)	Density of distinct time crystals for all 12 symmetries
No drive	No drive	Non-linear push-pull between a pair of primes e.g. 43-47
Physical dimension of object	Physical dimension of object	Geometry of singularity points in a network of clocks
No concept of time crystal	Time crystal with only one imaginary clock	Time crystal with 12 imaginary layers of clocks, UTC
Differential equation	Differential equation	Continued fraction geometric algebra for pattern of primes
No universal constant	Planks constant	Plank constant for quantum version, action, A for classical

FIGURE 4.4 (a) Four sub-panels explain what is energy in terms of nested clocks. First from top: Energy is absorbed and emitted, a shaded circle shows the high-density overlapping of energy levels. Second from top: Change in symmetry triggered by a singularity domain. Third from top: Density of clocks change when in an assembly of clocks, the direction of rotation of a group of clocks changes. Fourth from top: Energy transfer is explained as exchange of a set of clocks. (b) A pixel is a singularity. Singularity holds geometric information, exchange information via tensor mathematics that deals with multiple imaginary worlds. (c) A table comparing the classical quantum and fractal mechanics.

protein extrapolates a distinguishable feature in the PPM of Eukaryotic life form. Thus, even if we do not comment on how the universe was born, what is its future, we could predict a lot using black hole entropy explored here using time crystals (Figure 4.5b, c). During the interaction, two interacting time crystals, if the observer is morphed it is mass, and if the observer fails to become a pixel in the host, it creates space (Figure 4.5b). The transformation of the basic concept of mass, energy and space helps in reconstructing every single object in terms of time crystals as outlined in table Figure 4.5c.

Thermodynamic asymmetry: Why time and entropy flow in one direction Origin of statistical mechanics: Time is asymmetric, flows to the future and entropy is asymmetric, only increases with time, both are irreversible (Landsberg and Park, 1975). It is the current view, which suggests that once upon a time the entropy was zero and time had a starting point. For geometric artificial brain, we envision a universe where after integrating around seven trillion units of information (Clocking Bloch sphere), we reach a saturation point where adding a new symmetry by introducing a new prime does not help to add distinct dynamics. It means, in the PPM, a system makes a journey from the bottom to the top, to the peak of the temple-like structure. After $1 \times 2 \times 3 \times 5 \times 7 \times 11 \times 13 \times 17 \times 19 \times 23 \times 29 \times 3$ $1 \times 37 = 7.420,738,134,810 \times 10^{12}$ or 7 trillion micro-states a system behaves as a single unit, entropy is zero, and the counting starts from 1, 2, 3, … Entropy is clocking. When a system is changing, say, water becomes ice and vice versa, the structure of phase space (Earman, 2006) if determined would give a reliable description of the microstates. The ab initio theory of statistical mechanics is extremely debated. Primarily the reason for debate has been to extract the probability distribution of local groups, the interactions or interventions between the groups to generate a group of generic probability features, so that various different equilibrium states are formed as a part of deductive formulations.





Imaginary world	Action ML^2T^{-1}	Carrier velocity, m/s	Topological constant**,	Minimum pixel time, s
1	P, phase	Diffusion 1e-2	Helical $2\pi e - 1$	Conscience 1
2	Geometric phase	Ionic vortex 1e-1	Vortex , $2\pi e - 2$	Normalization 1e-2
3	Pitch, leng. dia, vortex	Magnetic loop foam, 1e0	H, Hinductance, $2\pi e - 3$	Singularity 1e-4
4	Lattice defect	Electromagnetic vortex 1e1	Vortex2, $2\pi e - 4$	Paraxial 1e-6
5	Topological path	electronic pulse 3e2	G0, Quantum conduct. $2\pi e - 5$	Helix 1e-8
6	membrane	Ionic pulse 1e3	Microtubule $2\pi e - 6$	Protein 1e-10
7	Lattice path	Sound like soliton 1e4	Magnetic const, $4\pi e - 7$	Vibration 1e-12
8	Tunnel path	Tunneling in ion channel 1e5	Fracture band $2\pi e - 8$	Fracture 1e-15
9	Ordered factor met	Magnetic loops 1e6	Prime periodic $2\pi e - 9$	Periodic 1e-17
10	Prime density	Magnetic particle 1e7	Prime pairing $2\pi e - 10$	Pairing 1e-19
11	h, Planck 1e-33	c, photon, 3e8	G, gravitation $2\pi e - 11$	tp, Planks time 1e-43

(d) **Nearest resemblance in magnitude, SI unit, experimentally determined in systems

FIGURE 4.5 The basic clocks are representing the known elementary particles, a perspective of nested clocks. (a) Integers 1, 2, 3, … 12 are basic units of particles, following ordered factor metric described in Chapter 3, these clocks or their 3D representation, phase space, 12 imaginary worlds could deliver at least 12 clocks, to build a dodecanion, it is used to represent mass. (b) The process to explain mass using singularity driven clocks is explained. When observer, e.g., photon morphs, the existence of mass is registered. (c) For a universal language elementary fields are represented in terms of circles. (d) A table demonstrating action parameter found in nature at different temporal scales. From natural examples, we compile carrier velocity, topological constant and minimum time.

Some proposals try to assign initial conditions to override microstate distribution (Price, 2002) such that the evolution of the dynamics generated by the micro-clusters of quasi-isolated systems is properly mapped (past hypothesis, Albert, 2000). PPM is a group of systems, where an integer represents a single system, or a time crystal, all integers or systems are quasi-isolated as time crystals overlap, one does not require to know initial conditions, all possible perturbations are meticulously mapped. So, be it a human brain or big bang, be it a journey from the bottom of a PPM to the top, or from the top to the bottom, entropy at both ends is almost zero, time at both ends is almost zero. In between it is an architecture of phase, convert it as a structure of time or phase or an ensemble of frequency (Loewer, 2001) or even space. One cuts a slice of maximum integer of PPM, and rolls it into a closed-loop, that is a geometric form of statistical mechanics or fractal mechanics. Thus, background asymmetry projects time and entropy as asymmetric, but closing a loop ensures that all laws are time-symmetric.

4.3 A COMPARISON BETWEEN CLASSICAL, QUANTUM, AND FRACTAL MECHANICS—SCALE SYMMETRY AND SCALE RELATIVITY

Why 12 imaginary worlds cannot be reduced to one imaginary world: One imaginary world of quantum mechanics is founded on the fact that momentum and position, energy and time, angular momentum and angle are connected by an action called Plank constant h. Now, when angular momentum of magnetic vortex atoms is a dodecanion tensor where uncertainties of 11 different worlds change the way groups of imaginary worlds would affect each other, then it cannot be translated into quantum mechanics (Figure 4.5d). A quaternion has four quantum-like imaginary worlds each world is 2×2 tensors, an octonion has 2 sets of 5 quaternions it means five 4×4 tensors, a dodecanion has 3 sets of 5 octonions. Icosanions have 20×20 tensor, hence one could find various fundamental tensors embedded. Thus, when a system follows octonion, one could deduce multi-level imaginary worlds into a pair of co-existing hyper-imaginary spaces, which then cannot be deduced to quantum mechanics, it requires a new one. However, dedocanion does not only spontaneously generates a hyper-hyperspace of quaternions, the triplet of octonions means a triangle, a topology that enables hyperspace to hold three functionally independent universes at a time governing reality. Thus, the journey of fractal mechanics begins at 12 imaginary worlds, at dodecanion.

Scale symmetry: Those who oppose multiverse, they need to prove that the universe we live in is not special. If it is not special, then we do not need many other universes. One way to do this is to alleviate the necessity of mass and length from basic formulations. What we would be left with is a dynamic of symmetry that nature uses as it does not differentiate between the scales. It means if we take a triangle and draw another triangle inside and continue to do so forever, we get a scale-free symmetry or a scaling symmetry (Bardeen, 1995). Interaction of charge would spontaneously break symmetry generating the mass and length. So, the charge of the particles interacts using equations that has no mass and length. In some sense the proposal is just opposite to the idea that suggests time is not required, space is sufficient. The real mass of the Higgs boson is a billion billion times of magnitude smaller than the Planck mass, (hierarchy problem), as per standard models of physics the quantum contributions from other particles should make the Higgs boson mass, i.e., Higgs mass does not exist as a fundamental entity. In order to explain the discrepancy, supersymmetry was considered, which studies the existence of anti-matter, both pairs of Higgs Boson could reduce the effective mass. However, since antimatter is unfound, one way to predict the very low mass of Higgs Boson is to consider that there is no mass and length in the universe in reality, it is subject to interaction. Thus, scale symmetry concept shapes the universe by chance and eludes understanding.

The concept of scale symmetry has multiple distinct proposals with beautiful consequences. First, since the gravity is born from zero mass, the elements that interact to give birth to gravity should not have any effect of gravity. In simple word, there is no mass, to begin with, that's why for 30 years, dozens of predicted particles were never found, probably calculating the mass was wrong. Second, supersymmetry considers twin masses, by interacting they can generate plenty of other particles, but scale symmetry does not allow creating new particles as many as we wish. In the scale symmetry proposal agravity (Salvioa and Strumiab, 2017), the scale symmetry introduces two kinds of dynamics, one generates Higgs Boson the other one generates a billion billion times higher Plank mass, there is a problem. Negative energy, negative probability and ghost particles are required which are not real. Third, there exists a proposal for a hidden sector, the phase transition like events (Carena et al., 2018) switch Higgs Boson like particles to a Plank class mass. All existing versions of scale symmetry models like agravity, hidden sector, predicts new particles, future experiments might reveal the winner. However, when we created the chart in Figure 4.5c, the reader could notice that all of the existing models received a form of acceptance.

Difference between scale symmetry and PPM: For PPM-GML-H triad, time crystals are the massless particles which are made of phase singularities, they constitute a charge, mass and distance (see Table 4.5c). It is a major difference with the scale symmetry where a cascade of interactions between the uncorrelated charges like dominos generates the phase transition. For PPM-GML-H triad, every single parameter, charge, mass and distance all spontaneously arise, since the geometric combination of time crystals determines when a phase transition would happen as per the PPM. Thus, spontaneous phase transitions of time crystals are programmed in the geometry following PPM.

Scale relativity: Fractal space-time and its relation to quantum mechanics were proposed in 1981 (Abbot and Wise, 1981) and fractal space-time came into being (Ord, 1983). Nottale coined the term "scale relativity" a decade later (Nottale, 1989, 1992). Scale relativity hypothesizes that space-time in nature is fractal and quantum behavior comes from that fractal feature. Einstein said, space-time is curved, and the proponents of fractal space-time suggested that the traversing paths through the curved space-time are fractal. Indeed, fractal geometries allow studying such non-differentiable paths. The fractal interpretation of quantum mechanics has been further specified (Abbot and Wise, 1981) showing that the paths have a fractal dimension 2, if infinite series then $4+\varnothing^3$ (Prigogine et al., 1995). Only scale ratios have a physical meaning, never an absolute scale. Multiple proposals exist that quantum mechanical paths or Feynman diagrams are a fractal path (Kröger, 1997). The fractal path has non-differentiability. However, the self-similarity allows generating the paths using complex differential equations. Some researchers used infinite cantor sets, still, a singular mathematical function express all of it. The fundamental "postulates" of quantum mechanics were derived (Ben et al., 2005) starting from scale relativity. Schrödinger's equation, the Klein-Gordon, and the Dirac equation can then be derived (Célérier et al., 2003).

Difference between scale relativity, quantum mechanics and fractal mechanics: We have made a few fundamental changes in the concept of space-time curvature. In all fractal space-time research over 40 years, the fractal path was defined as a simple equation, repetition of simple geometry. We use PPM to generate the fractal path, thus, no symmetric entity is pure, it is all about the composition of symmetries. Feynman suggested a few diagrams to connect the empty space between two elements (Feynman and Hibbs, 1965). Fractal space-time concept suggested that the path is a repetition of geometric paths for a finite time or infinitely as cantor sets (Prigogine et al., 1995; Marek-Crnjac, 2009). In general scale relativity, the fractal dimension can take any value, but only one value. For PPM-GML-H triad, when we use PPM, we have a superposition of multiple fractals, thus, the fractal dimension is not one, but a set of values, that too, is a function of location, where on the PPM the selected symmetry is located. Due to the superposition of several patterns of PPM, we get non-self-similarity, the changing scales generate several distinct scale-forces or scale-fields, instead of one (Nottale, 1997, 2004). In order to analyze, we find self-similarity between different scale dynamics. It is the reason, we cannot process the evolution of dynamics using quantum mechanics formulations using mass and length, we change the name to fractal mechanics. For PPM, if one uses simple patterns its quantum, complex set of patterns, it is classical, there is no boundary between classical and quantum-like de Broglie length scale (Turner, 2013). If a system represented by time crystal uses a few symmetries, say S, then measuring time crystals M with simple structures do not change S, hence M gets reproducible outputs.

