Vikalpabalādeva jantavo baddhamātmānamabhimanyante|So'bhimānaḥ saṁsārapratibandhahetuḥ|
Ataḥ pratidvarūpo vikalpa uditaḥ saṁsārahetuṁ vikalpaṁ dalayatītyabhyudayahetuḥ||

Non-dual Shaivism of Kashmir (Trika)
It is the sensory misperception that leads us to believe that our consciousness is locally confined to this world; that's why time to time an opposite thought (non-local) arises in our mind and that elevates us to a higher-level consciousness.

2 Replacing Turing Tape with a Fractal Tape
Fractal Information Theory (FIT) and Geometric Musical Language (GML)

2.1 INCOMPLETENESS OF CURRENT INFORMATION THEORY

Is it better to see a triangle or read 100001010101010000000? These sets of letters make no sense to us. We need a decoder to read it. What if we have a language that has a decoder, our perception, a higher-level argument? For centuries, information was an inanimate object. Imagine a time in the future when information is like a life form. It has a clock to keep time and a geometric relation as its significance or importance; it could be understood as a cognitive entity, with no reality or classical physical existence; it is like a concept. If we indeed find the information structure of the universe or our brain, we should be able to understand it as soon as we look at the information structure. Seeing a geometry, we must say, is a structure of fear or a structure of a joy.

When everybody bypasses *undefined* and *singularity*, here is a creature that cannot survive without them: If somehow, we preserve the way the events are linked in nature, we do not have to create scientific models or theories; the pattern that links is itself the scientific theory. Writing an equation may not be the only way to practicing science; it could be singing too. Unfortunately, connecting the events within and above was always considered scientifically impossible, and undefined, and if one could not make equations or differentiation, then what would be the point of studying these events? So, historically, scientists have always found a way to bypass such singularity. What if nature's journey is only through singularity? While traversing an infinite path within and above, nature might consider that every single event that has happened, happening, and will happen are all linked by a topology. One at a time, a sensor sees only one event as a single point, but there is an endless journey within and above. A new generation of sensors is required that could read to find that discrete, isolated events are not random and that they are linked by a topology; but that linking, even if regulated by free will, would not be random. If the universe is cooked using finite geometric elements, then it has a defined pattern made of undefined points. Free will is random only when we want to confine it in a linear sequence. However, if we want to see events as a topology growing within and above, finite events could be arranged following a finite number of choices in mathematics. Computing or decision-making is always about linking events: the choices of combining events make a pattern, and that pattern is universal. If a system or computer has an imaginary hardware that links events following that pattern, admittedly, it would be able to predict the future without depending on human imagination–driven scientific models or learning algorithms. That is the idea of making an artificial brain, and all artificial brains have an embedded event-linking pattern hardware, so when they interact with the events unfolding in nature, both arrange the events similarly, plan events similarly, and execute events similarly. Turing's culture to melt and rebuild is replaced by "be like it"—that is the new bit.

Connecting the dots: "It from bit," to continuous to geometric: Every single knowledge that science generates is asking a question by doing an experiment, whose answer would be in terms of "yes or no"; thus, we derive "it from bit" (Wheeler, 1990). "Every 'it'—derives its function, its meaning, its very existence entirely—even if in some contexts indirectly—from the apparatus-elicited answers to yes or no questions, binary choices, bits" (Tukey, 1984). Nature arranges events "bit by bit," linearly, and we read only one reply at a time. There are plenty of problems with this philosophy (Figure 2.1): (a) A directly opposite thesis could be that the physics at the bottom is continuous; nature does not write information as a bit, does not connect events linearly. (b) Nature could write events as vibrating strings, like string theory. There could be unknown grand unification theory, suggesting a unique event for physics at the bottom. (c) The local environment might change the response when