Note that scale relativity never attempted to rewrite the formulations of quantum mechanics. They consider the charge as the basic foundation of all, then derive mass and length required for Schrödinger's equation and all other forms of quantum mechanics. All existing formulations of quantum mechanics survive. Ours is a version of quantum mechanics that does not use charge or anything like the basic entity, rather, from a structure of phase inspired by the pattern of primes we derive all essential parameters. Thence we replace the equations with a changing geometric structure. We call this new form of mathematics as continued fraction geometric algebra, CFGA, where all formulations of quantum mechanics take a geometric shape. Equation = changing geometric shape. Moreover, since we always put a geometric structure inside a singularity point, a state is defined using phase value, no real classical path is there. Since wave functions are nested, it does not feature wave like but time crystal-like, we are bound to change the name from quantum mechanics to fractal mechanics. Scale relativity gives a geometric interpretation to charges only, we provide clocking geometric interpretation of everything. Matter wave, Schrödinger's equation and all fundamental operators of quantum mechanics could now be drawn as a 3D architecture of clocks where geometric shapes are rotating in a typical pattern.

The question may arise, how could it be that there is no conserved quantity for PPM-GML-H triad? New scale symmetries build all essential parameters from PPM just like the scale relativity (Nottale, 2011), the only difference being that for PPM-GML-H triad, it is not a singular symmetry but a set of symmetries arranged in another symmetry. Geometric quantization from numbers is not an ad hoc, but a well-observed feature. Quantization of charge happens because integers are quantized (Furey, 2015).

4.4 ACTION IS NOT LIMITED TO PLANKS CONSTANT—EVERY IMAGINARY WORLD HAS ONE

Deduce the Quantum and our universe from an understanding of existence: The dimension of Plank constant h is that of action, it is a limit on the position and momentum. Poor gravitational objects like us (a human body weighs ~70 kg) cannot cross a photon speed c (what makes photon massless?), similarly, loss-less solitons cannot cross ~10^{-5}c that means 10,000 times less than the speed of light. If we use solitons to communicate and change the state of another particle far apart, then it will be as slow as the speed of sound, using effective mass it could be shown that uncertainties and limiting values are there at various energy levels. However, we can even use a diffusion of ions, to lock particular parameter for hours or even years later; therefore, eventually, locking coupling values is the stringent condition in entanglement, not the apparent speed, that emerges with system co-ordination and those are written in the tensors, e.g., quaternion, octonion, and dodecanions. As coupling becomes a simple physical interaction, it opens up worlds beneath classical perception time scale and the worlds beyond quantum time scales. We have not remained confined in the materials and carrier transmission, because that would have confined us in a single clock. The geometry of clocks is limited to 11 layers one inside another for a dodecanion, all 12 layers have its distinct action, an equivalent of h and in the classical systems we could implement the concept of imaginary layers, a chart is shown in the Figure 4.5d, wherein we have used the universal constant values from the chart of Figure 4.6.

Eleven Mr. Topkins is moving around 11 imaginary worlds of George Gamow: The rule of the game is that never separate space and time, if we can preserve their coupling then even if we move one frame of reference to another the massively parallel coupling between large numbers of pixels carrying information of the event retains its originality. Every system built by nature has its own time of reference, because the speed of a photon in that medium is different from the vacuum. Inside that system, time travels in its own way. The fundamental rule of the living would change dramatically in that very world. We know George Gamow's story about Mr. Topkins, who traveled to a world where the maximum velocity of light is only 30 km/hour. Though the story is wrong completely since the observer always lives in the current world, and the photon while carrying information might change it suitably to fit that information in the new world, the story is important to feel the new world. There are several systems around us that follow the modified "time" based on photon velocity and or carriers of time defining action. We live with these worlds together, for dodecanion, its 11 imaginary worlds. Therefore, the modulation of time domain by a computing system is essential for the true replication of a natural event. The time-domain means maximum and minimum time-lapses for all possible events occurring on the brain. The minimal two events could be a change of states, the fusion of states to form groups, the disintegration of groups etc. Eleven layers of actions set 11 Mr. Topkins in a nanobrain, and brain jelly, how is it possible to manipulate the symmetry of architecture to modulate the time domain of pattern evolution in a molecular cellular automaton.

> Physical systems (when viewed from a distance) can be grouped into a small number of classes, with identical scaling laws.
>
> **Ken Wilson**

Fundamental constant	Actual value	Prime-e-prime
Cosmological const Strong coupling const α	0.7 0.5, 0.3, 0.2, 0.1	7e-1 Prime-e-1
Wein displacement Fine structure const Helion molar mass	2.8e-3 m K 7.2e-3 3e-3 kgmol-1	3e-3 7e-3 3e-3
Fermi coupling const Quantum conductance	1.1e-5 GeV-2 7.7e-5 S	1e-5 7e-5
Magnetic constant Nuclear magneton Stephan Boltzman	4πe-7 N A-2 0.3e-7 eV T-1 0.56e-7Wm-2K-4	11e-7 1e-7 1e-7
Gravitational G, electrical ε Bohr radius Atomic mass	6.6e-11, m3kg-1s-2 0.8e-11 Fm-1 5.2e-11 m 0.14e-11 kg	7e-11 1e-11 5e-11 13e-13
Compton wavelength	3.8e-13 m	3e-13
First radiation const Atomic unit of time	37e-17 Wm-2 2e-17 s	37e-17 2e-17
Electronic charge	1.6e-19 C	1e-19
Boltzman const Bohr Magneton Elec mag moment	1.38e-23 J K-1 0.9e-23 J T-1 0.9e-23 JT-1	1e-23
Thomson cross section	6.6e-29 m2	7e-29
Electron mass	9e-31 kg	7e-31
Plank's constant	6626e-37 Js	3313x2e-37
Electronic polarizability	1.6e-41 C2M2J-1	1e-41
Plank time	0.53e-43 s	1e-43

Fundamental constant	Actual value	Prime-e-prime
E-mag-mom to Bohr mag ratio Absolute entropy Sackur-Tetrode Weinberg angle Quark mixing matrix CKM	1 -1 -1.1 0.23° 0.97, 0.23, 0.41	1 11e-1 23e-2 Prime e-2
Proton G factor Molar gas const Cabibbo angle (Weak interac)	5.5 8.31 J mole-1K-1 13.02°	1e1 13e0
Vacuum impedance Muon mass energy equi	3.7e2 Ohm 1e2 MeV	3e2 1e2
E-mag mom/nuc. Magne.ratio	1.8e3	2e3
Faraday constant Standard atmosphere Magnetic flux density Von Klitzing Const	0.9e5 Cmol-1 1e5 Pa 2.3e5 T 2.5e5 Ohm	1e5 1e5 23e5 3e5
Velocity of light Rydberg constant	30e7 m/s 1e7 m-1	29e7 1e7
Electron charge to mass Electron gyromagnetic ratio	1.7e11 Ckg-1 1.7e11 s-1T-1	1e11
Electron volt Hertz relation Josephson constant	24.1e13 Hz 48e13 HzV-1	23e13 47e13
Kilogram-joule relation	0.89e17 J	1e17
Atomic unit e-field gradient	971e19 Vm-2	37e19
Avogadro constant Loschmidt const	6e23 mol-1 268e23 m-3	7e23
Joule Hertz relationship Plank temperature	150e31 Hz 14e31 K	37e31 13e31
Kilogram inverse-meter	4.5e41 m-1	5e41

FIGURE 4.6 Fundamental constants found in nature and trying to visualize the constants in a prime-e-prime.

What if our universe is made of virtual atoms of waves, the universe of mass is an illusion?: Origin of the universe is beyond the scope of this book, but when the identity of nature's true information structure is developed often the key features of this universe factor in. Battle for the heart and the soul of physics: Experiments to find out the smallest indicate that the fundamental constituents of the universe are 10 million billion times smaller than the resolving power of the Large hadron collider, LHC. Massless virtual objects like the vortex atoms made of wide ranges of electrical, magnetic, mechanical ripples are the key ingredient using which the human brain model and its artificial analog have been created here. The whole idea that "no mass" or a very low effective mass is equivalent to an infinite space holds a "time" in it, a unique time crystal feature has been assigned to tag it as a mass. In general mass is a geometric shape of a unique kind as shown in Figure 4.5a, it is in line with the field theory. Fractal information theory, FIT proposes that rhythms are the keys to everything that originates from the concept of spin. However, then replacement does not end in the mass or space, "phase change" creates both "space" and "mass."

Spin is a property of a material that enables it to exhibit the rotational symmetry. For example, the symmetry of a particle is such that after two rotations, it returns to the initial symmetry, then it is spin ½. However, if just by rotating 180 degree it returns to the initial state, then the spin is 2. We know that the spin governs the nature of force, why then we do not see so many different long-range forces other than photon and graviton. Both are massless, and lower the mass, more global is the interaction!!!! Of course, Weinberg argued that more than spin 3 is not possible because they would not interact, but how true is that proposal is not important.

Wigner found that in the massless situation, instead of particles labeled by a single spin, there could be a range of values. Photons only have the spin 1 label while gravitons only have spin 2, it could be that the photons and the gravitons are actually special cases of a more general massless particle with an infinite list of integer spins. The massless particle is labeled by spin 0, 1, 2, 3, all the way to infinity! Wigner called these "continuous spin particles" (CSPs; Schuster and Toro, 2014). The spins are definitely discrete not truly continuous (see below QSP). For FIT, these are signatures of a time crystal or organized spin foam where each spin is a guest clock located on a host clock.

Weinberg showed how the spin of a particle could provide insights into the electromagnetism and the gravity. Continuous spin particles (CSP) are objects with all possible spins. Natalia and Toro argued that instead of all possible spins, the spins would take certain values, Quantized spin particles or QSP (Schuster and Toro, 2013). It would definitely change the way we look at nature. When the geometric space was imagined for the number system theory, imaginary iota was brought in and showed that it returns the quantized values. Dodecanion in combination with octonion and quaternion would bring about further organized structures where symmetry would govern the degree of quantization.

4.5 A TABLE OF FUNDAMENTAL CONSTANTS IN NATURE

Fractal space-time: Throughout this book, we do not debate whether our brain is a classical or a quantum device because if the two formulations are combined then, the fractal space-time features naturally make a smooth transition from classical to the quantum regime. Feynman showed that the quantum mechanical paths that contribute mainly to the path integral, these paths are non-differentiable and are fractal. Though there are three routes following which the laws of quantum mechanics are derived from the fractal geometry of space-time (theories of scale relativity). The first route is, a random walk through the Feynman chessboard as suggested by Ord et al. Second is the scale relativity approach wherein a collection of coordinates, some points are finite, has limits, so its classical and some points in the space-time are fractal, means, infinite, and minimum energy path or geodesics are irreversible. When these typical fractal features are applied to classical coordinates, Newton's equations are written in terms of Schrödinger's equation (Nottale, 2005). So, quantum to classical transitions is feasible in fractal worldview. Third, El Naschie approach, where he replaced the "continuity" part of a fractal and replaced it with the Cantorian space-time fabric. The Cantorian approach is exciting because using this space-time fabric, all fundamental constants including the fine structure constants, gravitational constants are derived (El Naschie, 2004, 2009). The approach allows the formation of wild topologies (multi-fractals). A Cantorian space-time metric uses multi-fractals, means fractals with different dimensions, this generates the E8 symmetry. The experimental verification of a unique fusion of E8 symmetry (248-dimensional rotational symmetry) is shown, we call it the lotus symmetry. One reason for stressing a new metric—fractal time considers no limit, not even in the Plank dimensions, hence, the Plank cut off as considered by some fractal space-time theories contradict themselves. PPM guides linking the symmetries, no imagination on the space-time could be left out.

Explaining all of quantum mechanics using geometry: The foundation of entropy and fundamental constant: Wheeler tried to explain everything that is happening in the universe in terms of changing geometric shape. Now, Wheeler used classical points, not phase space like us to construct the geometric shape. As a result oscillating geometric shapes gave rise to incredibly non-physical behavior at certain scales. The boundary of a boundary is zero is the foundation principle of geometric algebra (Spanier, 1966). As Wheeler argued, "we will someday complete the mathematization of physics and derive everything from nothing, all law from no law." We extend the statement here, possibly, one day we could derive everything from a metric of primes including all laws. In brief, the choice of the question asked, and choice of when it's asked, play a part—not the whole part, but a part—in deciding what we have the right to say (Wheeler, 1984, 1986). When phase singularity accommodates geometric shapes, the boundary of a boundary is zero, shapes, irrespective of their oscillations are confined within the singularity domain. Hence non-physical situations do not arise. Due to the PPM we find that each prime writes its typical signature in the metric of primes, we can easily test it by keeping say products of 11 only to see what prime 11 does to the metric. Consequently, we found that around 15 proteins are sufficient to generate a self-similar pattern for each prime as a physics law and typical curves at the junction of two primes as a fundamental constant. Thus, universal physical laws are observed in the changing geometric shapes generated by primes. Not just quantum, serious attempts were made to include gravity as changing geometric shape (Wheeler, 1967; Misner et al., 1973) that could be done with PPM and GML, as we would see below. We do not try to derive quantum origin, but we see quantum as an opportunity to resolve the asymmetric flow of time and entropy (Price, 1996).

The emergence of fundamental constants from PPM: Fundamental constants are not that universal as we are taught in the textbooks, they vary with measurement conditions and environment (Gross, 1989). Figure 4.15a explains Fundamental constants are functions of e, π, and Φ. These three fundamental constants e, π, and Φ. are connected by quadratic relations. If in our universe, there truly exists an orthogonal triangle of e, and Φ, whose three angles are $\theta_1 = \cos^{-1} e/\pi$, and $\theta_2 = \cos^{-1} \varphi/\pi$, which could change. The quadratic relation is beautiful, since angles between e, π and Φ, π change, keeping the quadratic relation $e^2 + \varphi^2 = \pi^2$ intact. In the PPM when we find the topological shapes (12 has 3 nested points, hence a triangle, 8 has one nested point so it refers to a singular point, etc.) by the time we reach 10^{12} integer space, covering $1 \times 2 \times 3 \times 5 \times 7 \times 11 \times 13 \times 17 \times 19 \times 23 \times 29 \times 31 \times 37 = 7.420, 738, 134, 810 \times 10^{12}$ = B (Brahman), we get dodecahedron, a 20 planar 3D architecture. If we include two more primes 41 and 43 to avoid the debate whether 2 is at all a pure prime, B = 1.308276133167003e + 16. We can go for a higher number of clocks but as explained in Chapter 2, even if we build a system with more number of clocks, we will not add more symmetry to the universe. Ninety-nine percent of all non-primes could be created by 12 primes only, therefore, it is wise if we reach the number B, we would consider the whole system as one unit and start counting again, 1, 2, 3, … *n*. It means, starts building a new system. Now, we have also explained in Chapter 2 that due to phase quantization we get clockwise and anticlockwise rotations, but, certain integers start the rotations in the phase space, the others follow. The rotational space forms a lotus satisfying various logarithmic spirals, around $e^2 + \varphi^2 = \pi^2$. In the PPM, as distinct metrics generated by each prime superpose, certain critical folds with an angular gap θ need to be bridged for generating a continuum in the metric. The bridging factors are fundamental constants that we see around. The generic formula for fundamental constant is $\theta(e^2+\varphi^2)^{\pm\text{prime}}$. It is not the ultimate one, it is the first and the most primitive attempt to topologically derive the fundamental constants in the future (Figure 4.6). Consequently, the physics laws would be born in the landscape of symmetry, PPM.

4.6 QUANTUM INTERFERENCE- AND FRACTAL INTERFERENCE-EXPERIMENT ON A SINGLE MICROTUBULE

A journey to entanglement in room temperature under noise: The hallmark of a quantum oscillator is a textbook-like quantum interference pattern depicting the wave functions of the quantum well with all possible nodes starting from the ground zero. Nanoelectromechanical oscillators (NEMS) are the newest classical window to the quantum world. Microtubule nanowire found abundantly in eukaryotic cells (Figure 4.7a), spontaneously generates a pair of coherent sources due to birefringence (Figure 4.7b). Sahu et al. carried out a series of experiments on a single microtubule to check if it is a quantum device (Figure 4.7c). While basic relation $h\upsilon = k_BT$ sets limits to the quantum preparation and measurement (Figure 4.7d), the thrust to bring quantum features to the classical regime remains confined either in ultra-cold temperatures and/or in an ultrafast time domain. Journey to hot entanglement has stemmed recently (Galve et al., 2010) by squeezing the normal mode of vibration of synchronously coupled oscillators vulnerable to heat contacts, advancements are too limited to make an impact. Thanks to quantum-discord that harness quantum benefits, even without entanglement. Squarely apart, on a carpet of strongly coupled oscillators, the coherent stream of soliton particles does not de-cohere under thermal or electronic noise, remains pristine for kilometers; thus, could replace the entangled atoms or ions. However, the problem for not having superposition principle restricts their localization; hence, quantization is possible only if individual solitons are weakly coupled, non-linearly shaping into a waveform (Rajaraman, 1982). Once soliton's limitation to form wave is resolved, discretely spaced soliton-particles all along the NEMS structure are synchronized as sinusoidal wave delivering all that quantum entanglement and quantum superposition had promised, semi-classically, in the open air (Figure 4.7e). Quantum was prepared theoretically, using solitons; but no attempt was made to realize it experimentally by breaking the limits set by $h\upsilon = k_BT$.

With an ideal ferroelectric behavior (Tuszynski et al., 1985), microtubule is piezoelectric, oscillates mechanically if an electrical signal sent through it (Sahu et al., 2013a, 2013b); lattice sites on the cylindrical 2D surface generates symmetrical points in the power spectrum, with large piezoelectric degrees of freedom. Size of the constant-voltage step in multiple ferroelectric states measures the degree of resonant velocities of solitons; thus, varying ac driving bias the velocity of solitons could be controlled. Velocity tunes delay, essential to generate normal modes of vibration among all the classical soliton particles vibrating at the single resonance frequency. MT's dc resistance remains constant unless an ac signal of particular frequency triggers one of the eight co-existing quantum wells inside and release energy to the external circuit reducing the contact-resistance. Even a ±50 mV_{rms} ac signal turns a ~23.5 µm semiconducting MT (1–10 MΩ or ~300 MΩ) into a nearly ballistic conductor (39 kΩ~$3G_0$, independent of L), at those eight resonance frequencies (f) ~15 kHz(Q~4,|1>), ~9 MHz(Q~43,|2>), ~12 MHz(Q~75,|3>), ~15 MHz(Q~46,|4>), ~18 MHz(Q~64,|5>), ~20 MHz(Q~110,|6>), ~22–23 MHz(Q~129,|7>), ~24–25 MHz(Q~62,|8>, Figure 4.7f). Length variation study of resonance peaks shows that a single microtubule exhibits any one of the four pairs of dominating peaks, |1>|2>, |1>|4>, |1>|6> and |1>|8>. The co-existence of two peaks reflects the possibility of four quantum bits. four distinct coherence times that a particular microtubule delivers for four quantum bits. Soliton takes 23.5 × 10^{-9}s ($\tau_\phi = L_\varphi/c$, c~10^2–10^3 m/s) to cross $L\varphi$, since coherence time $\tau_C > \tau_\varphi$, quantum bits can survive sufficiently long to observe classically.

Microtubule is quantum device but only at certain ac frequencies: During four-probe quantum interference measurements using a single microtubule device (Figure 4.7c) it was found that at certain ac frequencies, there is a current at zero gate bias and zero probe bias (quantum), at all other frequencies the center is dark (classical). Two coherent electromagnetic (em) pulses are given by $E_1(t) = \left(A(t)\exp(ik_1r) + c.c\right)/2$ and $E_1\left(t+\tau\right) = \left(A\left(t+\tau\right)\exp(ik_2r) + c.c\right)/2$, where $\tau = 2\pi d/\lambda$, d is the path difference, λ is the wavelength of em signal, k is wave vector, $c.c$ is complex conjugate. The intensity of their interference pattern is $I = \left\langle \left| E_1(t) + E_2(t+\tau) \right| \right\rangle^2 = C + \left\langle A(t)A^*(t+\tau) \right\rangle$ $\cos\{(k_1-k_2)r\}$, here normalized temporal coherence function is $\gamma(\tau) = A(t)A^*(t+\tau)/C$. When we change the em frequency, we tune τ (delay), which first increases and then decreases the amplitude I of the output signal, i.e., $\gamma(\tau)$. Full-Width-Half-Maxima (FWHM) for $\Gamma = I_{max} - I_{min}/I_{max} - I_{min}$ vs. τ provides the coherence time $\tau\varphi$ (Iwata and Hieftje, 1992). When the gate voltage changes (inner electrodes in Figure 4.7c) the Fermi-level of synchronized soliton packet, original and gate-modulated (wavenumber, k) signal develops a phase difference, which generates a Quantum Interference pattern but only at certain frequencies.

One easy way to prove that microtubule follows fractal mechanics or it is a fractal harmonic oscillator is to zoom the interference pattern (Figure 4.7g). If applied bias shifts wave vector k largely by zooming a particular domain as shown in Figure 4.7g, only the ballistic paths for solitons change, the weak coupling among all the solitons is not affected, so we observe a similar pattern. It also depicts that transition to hexagonal lattice phase is essential for two co-existing quantized soliton waves to reside physically on the MT surface. Distinct quantum interference patterns for eight dielectric resonant states in the range was 10 Hz–50 MHz for different lengths, confirms MT's