we ask a question to a single entity. "The choice of a question asked, and choice of when it is asked, play a part—not the whole part, but a part—in deciding what we have the right to say" (Wheeler, 1984, 1986). Who, what, when, and how are four questions that structure a bit at the bottom. (d) A bit could be an expression of many, indistinguishable, entities. If the physics at the bottom is topological, then events are connected by phase; a qudit can model such physics at the bottom. However, if every single event in the universe is made of a topology of subevents, then neither classical nor quantum mechanics could act reasonably. The information is not a language of bits, but a geometry of silence. (d) Always, there is a question, information of whom? If there is no answer as to whom, the rest is human imagination, and we build physics models as an extension of a black box. (e) Connecting the bits to regenerate a natural phenomenon includes a human bias. Probability, like space and time, is invented by humans, and different people have a different belief; they connect the bits or dots differently to produce the same output, assess the future differently. Probability as frequency, per Bayes theorem (Jaynes, 1986; Denning, 1989), is a function of human belief (Berger and Berry, 1988), agreed upon by a large number of people (Burke, 1985); thus integrated information theory (IIT) accounts for the political strength of a human belief. Despite their great explanatory power, physics laws do not describe reality; they lie (Cartwright, 1983). The reason for non-reality is the scientific method (Feyerabend, 1975).

Define what understanding is: Define whose information, and who measures: The structure of science is loaded with human bias and a luck factor that, if interacting with the right entity, would address the question we ask (Figure 2.1, see human bias). The scientific endeavor to understand the existence of life or that of the universe is a trial and error to ask the right question at the right time, to a right entity, and in the right way. Understanding is not universal. "Meaning is the joint product of all the evidence that is available to those who communicate" (Follesdal, 1975). We need an information theory that addresses the silence or even non-communication. Thus far, we have no structure, no plan of organization, no framework of ideas underlaid by another structure or level of ideas, underlaid by yet another level, by yet another, ad infinitum, down to a bottomless night. Here we argue that it