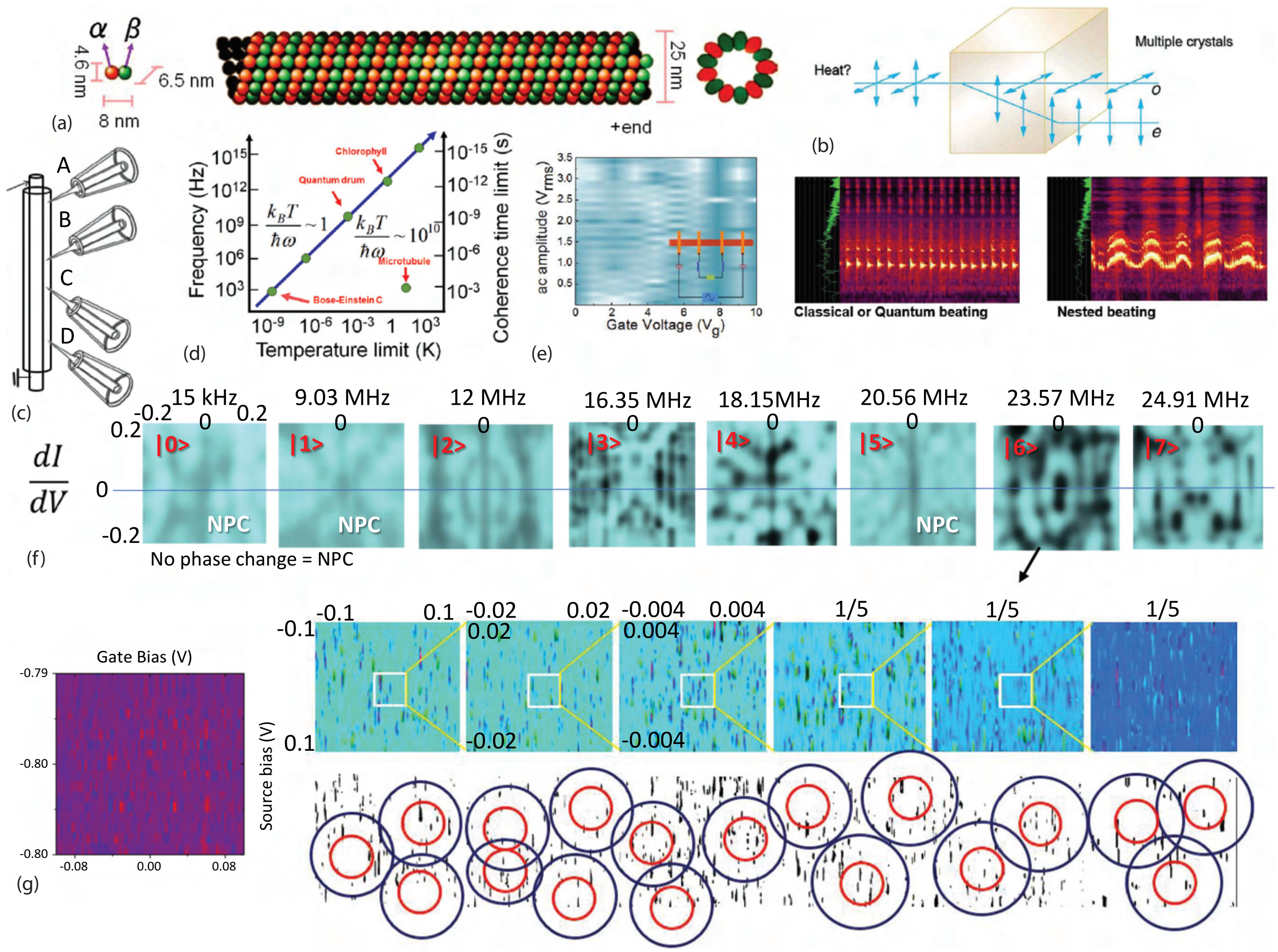


FIGURE 4.7 (a) Microtubule and tubulin protein. (b) O-ray and E-ray for the crystal that shows birefringence (top). The corresponding beat frequencies measured in microtubule nanowire is shown below. Both the bottom panels show frequency (vertical axis) with respect to time (t) in the horizontal axis. The left panel shows the patterns for classical and quantum beating. The right panel shows fractal beating where the conventional beating ripple is split into multiple sub-ripples. (c) Four probe system that is used to measure the 2D interference pattern. Inner two probes act as gating channel and the outer two rings are to send input and read output signal. (d) The ratio of available energy in the thermal noise (k = Boltzman const) and T is the Kelvin temperature, to the energy or quanta for resonant oscillations is plotted, h is Plank's constant. The ratio is plotted as a function of the environment temperature and the applied frequency. The coherence time limits reported in different kinds of literature have compiled the scale in the right. (e) One example of interference plot when no ac signal is applied to the microtubule. (f) Differential conductance (dI/dV) is plotted (vertical z-axis, perpendicular to the page, color contrast of the 3D plot) against the gate bias (horizontal axis) and the input bias (vertical axis). Eight 3D interference plots are presented, each for one typical frequency. (g) Apparent feature of the interference pattern, horizontal axis is the gate bias and vertical axis sample bias. The axis perpendicular to the page is the current. The fundamental difference between panel f and panel (g) is differential conductance and current. During the experiment, a small part is zoomed and new scan run. The zoomed domain is all about reducing the scan boundaries continuously five times.

identity as octave quantum-like cavity-resonator. In sharp contrast to conventional resonators (mV, mA~microwatt), microtubule operates in the atto-watt (μV, 10 pA) domain, consuming 10^{10} orders lower power. Since coherence length is ~23.5 μm all microtubules produced in any living eukaryotic cells, brain neurons are a quantum-like device, if and only if one triggers it with a suitable ac frequency. Two possible co-existing lattice paths on the hexagonal tubulin lattice those constitute a quantum bit is also explicit in molecular simulation.

4.7 FRACTAL ABSORPTION–EMISSION OF THE OPTICAL BAND OF A NANOBRAIN

Molecular foundation of the fractal logic gate: We discuss the design and synthesis of a Fractal logic gate that operates with pH and density as input variables (Ghosh et al., 2015b). Fractal logic gate means its truth table is not permanent; any operational region could be zoomed to get a new truth table, continuously. Thus, it can sustain changes in the input condition unlike conventional molecular logic gates.

The fractal feature was never realized in a logic gate before. Fifth-generation PAMAM dendrimer [P] encapsulated with 2 Nile Red [C] molecule and surface attached with 32 molecular rotors [M] and 4 pH sensor molecules [S] is the functional unit whose water solution was used as logic gate matrix, including PCMS; we call it PCMS or nanobrain (Ghosh et al., 2015a). The final derivative is 10–15 nm wide particles. The logic gate output is read by measuring fluorescence. Proper choice of functional groups balances the energy transfer between encapsulated molecule inside the dendrimer and the externally attached functional components, we image that energy transfer route (M↔C↔S) precisely using combined excitation-emission spectroscopy (CEES). One could zoom a CEES spectrum similar to the interference pattern described above, to find that new bands are found (Figure 4.8a). The reason is not newer parts of the molecular structure being probed, rather an interaction of participating molecular systems. A few functional groups using the phase interaction build a dynamics that is similar to a fractal, say Mandelbrot fractal needs only one imaginary world and it can create an infinite space using that (Figure 4.8b). Fractal logic gate feature is aimed at delivering programmed output at all scales using a single instruction (Figure 4.8c) even under noise, e.g., drug delivery systems, chemical pattern recognition, chemical data encryption, etc.

A note on chaotic, deterministic and quasi-determinism in computing: Unlike deterministic system, a chaotic system is apparently random but predictable only if we know the initial condition, see butterfly effect, thus one can calculate the output of such a multi-directional chemical reaction. In contrast, in a classic random system, the same reaction would give

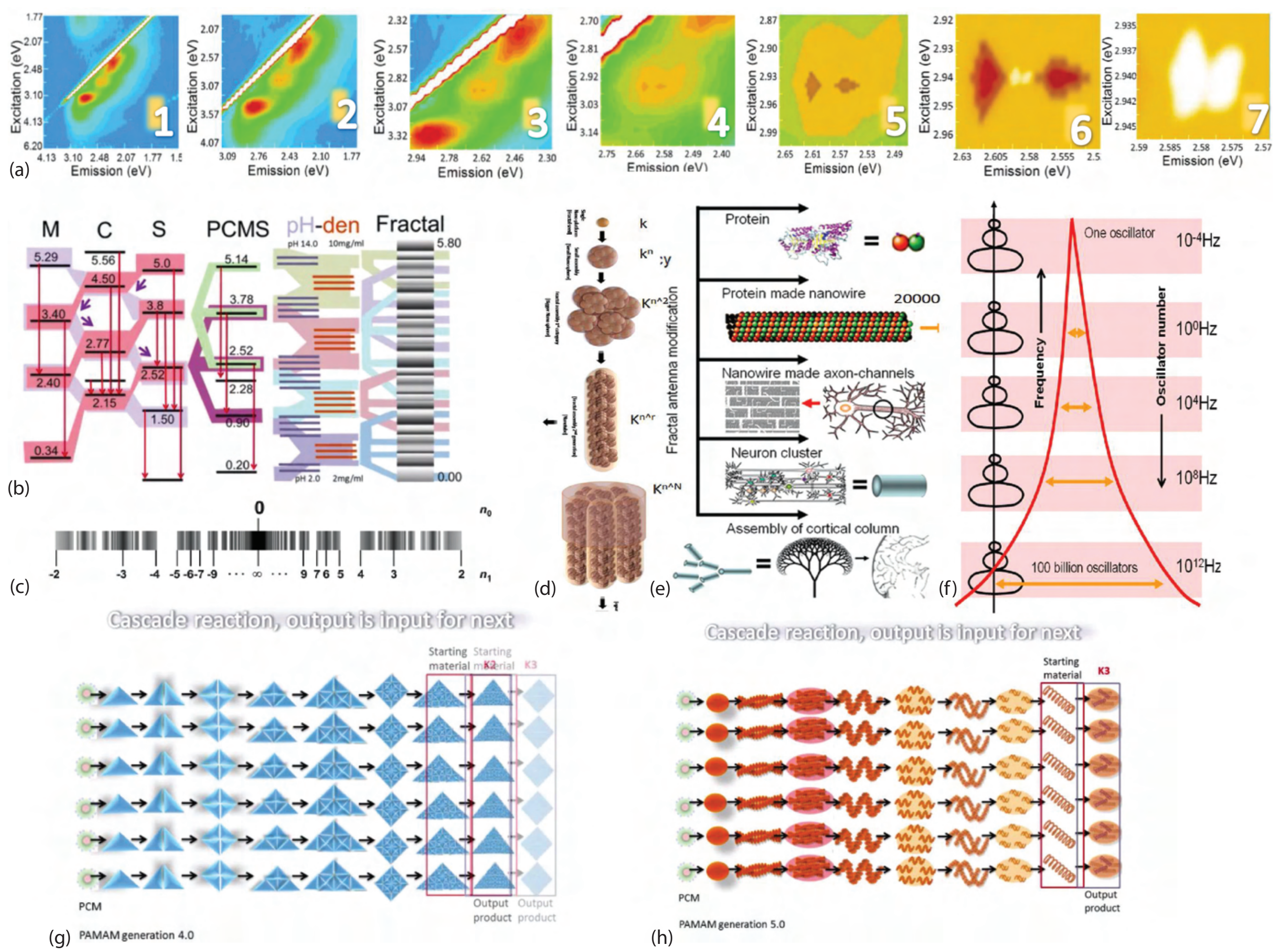


FIGURE 4.8 (a) Combined excitation-emission spectroscopic (CEES) plots, where PCMS molecular solution (P = PAMAM, C = controller, M = Molecular rotor, S = Sensor), the range of excitation and emission wavelengths were zoomed six times to extract the local pattern in the 3D absorption emission spectrum. (b) Motor, controller and the sensor molecules energy levels are plotted as calculated from the CEES spectrum. The new energy levels observed while zooming the spectrum shows self-similar patterns in the energy levels. (c) A schematic presentation of the fractal energy levels. (d) PCMS self-assembly process that starts at single-molecule forms a cylinder and sphere sequentially during growth. (e) Growth is shown from single tubulin dimer to microtubule to neuron bundle to the entire brain network. (f) The number of oscillators increases manifold as one enters a human brain architecture, with more layers, an increased number of components takes part in the organization. (g) PCMS self-assembly runs by two steps. Alternative formation of triangle and square. (h) PCMS self-assembly runs by two steps, sphere and spiral.

different results in two consecutive runs. The three systems are (i) "chaotic (if we know input then predict random output)," (ii) "random (even if we know the input, cannot predict)," (iii) "deterministic" (input-output fixed). Here we realize "quasi-determinism," a system where a reaction system always approaches determinism, but as an asymptotic function, the determinism is never reached. Say, the solution is 1, the system reaches 0.999 then after some time, 0.9999999, etc., then if conditions change then if the output is 2, the reaction system drives toward 1.99 then 1.99999, etc.

Triangular energy transmission network in nanobrain enables accurate programming: Period, or time cycle or rhythm is what remains constant even under random PCMS (nanobrain) motions. Strict energy transmission route like M↔C↔S is itself a rhythm encoded in the atomic arrangements and PCMS restores it under noise. The attempt allows PCMS to sustain a defined geometric path on a surface under noise and a logical fluorescence output in solution even though a particular pH and density range are continuously zoomed creating a fractal logic gate. Fractal gate means one can continuously zoom to expand any part of the operational matrix converting say, a 10 × 10 pH-density matrix into a 1000 × 1000 one, thus, eventually capturing astronomically large data. Even for a large matrix, time-lapse is determined by the smallest matrix time cycle, this is what we call "instantaneous"—it's finite indeed.

Fractal reaction kinetics to synthesis brain jelly: However, M↔C↔S vibrational chain has been programmed by Ghosh et al. to replicate the evolution of neural network circuits in a chemical beaker (Figure 4.8d–f) using fractal reaction kinetics, see Chapter 9 for details. However, we should note here that the fractal synthesis that repeats the formation of triangle and square alternately (Figure 4.8g) and sphere, spiral alternately (Figure 4.8h) from 8 nm to millimeter-scale is an amazing (Ghosh et al., 2016b) observation. Therefore, fractal mechanics could be used using table 4.5d, from building decision-making devices to the chemical reaction kinetics. Universalization of the Plank limit would have enormous effects on the materials engineering in the coming days.

4.8 BASIC MATHEMATICS USING CLOCKS

Figure 4.9 describes how using a pencil one could write any basic integer, powers, equations on a piece of paper as a precursor to the development of continued fraction geometric

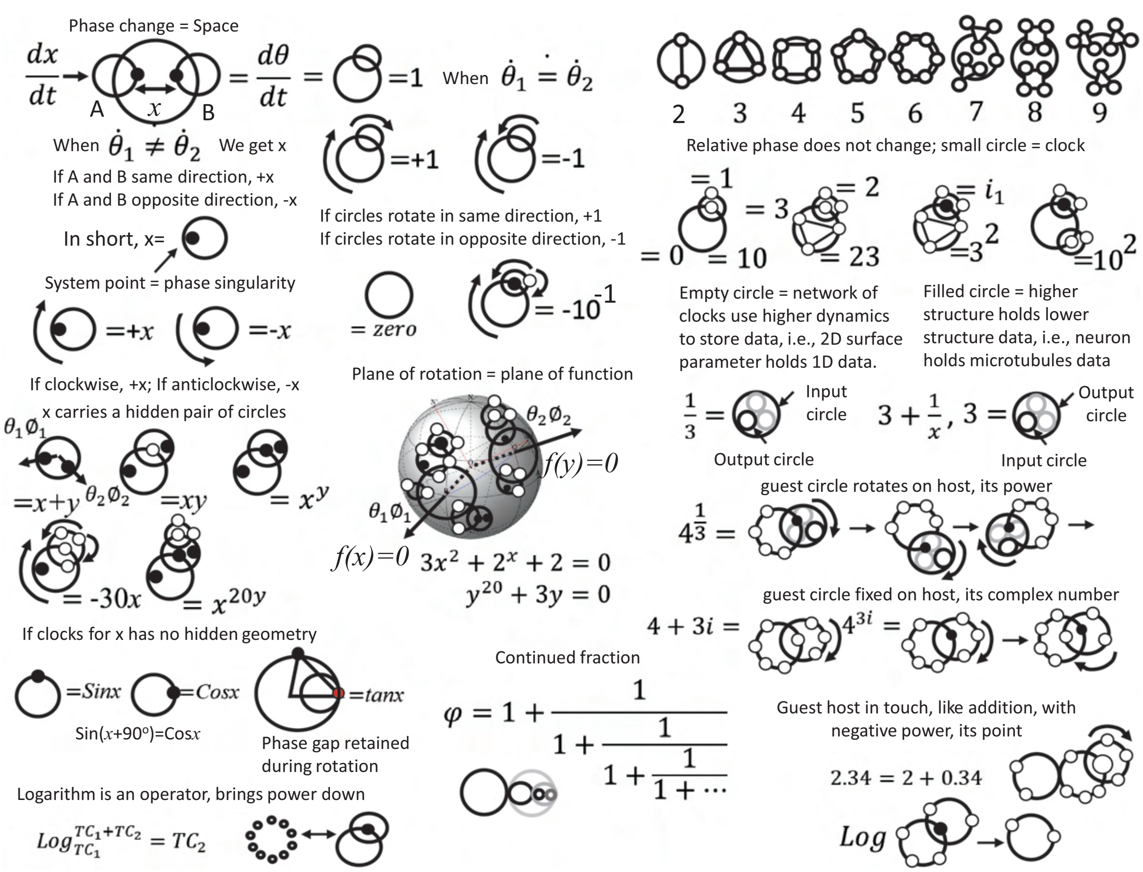


FIGURE 4.9 In three columns all basic mathematical operations are explained in terms of circles or clocks. The top left is how to encode a variable x? Then, different power relations of x, trigonometric parameters of x are shown. The second and third column top panels are integers. Toward the right bottom, we demonstrate the fractions and the decimal numbers. The protocol to write an equation with multiple variables are noted at the center.

algebra, CFGA, where one could carry out all complex mathematical operations simply by drawing. The process is part of GML and suitable to be implemented using fourth-circuit element H described in Chapter 8. The chart begins with the writing of a variable x, one needs two system points on two circles, their difference replicates the dynamics of an unknown variable x. Clockwise and anticlockwise rotation determines $+x$ and $-x$, always in CFGA, sign depicts direction. For simplification, a tiny dark filled circle is added at the inner side of the perimeter of a circle. When the dot is an empty circle, and located on the circle perimeter, it is 1. Using empty circles, one could write 2,3,4,5,6,7,8,9. Empty circles are nested to create integers, two examples are shown like 10 and 23. When these circles are filled we add a number in the power position of another number. For representing a continued fraction, a given circle is divided into small parts. These parts could be at the base and at the indices, for example $1/3^{1/5}$. We could write complex numbers. Logarithm operation could be performed taking power to the base.

Figure 4.9 also describes how one could write complex equations with multiple variables. We noted above that a black filled circle, is a variable say x. Now, if we have multiple variables, then we need to write it on a Bloch sphere or 3D phase space. If we have multiple functions then on the sphere each function acquires a plane with a vector that is an axis of rotation or central control. The difference between a function and an equation is that an equation has an additional circle or clock that loops all functions into a bond.

4.8.1 Numbers, Equations, Addition, Subtraction, Multiplication, and Division

Figure 4.10 explains different arithmetic processes. The panel "a" shows how one could add a few numbers by adding the diameter of the circle and creating a new clock, or simply adding the number of dots on the perimeter of a circle. Even power addition is also possible. The panel "b" shows the different

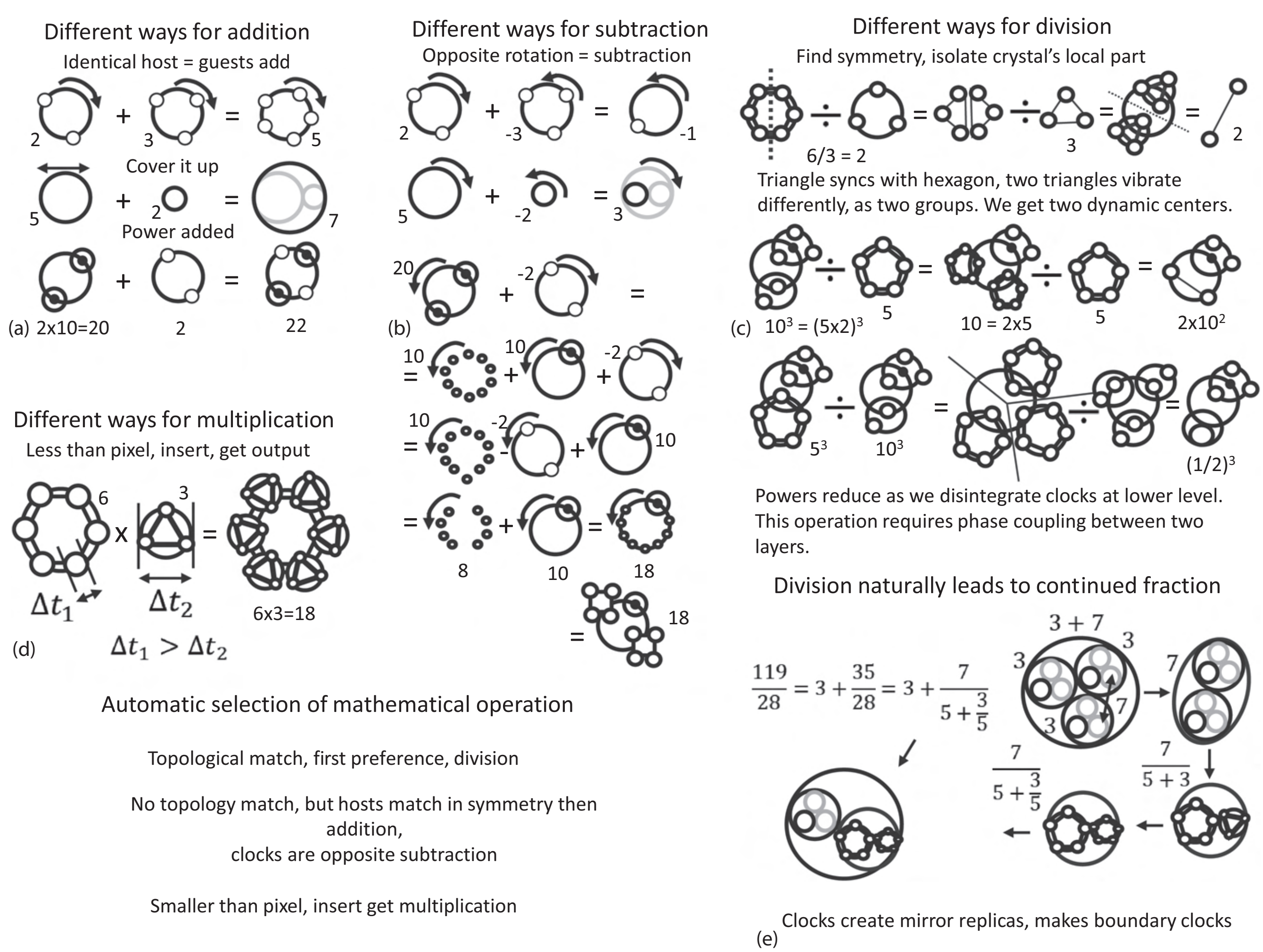


FIGURE 4.10 Basic mathematical operations to be c.arried out by clocks. (a) Three ways addition could be performed. (b) Different ways of subtraction of multiple integers. (c) Different ways of division. (d) Different ways of multiplication. (e) How division automatically leads to the formation of the continued fraction.

ways for subtraction. The system of clocks naturally decides to go for addition or subtraction based on the rotational direction of the clocks, those who run in the same direction, go for addition and those who run in the opposite direction, subtract. Panel "c" shows different ways for the division. In the case of division, it is important to isolate the time crystal representing the number into multiple parts based on the symmetry of the divisor. For example, if we are dividing by 2, then using the C2 symmetry, we would divide the time crystal into two different parts. If dividing by 10^3, then we would split the time crystal into three parts, there is a simple way of doing it. Panel "d" shows different ways for multiplication. Here to multiply, one has to insert the time crystal for one integer into the singularity points of the other. Panel "e" shows that if the division fails, how fractionalization, could take over and if there is no completion, the process would continue.

4.8.2 Differentiation, Integration, and Partial Differential Equations—Lie Algebra

In Figure 4.11a, we demonstrate how the differentiation and integration could be implemented by rotating the system point or changing phase (for trigonometric functions), or editing the power of functions. Integration and differentiation are opposite processes. One nice example is shown in Figure 4.11b, where we differentiate one of the products for partial differentiation. A partial differential equation is realized by keeping a set of clocks intact and changing a few. Figure 4.11c enlists the process on how to geometrically address differential equations of different orders. There are several popular equations made of partial differentiation, they appear beautiful.

Lie algebra and bypassing the non-differentiability: The physical significance of log is that a physical parameter varies depending on how much a parameter weighs at that point. Now, this is a very interesting situation even if we have a single log relation. Lie algebra (Bourbaki, 1989) developed in the 1930s nicely address this issue. Kac-Moody Algebra (1960) an extension of Lie Algebra developed over a complex space addresses infinite dimension. The linear space transformation that governs the "rate of change" could be a complex number if there is self-similarity, in PPM-GML-H triad case we have self-similarity. Now, the interesting part is that the linear space transformation cannot define a rate of change which contains a parameter that is defined by another complex number's space transformation. In such situations, without a debate in mathematics we consider that a function becomes