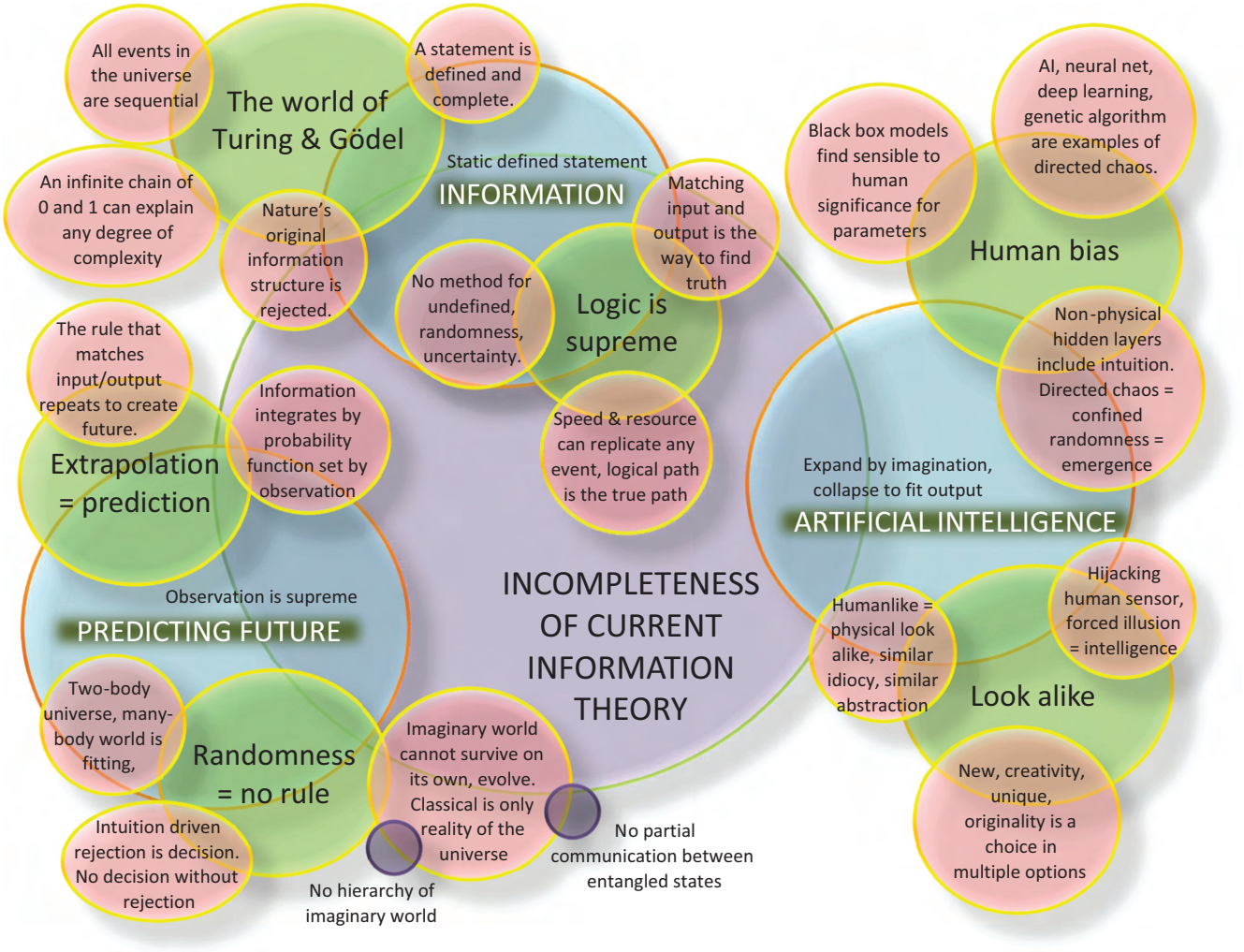


FIGURE 2.1 A diagram showing the problems with the current information theories.

is not mandatory to have a grand unification theory, to have such an architecture of information. To endlessness no alternative is evident but a loop (Wheeler, 1988), and such a loop as this: Physics gives rise to observer-participancy (Wheeler, 1977), observer-participancy gives rise to information, and information gives rise to physics. Quantum interactions tell us that it is possible to do measurement without changing the state. In that sense, a new information theory should inspire from the Ahranov-Bohm experiment (Aharonov and Bohm, 1959) where that flux of magnetic lines of force finds itself embraced between—but untouched by—the two-electron beams that fan out from the two slits. The shift in the interference fringes between field off and field on reveals the magnitude of the flux:

$$\begin{aligned}&\text{Phase change around the perimeter of the included area}\\ &= 2\mathbf{v}\mathbf{r}\times\begin{pmatrix}\text{shift of the interference pattern,}\\ \text{measured in several fringes}\end{pmatrix}\\ &= \left(\text{electron charge}\right)\times\left(\text{magnetic flux embraced}\right)/\hbar c\end{aligned}$$

Even quantum experiments that avoid collapse as they are "untouched by electron beam" and gather "it from bit." Even quantum experiments consider that truth about nature could reveal as a "yes" or "no" answer to the query (Wheeler, 1984).

The answer to "yes" or "no" is not the only way to learn the truth; not bit-by-bit but within-and-above, singularity in geometric phase: We suggest that there could be an experiment where we do not need to ask questions. We built a series of technologies with simple instrumentation to sense pure information from a system. Quantum provides the trick to measure the change in phase, a non-demolition way of measuring an event.

The universe is not just participatory; both the observer and the environment are part of information content. Thus, the information is geometric. All Wheeler's criteria are fulfilled, except for the following:

1. Information is an infinite network of geometric shapes.
2. Observer and environment effects are neutralized as an infinite conformal network is created
3. Time and space are both tools to measure interval: the phase is a continuum, and we create interval looking into the location of singularities on the loop perimeter. Thus, mass, time, and length disappear; we intricately map the singularities.
4. Geometric shapes are made of singularity points. Events are not real; there is no classical point in the network of events.
5. Geometric phase is not continuous, as believed in the classic version of quantum mechanics (Anandan, 1988; Anandan and Aharonov, 1988).

All solids we see are dead and empty by science, and that is a fact: Mathematically several researchers argue for a fractal world, and possibly that is why nature is proposed as a computer (Margolus, 2003). There are plenty of rhythms far outside our body, and there is plenty of rhythm deep inside our body. Both kinds of rhythms run beyond our senses. Beyond our senses, the rhythms run, we perceive those only when they affect the rhythms of our conscious experience. Therefore, for Turing's world, the universe is melted and rebuilt as an infinitely long thread whose pixels are binary bits; for the universe we explore here in this book, the entire universe is an intricately connected 3D geometric shape whose only reality is the bursts from the singularity points, and rhythms bridge the gap between the singularity points. Zillions of system points touch the corners of the geometric shapes, and its periodic motions are seen as running clocks. The universe is lifelike and cannot be melted and rebuilt; we need a probe that has a similar architecture in order to learn about it, and that is the artificial brain explored here.