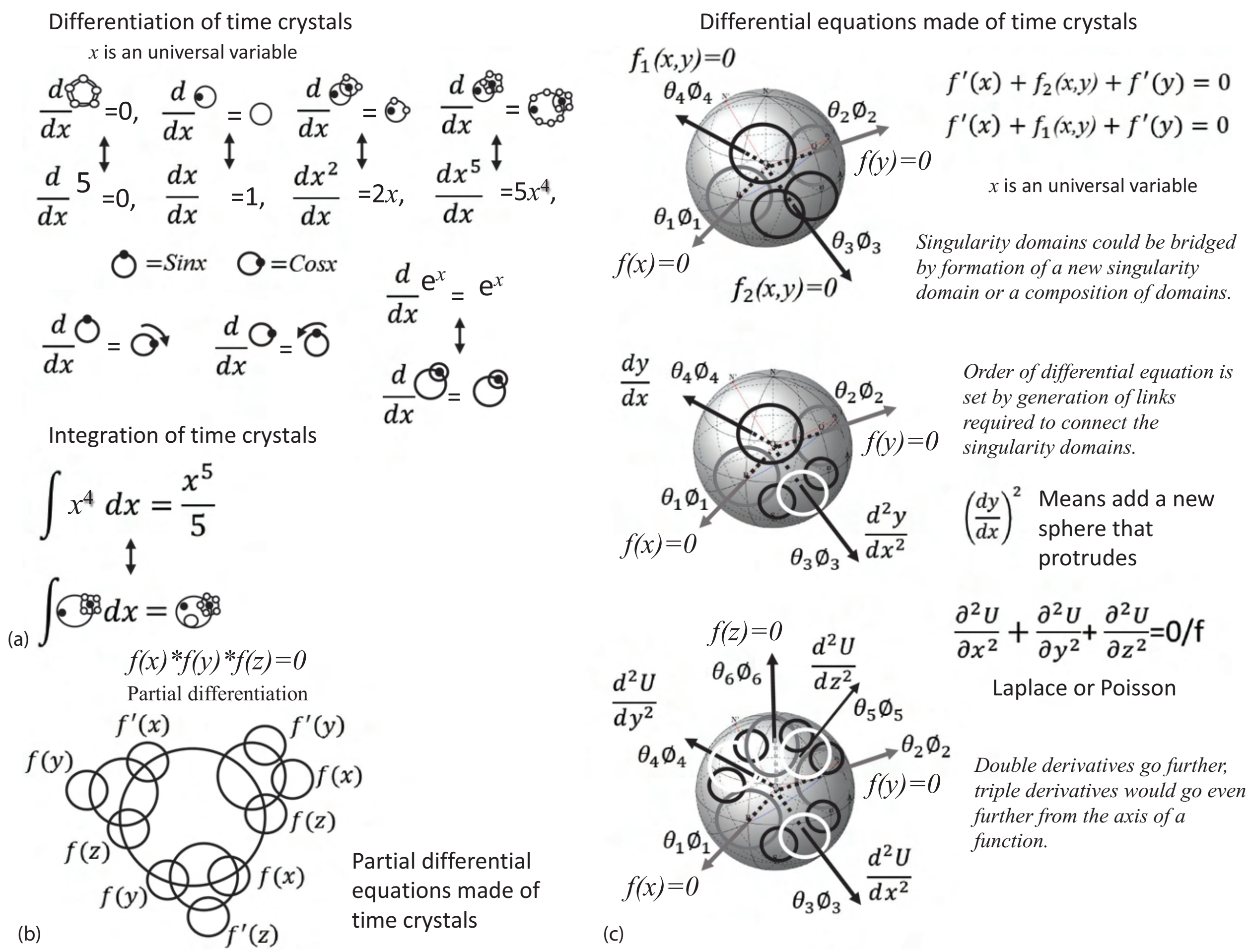


FIGURE 4.11 (a) Differentiation and integration using clocks or time crystals. (b). Partial differential equation. (c) Differential equations made of time crystals. Three different types of time crystals are described in the three panels.

an undefined mathematical entity. However, we leave with a major conclusion that since in PPM-GML-H triad case the complex number's real and imaginary parts are frequency, therefore, we have an imaginary space-time world inside another imaginary space-time world and so on. Already a part of this theory was formulated in Riemannian manifold.

Iterative function systems are resolved in the images given to the new class of computer in the way described above, however, during computation, at different layers of the hardware, synchronization and de-synchronization of the resonant oscillation continue. Computing time is the synchronization time of the fractal seeds. Synchronization leads to coherence which means Fractal seeds oscillate in the same phase and frequency. Spontaneous switching between synchrony and de-synchrony is essential, thus, entanglement is not a pre-requisite. The information perspective of that physical process of computing is that several fractal seeds of iterative function systems form the network, coupling and de-coupling of large networks is a generic event that happens during computation.

Lie group, conformal group of the sphere: Geometric language of PPM computing: The conformal group is the group of transformations from a space to itself that preserve all angles within the space. It is the group of transformations that preserve the conformal geometry of the space. Harry Bateman and Ebenezer Cunningham showed in 1908 that the electromagnetic equations are not only Lorentz invariant, but also scale and conformal invariant (Bateman, 1909). Putting coordinates together with sphere's radius was Lie's first work in 1871, The conformal group includes the Lorentz group and the Poincaré group as subgroups, but only the Poincaré group represents symmetries of all laws of nature including mechanics, whereas the Lorentz group is only related to certain areas such as electrodynamics. Due to this universality, the conformal feature has been used in constructing the geometric language for PPM computing. All basic geometries used as letters for operational language are encompassed inside a circle or sphere and ratios of contact coordinates are used. The preservation of conformational geometry enables a precise encoding of sensory data as a stream of nerve impulses. List of simple Lie groups Classical An Bn Cn Dn; Exceptional G2 F4 E6 E7 E8. This book does not endorse any unified theory starting from a single geometry because PPM metric described in Chapter 3 demands for several evolving vortexes each carrying a distinct PPM, and depending on its prime number origin, the evolution of symmetries change, redefine. Also, for a conscious machine, E8 does not suffice, we need a dodecanion with 11 imaginary and one real world, whose manifold geometries with 12 planes overlap to create a physical form of conscious thought.

4.8.3 CFGA Operator That Runs 13 Math Operations in a Time Crystal Structure

In Figure 4.12, we have summarized a list of 13 mathematical operations described in Figures 4.9 through 4.11. One of the most important features of continued fraction geometric algebra, CFGA is that naturally it is selected which means, from outside, there would be no need to encode an instruction. Time crystal self-assembly is a process that detects minute simple changes or differences in the structure is detected and action is detected. The third and the fourth columns of the table in Figure 4.12 lists processes in such a way that materials self-assembly runs as is mathematical operations. Thus, careful observation of this table would reveal that natural weak interaction-based material self-assembly of Hinductor devices would spontaneously trigger the actions listed in column 4. CFGA operator execution is not a linear sequential process, its managed by a time crystal, which helps to isolate typical mathematical operations and run them repeatedly so that particular self-assembly process autocorrects itself if there is an error. One such problem is described in the bottom right panel of Figure 4.12. Interaction between the imaginary worlds is a critical aspect for the quaternion, octonion and dodecanion tensors. There are three aspects that create information exchange channels between different imaginary worlds. The journey through singularity addresses the power of an integer, tensor element transformation and finally fractal geometry.

4.9 THE FUNDAMENTALS OF QUATERNION, OCTONION, AND DODECANION

No more Fano plane, now it's time for manifolds: Using shades, we have pointed out how one could find a quaternion in the octonion and dodecanion in Figure 4.13. Most off-diagonal elements of the four multiplication tables for dinions, quaternions, octonions and dodecanion are antisymmetric, making all four of them almost a skew-symmetric matrix except for the elements on the main diagonal, as well as the row and column for which h_0 is an operand. A single Fano plane that links seven imaginary worlds with seven lines explains the multiplication of an octonion world. One could notice the clocking loops in the Fano plane, each loop is made of three elements, making sure that a triangle is stored even at the smallest level, when each element is a singularity point. The clocking direction is fixed and very important, so they do not build a matrix but a tensor. Similarly, when the clocks made of three singularity points are used to build the multiplication of a dodecanion world, we find that four planar structures are required instead of one. One planar structure is made of 11 points centered at 1, here 9 occurs twice, so we need to fold the plane, two points with 9, touch each other. The second planar structure is made of 13 points centered at 11, here 3 occurs thrice. The third planar structure is made of 9 points, where 4, 5, 6, and 7 occur twice. The fourth planar structure has 6 points. In order to understand how a dodecanion tensor would connect the clocking triangles, we need to join the four planes by touching the common points. Thus, we get a manifold. The journey to manifold machines begins here, we have outlined the futuristic machines in Figure 10.12.

4.9.1 The Rule of 11D Manifolds

A quaternion-topology of dodecanion for consciousness: One interesting plot at the bottom of Figure 4.13 is that there is three quaternion composition for the dodecanion. The coexistence of three distinct quaternions suggests that simultaneously three solutions would generate for every single dodecanion produced in a device. It means single hardware, if it acquires a topology that allows it to put three, time crystals of solutions in the three singularities, a new time crystal is born with a triangular control. When each contributing element from the tensor is a singularity point, for a dodecanion tensor, the triangle made of quaternions as noted above, would be a higher-level geometry. However, when eleven imaginary worlds would send complex time crystals, the resultant quaternion as shown at the bottom of Figure 4.13 would depict a new phenomenon. At the highest level, when all the components have already contributed, three distinct information processing could run at a time in the single hardware. In quantum, one could sense the contributions from unknown to the reality, but when 12 imaginary layers operate together, the hardware could remain in the imaginary world, with a distinct geometric identity, here it's a triangle. The ability of single hardware to package entire information in three identical parts and then edit three of them independently is considered here as consciousness. The quaternion-topology of dodecanion satisfies the minimum requirement for reverse engineering a conscious machine, for the higher-level tensors, one could extrapolate consciousness to a superior scale as outlined in Figure 10.12.

Where does the physics laws come from? What distinguishes between laws and no laws is a mystery (Goodman, 1954), it was suggested that the laws are relations between properties or universals (Armstrong, 1983). It was a departure from Hume that "laws assert no more than regularity of coincidence between instances of properties." There are anti-reductionists who think that there are laws in the universe, but no need to specifically appeal to properties or universals (Woodward, 1992). Anti-realists think that there are no laws in the universe. Two arguments we note. First one is that all generic laws are derived in a boundary condition, outside, it is not verified cannot be said to be valid, a law should be an external entity (Mumford, 2004). The second one is that derived laws are properties of a system, not a system-independent feature that a system follows

Spontaneous activation of math operations by clocks, CFGA operator $\hat{C}$ symbol Ж

Steps	Math. Operation	Condition for spontaneous operation	Circle Property
1	Multiplication	Temporal match, (Width of phase singularity = clock diameter to be fused).	Insert
2	Division	Topological match of local parts.	Split the gaps
3	Addition	Hosts are identical, guests bond. Participants rotate same direction	Form closure
4	Subtraction	Hosts are identical, guests bond. Participants rotate opposite direction	Complement
5	Differentiation	Higher world (power) topology becomes essential to the lower world.	Transfer
6	Integration	Taking higher world topology to the lower world.	Transfer
7	Fraction, decimal	Subtraction/division fails to match, process continues.	Repeat
8	Logarithm	Higher world, or topology of power alone survives, host disappear, due to match.	transfer
9	Power	Reduction of large number of identical clock geometries, by adding a guest.	Reduction
10	Polynomial, series	Phase axes of clock geometries differ, they fail to bond, so adds as guests.	Fusion
11	Partial diff. equn.	In a composition of clock geometries, if one changes & others do not.	Split
12	Matrix, tensor	Clocks self-assemble to form clocks, not discrete isolated chain of clocks, closed.	Fusion
13	Fractal shrink	Each imaginary or real higher world (power) have identical clock geometries.	Reduction

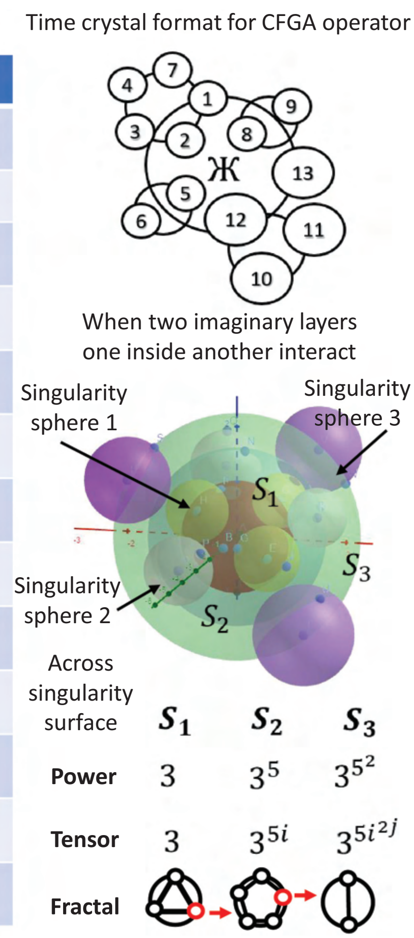


FIGURE 4.12 A table represents a set of 13 steps that describe essential mathematical operations, automatically selected and executed. This function is named as continued fraction geometric algebra, CFGA. We use the symbol Ж to denote the operator. To the top right, the 13 step operations are grouped as a nested circle. In the middle nested singularity spheres are noted. Three singularity spheres located one inside the other, processes integers or numbers as powers, tensors as imaginary powers and geometric shapes as layered structures.