No event in nature could be re-created by arranging a set of elementary events one after another. An event could itself be a closed 3D topological structure. Imagine a cube: each of its eight points is a subevent, so, when we linearize, we destroy coexisting paths linking the subevents. If nature integrates subevents as topology, the journey to integrate information would be within and above, never side by side. If we could reduce Big Data into a topology, once we convert, then we apply pure physics: how topological structures change, break symmetry, and undergo a phase transition. So, without finding a programmer to unravel ideas in dead "bits," we can use physicists to predict threats or other decision-making. Then decision-making is possible without writing a single line of an algorithm, just like our brain does it always. Geometric entities could be used for computation, and the idea is not new (Forrest, 1971; Preparata and Shamos, 1985); but the use of geometric shapes as a composition to build up mathematical constructs was not yet there.

Simple analogies to understand a time crystal: Space singularity creates a spatial crystal, and the phase singularity creates a time crystal. Time crystal does not have time within, by closing a loop it defines a unit of time. Imagine many such clocks are arranged in a 3D space; one could build infinite close pathways by connecting the clocks. The topology of time cycles is different; therein, we cannot add the time linearly. Time is not a flow of the wave, and it is a cycle, a closed loop. One has to wait for the singularity bursts to sense that a circle has completed a rotation. Only then we can estimate the phase structure. That is why we sense the phase singularity points and note the geometry they reveal. A good analogy is an electron rotating around a complex orbit, on the phase sphere always there is a circular orbit, but that orbit rotates with a phase velocity. If the phase change makes a sudden jump and an energy packet emits only then we get the information about a phase change, else if there is an orbital jump we get different information. Orbital transition is not our target, for detecting a time crystal we wait when the rotation of an orbit reaches a singularity and makes a jump, the energy

emits naturally. So, a time crystal is not about the clocking of an electron, a symmetry breaking or phase transition when an electron jumps from one orbit to another, it is exclusively a topology of phase singularity on the sphere only. Take another analogy. Several car drivers running cars, all of their minds are connected, for a time crystal we are not interested in the time required to travel, the path being traversed, but sudden maneuver to avoid accidents is visible which accounts for the interconnected state of the minds of all drivers. That sudden event is analogous to burst from a singularity and thus, reflects some features about the topology in the mind of the drivers. That static architecture of phase singularities is the time crystal, an engine that bursts at the singularity.

Particles move clocks run, Clocks interact singularities burst, Phase of bursts jumps in architecture, those jumps build time crystal. The photon moves like a particle; it is not time; it does not keep time; it is not a time crystal. However, if several photons interact, all clocks would run, change each other, that is not time crystal. However, when interacting clocks jump in phase, they reveal singularities. Only a time crystal reads another time crystal. Since there is no signal propagation, it is all about a match between two-time crystal releasing coherent bursts and clocking signals from singularity points. Reading one singularity points one by one not possible.

2.1.1 Fractal Tape and Surgery of a 2D Image to Place It in a Nested Sphere

All journey begins from a tape: Universality is nothing but a statement written in a piece of paper that can be solved without taking outside help. If we write statements line by line on a piece of paper and after cutting those parts, we can glue them in a line exactly as we said above, this is universality, this is complete (Gödel's completeness theorem; Gödel, 1938, 1947). However, we can imagine millions of different ways so that we need some arguments not written in that piece of paper. Figure 2.2a shows one such way. In biological systems, there are multiple clocks one inside another and all are triggered simultaneously, we do not know why biological systems do that? All fractal Turing tapes proposed till date are Iterative Function System (IFS) class as shown in Figure 2.2a, which means a particular seed geometry is repeated in a 2D or 3D space. One can see the entire fractal shape like a fractal antenna, nothing lies in the imaginary space. Such systems were introduced to compute at a "nearly linear time" (Gurevich and Shelah, 1989). Only when we enter in a cell, we find another tape as shown in Figure 2.2a (Ghosh et al., 2014a). In principle this is an infinite network, each tape is incomplete. For a particular tape, all other tapes are in the imaginary space and time. We simply cannot define a state as is, every single element is a door to another universe inside and it is a constituent of another universe, including the observer, and the journey is endless. In mathematical terms, we say every single matter is an "escape point," building escape time fractal, ES tape. One could argue that why should one care about the imaginary tag, have two Turing tapes, one for real-world data and the other for the imaginary world. Together, two tapes process the entire information in parallel, then even quantum computer is a Turing machine. Though we start with a Turing tape, since (i) not a single cell in entire tape network is complete, (ii) no part of tape network cannot be cut into isolated tapes, (iii) we cannot take derivative at any cell space, therefore, it is not a Turing tape network anymore.