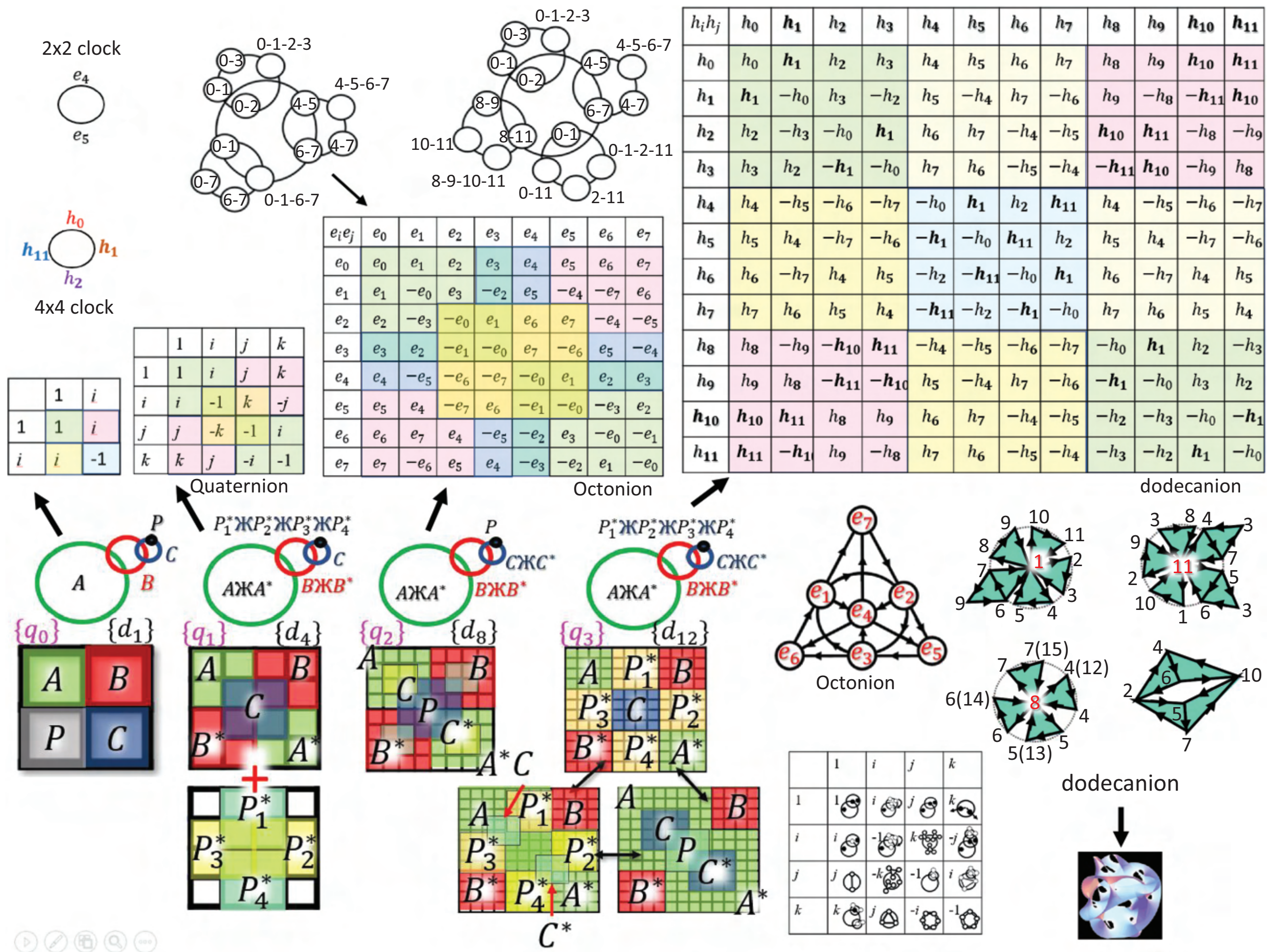


FIGURE 4.13 Four types of tensors represent the data structure of the artificial brain. Four types of tensors are presented here dinion, quaternion, octonion and dodecanion algebra for the time crystal representation. Four different ways the multinions are explained. First, time crystal presentation of the multinion, second, matrix representation which is colored as square matrices; third, linguistic presentation, here, we present the tensors as a subset of four clocks, each clock represents a sub-matrix of the entire tensor. Sub-matrices A, B, C, and P. Quaternions show duality and dodecanions show simultaneous co-existence of three matrices. To the bottom right corner Fano plane for quaternions and manifolds for dodecanions. There is a pictorial clock like presentation of a quaternion at the bottom right, it suggests how a single element in a tensor looks like.

(Giere, 1999). The most important of all, if there is any law, how did they come into being (Cartwright, 1997). Since we derive fundamental constants partially from the PPM and geometric musical language (GML), various topological identities like $e^2+\varphi^2=\pi^2$, we avoid laws, generate the transition of one dynamic to another. Thus, when we convert properties or universals as changing geometric shapes, and link them using the metric of symmetry, PPM, the laws may or may not be out there in the universe, at least we do not have to find them.

4.10 TWELVE EQUATIONS THAT REGULATE A FRACTAL TAPE FOR PRIME-BASED COMPUTING

Figure 4.14 explains how different imaginary worlds of the quaternion, octonion and dodecanion tensors operate. The tensor elements affect different imaginary worlds. While doing so, there is a topological restriction which is geometric in nature, then there is a materials restriction which is weak interaction based self-assembly rules, finally there is a manifold restriction which is regulated by the symmetry of the distribution of primes. Twelve equations which were noted earlier in the context of geometric operation in Figure 3.12a. We have extended the same table in Figure 4.14 where we introduced the picturization that is spread all over the book, how the projection from infinity looks like.

4.10.1 Projection from Infinity—Future Impacting the Present

To the extreme right of Figure 4.14 we have explained using a continued fraction how exactly, projection from infinity redefines the basic dataset. In the expression of a complex data, in the continued fraction form, one could easily find the simplest geometric shapes that would repeat as is, isolate that one and send it as an output. This is very

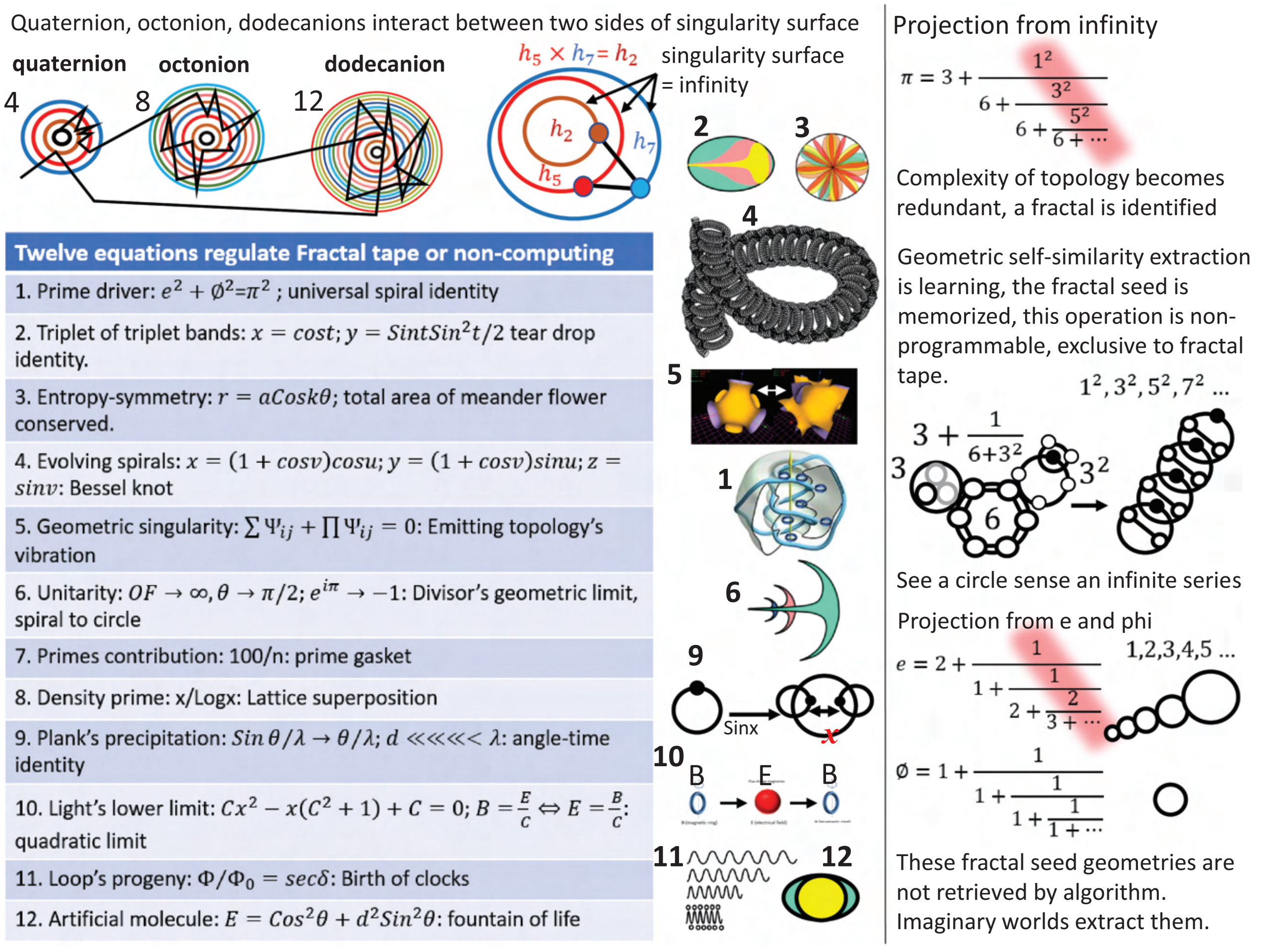


FIGURE 4.14 The fractal tape operation of an artificial brain is demonstrated. There are 12 key equations that govern the dynamics of artificial brain, shown in a table. Using schematic plots the projection from infinity concept is explained to the right part of the table for all 12 equations. To the extreme right panel how self-similarity of nested clocks distributed over an entire network of imaginary layers is shown. The top left panel shows layered circles showing quaternions, octonions and dodecanions. Computation or decision-making in the brain means exchanges of information between different concentric circles, shown with arrows. Interaction between layers follows the tensors explained in Figure 4.13.

important, since, here, no logic works, geometric self-similarity or numerical self-similarity is a feature that is truly fractal but absent in the pattern of primes. In fact since a pattern of primes never repeats itself, it is impossible to find a rule, making a decision. The projection from infinity is also like normalization that bridged singularity in the 1930s, but with a difference that it provides much more insight into the singularity before bridged using fractal seed geometry and neglecting the true delicacy of nature. Also, at the same time, here we know what we are losing, but in the conventional normalization it was an unknown process.

4.11 DIFFERENT KINDS OF SPIRALS IN NATURE

The origin of spirals come from hyperspace geometry. Here is a simple example of hyperspace equilibrium generating various spirals.

Prime number theorem implies that $P_n \sim n\ln n$, wherefrom it has been derived that if $\pi(n)$ is the number of primes less or equal to n, then $\limsup_{n\to\infty}(P_{n+1}/P_n)^{\pi(n)} = e$ while the lower limit of the same function is 0. The total contribution of n primes $\sum_{i=1}^{n} C_{P_n}$, if infinite integer space is depicted as unity, the normalized density of primes $D_{P_n} = 1 - \sum_{i=1}^{n} C_{P_n}$, within a certain range, if there are r primes $P_s \le P_n \le P_{s+r}$, we get ΔD_{P_r}. If we consider paired primes, since $\lim_{r\to\infty}(1+1/n)^n \sim e$ we get $\lim_{n\to\infty}(P_{r+1}/P_r)^r \sim \lim_{r\to\infty}(1+\Delta D_{P_r}/P_r)^r \sim \lim_{r\to\infty}(1+1/\varphi)^r \sim e$. Here φ is the golden ratio, i.e., if a and b are two primary linear distances, they self-assemble to determine the next length as a+b, then $\varphi = (a+b)/a$.

Wherein $(P_n + P_{n+1})/P_n \sim (a+b)/a \sim j$ across N is a logarithmic variation, i.e., we get e along the horizontal. Moreover, if we implement the planar angular drift explained earlier, then the projected normalized hyperspace $(1:\varphi)$ is a golden ellipse with an area π. Projected hyperspace by φ and e for any dimension is the sum of their generic power, hence we get $\varphi^{Jh} + e^{Jh}$, now since the projected hyperspace of φ and e is π (π measures points in H1; see Figure 4.15a) in one dimension and ($p\gamma = l\pi$, i.e., total points = total lines; i.e., total area = total lines = total points), therefore, sum of their

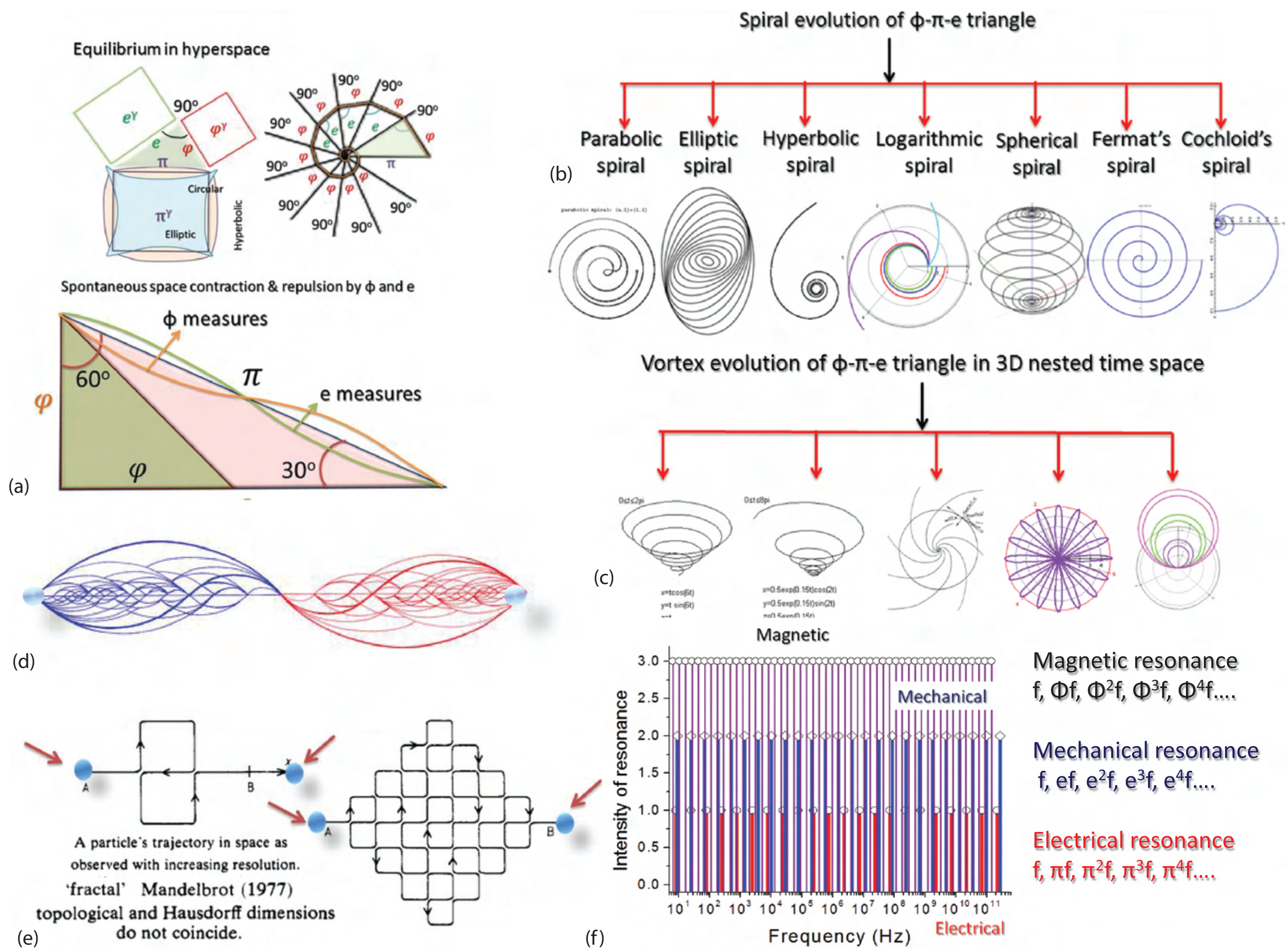
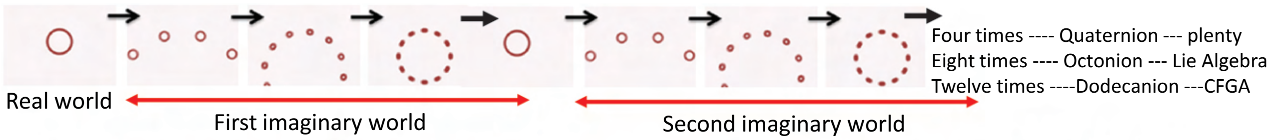


FIGURE 4.15 (a) e-pi-phi forms an orthogonal triangular relationship. This relationship governs every single step of a spiral formation. (b) Seven distinct 2D classes of spiral formation are shown in a chart. (c) 3D vortices of five different classes. (d) nested waveforms form the space-time geometry in the multinion world of information processing. (e) Fractal space-time concept. (f) How the resonance band for magnetic, mechanical and electrical would look like.

orthogonally coupled hyperspace is the hyperspace created by π of the same order $\varphi^{Jh}+e^{Jh}=\pi^{Jh}$. Now we try to find the value of Jh, we can easily estimate that $Jh > 2$ (for orthogonal triangle $a^2 + b^2 = c^2$, hence $Jh(\min) = 2$. The orthogonal relationship suggests that ideally angular deviation should be 30°, 60°, and 90° following the ratio $\varphi : e$ but φ is a function of $(P_n + P_n + {}_1)/P_n$, so is e.

First, φ and e are orthogonally connected to hyperspace, $\sum_{r=1}^{\infty} 1+(k/e)^r=\varphi$; $k(e)=1.05$, and $\sum_{r=1}^{\infty} 1+(k/\varphi)^r=e$; $k(\varphi)=1.03$, so it proves that they are orthogonally coupled, but the hyperspace is not planar $\left(k(e)-k(\varphi)=\Delta Jh\neq 0\right)$. We vary the $(P_n+P_{n+1})/P_n \sim (a+b)/a \sim j$ plot. Note that RNP(Δn_r) generates various logarithmic variations. It shows that the projected hyperspace could be spherical, ellipsoidal and hyperbolic, depending on the non-linear oscillation frequency matching between two neighboring closed loops in the NC/OF metric. The deviation in the projected hyperspace is strictly a function of deviation in orthogonality, ΔJh; hence $Jh = Jh(\min)+\Delta Jh$. Here, its 2.00001 (an infinite series). In order to verify, we assign φ (AB) and e (BC) two perpendicular sides of a triangle ABC, where angle/ABC = 90°, while AC is π. We find that if $Jh = 2.02\ldots$ The angle between π and e measured by e is 29.62°, the same angle measured by φ is 31.28°. The angle between π and φ as measured by e is 60.42°, and measured by φ is 58.75°. The deviation of ±1.6° is from non-planar projected hyperspace. ABC relates φ, e and π as $e^{2.0}+\varphi^{2.0}=\pi^{2.0}$. Second, by continued fraction expression for φ and e are a linear function of N as $N\rightarrow\infty$, while π infinite continued fraction needs a square of integers $\pi = f(N^2)$, while $\pi^2 = f(N)$, hence π^2 could integrate both φ and e as the sum of areas. We estimated π accurately from $e^{2.0}+\varphi^{2.0}=\pi^{2.0}$. Once the triangle with hyperspace twists the Jh value, at least seven distinct 2D spirals (see Figure 4.15b) and five 3D spirals (Figure 4.15c). When these topologies are projected in the fractal space-time of nested clocks (Figure 4.15d) or in the fractal space-time of nested regular grid pathways (Figure 4.15e) we derive the resonance bands.

In the resonance bands of Figure 4.15f, we see that electrical resonance frequencies are $f_{e0}, \pi f_{e0}, \pi^2 f_{e0}, \pi^3 f_{e0}\ldots$, mechanical resonance frequencies are $f_{m0}, ef_{m0}, e^2 f_{m0}, e^3 f_{m0}\ldots$, magnetic



Dodecanion, d is written in the form (d is the decision state made by our artificial brain), h_0 is real, d has 12 tuples

(a) $$d = d_0h_0 + d_1h_1 + d_2h_2 + d_3h_3 + d_4h_4 + d_5h_5 + d_6h_6 + d_7h_7 + d_8h_8 + d_9h_9 + d_{10}h_{10} + d_{11}h_{11}$$

General algebra	Continued fraction geometric algebra, CFGA
Dimension or number of imaginary worlds are fixed, for example, octonion has 8 Tuples, 8 dimension. No one explored interaction between universes of different dimensions.	It is a composition of multi dimensional universes. 12 tuples, 12 dimension, 12 worlds or dodecanion, then octonion and 4 tuples, 4 dimensional quaternions or 4 worlds etc.
Works on a linear number system, 1, 2, 3...	Each number has a geometric shape, 8=361=point; 12=18=28=triangle, composition of geometries is analogous to number system
Within a universe, say, dodecanion universe, higher level interactions between imaginary worlds were not allowed.	Allowed. For dodecanion 3x(12C2x12C2x12C3) = 66x66x220 distinct triangles; 8C2x8C2x8C2 = 28^3 distinct single point composition.
Fano plane, Jacobi identity, nothing governs.	Fano sphere, $e^2 + \emptyset^2 = \pi^2$ identity, PPM governs
Equation is used, sometimes syncopatic or symbolic instead of rhetoric algebra.	Question/answer are all 3D structure of circles or geometric shape, one draws circle to do all.
Fractal or non-differentiability is avoided	Fractal or non-differentiability is essential
Abstraction of variable. Dynamics, unknown values are obtained	Abstraction of symmetry, link symmetries forming topology, solutions are knots, loops.
Reduce, transform, differentiate, integrate.	Topological analogues exist
Axioms, idioms, proofs are basic practices to explore reductionism, abstract operations.	Symmetry breaking rules are geometric, cant be imagined, density of primes regulate them
Projection of infinite series have no effect	Geometric projection sends feedback to input

Fractal mechanics	Geometric algebra
Insert in pixel is measurement	Same operation is multiplication
Hilbert space has sub-regions	Functions of distinct variables
Planck constant like multiple actions active	Actions help in higher derivative, higher power
Multiple condensations	Reduction
Quaternion, octonion, dodecanions	Transfer of power to the indices
Fractal interference	Complement for subtraction
Fractal beating	Addition
Return of entanglement or coupling	Finding fractal seeds naturally

(b)

FIGURE 4.16 (a) A dodecanion tensor means a directional journey within or above 12 layers, each imaginary world value is represented with a new distinct tuple. (b) Two tables. The table in the left demonstrates a comparison between the existing geometric algebra and continued fraction geometric algebra. Table to the right represents one to one correspondence between the fractal mechanics and the geometric algebra.

resonance frequencies are $f_{g0}, \phi f_{g0}, \phi^2 f_{g0}, \phi^3 f_{g0} \ldots$. In experiment such integrated coevolution of resonance frequencies does not occur ideally. However, we get nearly quadratic resonance regulation in the system. This is called $e - \pi - \phi$ quadratic driver.

4.12 A MARRIAGE BETWEEN FRACTAL MECHANICS AND GEOMETRIC ALGEBRA

Materials self-assembly = mathematical operation = implementation of the rules of fractal mechanics: The established route of a fractal space-time adds a physical reason for connecting the neighbors (Reddy et al., 2018). It is noted that as one moves between different imaginary worlds, the interaction between different worlds, one affecting the other, in a unique way. It is not about the imaginary worlds in an isolated manner, CFGA is exclusively designed so that materials could implement the algebra during its self-assembly process, and address the interaction of the worlds intimately. Materials self-assembly = mathematical geometric operation. And finally, no result is confined in one imaginary world alone. The critical differences are listed in the table of Figure 4.16. The funny comparison of fractal mechanics and geometric algebra: The bottom right table in Figure 4.16b shows a few funny situations where CFGA implements the rules of fractal mechanics. The coolest part of this table is that we see mathematical operation to change geometric shapes and the complex mechanical principles are naturally implemented. Thus, it is a more generic route toward implementing physical phenomena in the materials as conceived by Bandyopadhyay et al. (2010b, 2010c).