Inventing a fractal tape that does not have a Turing analog: In the Turing vision of the universe, one could melt and everything out there as a long 1D chain of bits. It would be a complete description. The concept of fractal tapes as shown in Figure 2.2a right, was proposed to run many Turing tapes side-by-side like a tree or in any self-similar or fractal geometry (Pippinger and Fischer, 1979). The advantages of geometric shapes in decision-making were explored in details in the 1990s. There are a series of pioneering works to keep time nearly linear using various geometric arrangements of Turing tapes (Gurevich and Shelah, 1989). Every single cell in a Turing tape is defined. Since we redefine any event happening in the universe as a clocking geometric shape, whose corner points are sub-events, an architecture of the clocks is important. To build that architecture, we need a defined machine, to eventually replace the Turing tape. The new tape we call Fractal tape, the name is an oxymoron, because there is nothing fractal about it, except that researchers and general readers, all consider that if there is a set of objects inside an object in an infinite network that is a fractal, we call it Mandelbrot attraction. We get a Fractal tape by placing a Turing tape in every single cell of a host Turing tape (Ghosh et al., 2014a; Agrawal et al., 2016b), so, every single cell is undefined in the infinite tape network. Since undefined, one cannot build a differential equation. The result is the development of multiple technologies, which are junk in conventional electronics, and making several nonsense and irrelevant computing concepts useful.

The discovery of time crystal and remarkable effort for two decades (1970–1990): We all know that a crystal is made of matter, but how could it be made of time? It was the genius of Winfree A., who made two striking observations (Winfree, 1977). He noted that a random noise could not change the biological clocks arbitrarily, the perturbation should be particular. Only at a particular phase of the clock, if the perturbation sustains for a long time, only then the output phase changes significantly. However, once a system is perturbed, even after removing the source of perturbation, three spontaneously emerging frequency peaks emerge in the output ripple, not one. In between 1970 and 1990 for two decades, a wide range of living biological samples showed these incredible features. In summary, (i) biological clocks have a hidden structure of phase singularities, (ii) the mechanics of this structure of clocks are undefined, neither classical nor quantum. Both the mechanics do not have any provision for triggering a chain of events in the absence of a perturbation or a noise. (iii) The hidden architecture of clocks is designed to operate with noise as a perturbation and no random noise can edit or even manipulate that structure. By conditioning when, how, and which noise could interact, a biological system uses noise as an intelligent and programmed signal source.

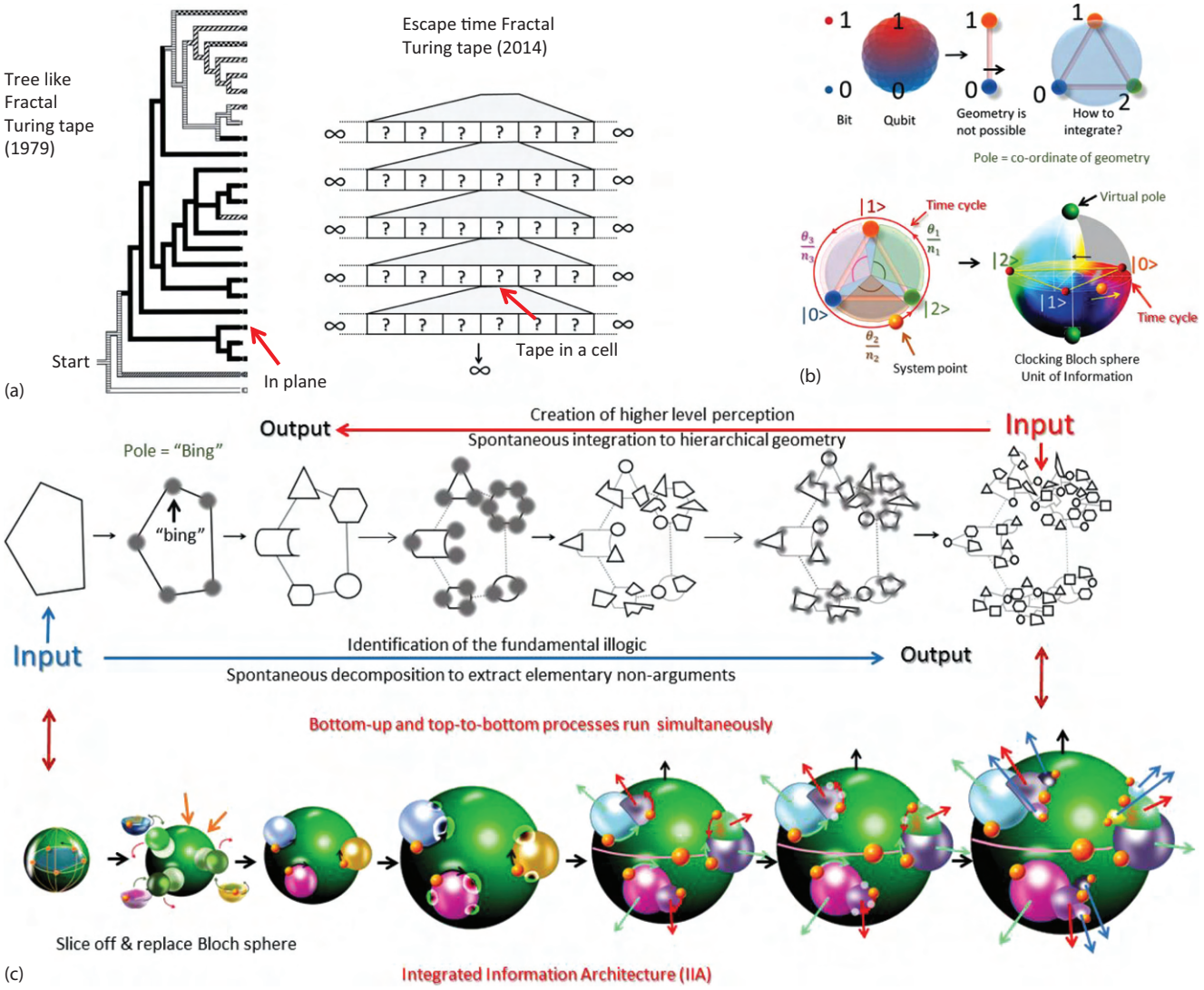


FIGURE 2.2 (a) Two types of fractal wiring of Turing tapes. (b) A transition from bit to qubit (top-left) to clocking Bloch sphere holding a geometric shape (bottom-right). (c) The top row shows decomposition of a pentagon. Corner points are singularities. Each point holds a geometric shape inside. The bottom row shows the corresponding time crystals.

Engineering the Bloch sphere: Brain is neither a classical nor a quantum computer because it does not have a defined classical state; it is not even a computer. Quantum can survive with an infinite number of real solutions (Unruh and Zurek, 1989), but we do not need a single real state, but 12 imaginary worlds affecting the reality. Probability, like time, is a concept invented by humans, and human observation that decides when and where to measure finds unique solutions accordingly (Wheeler, 1990). So, we need to add an observer to the wave function (Wheeler, 1977), and the environment too. These are not possible if there is a classical point on the Bloch sphere. We need a Bloch sphere, a sphere with infinite solutions between two choices. However, instead of impure classical (Joos and Zeh, 1985), it should be made of singularity points, paving the way for an observer, environment and geometric shape to be part of the fundamental unit of information of the universe. We need quantum for using the beautiful concept of Bloch sphere, modify it by adding a clock on its great circle to build a suitable unit of information for the universe (Wheeler, 1983b). The Bloch sphere does not have a singularity, here for the new unit of information, and it is all about opening/closing multiple holes or singularities on the Bloch sphere, as shown in Figure 2.2b. Then time as a 3D geometric structure made of the phase of a set of vibrating material, so we may think, the matter is real, the phase of vibration is imaginary, dependent on the matter but it is not valid. When a pair of clocking spheres synchronize, the phase difference of these vibrating clocks gives the concept of time, when several clocking spheres couple to bond, they fill up a region of time-domain wherein it does not allow other phase structures to occupy, it is just the concept of space. Thus, a phase structure could govern a physical space, so neither space is fundamental

nor the time is, it is a phase. As Einstein said, "Time and space are modes by which we think and not conditions in which we live." (Einstein, 1963).

Six fundamental changes to be made in defining what is an event in nature: (1) Nature store event in a geometric shape, if we do not change the sensors and capture the geometric structure of the events in the pure form, once destroyed, human imagination using deep learning cannot rebuild the accurate information ever. Time crystal analyzer should capture natural events as nested clocks to build a generic time crystal. (2) Existing science and the foundation of artificial intelligence tells us that whatever be the complexity of events, we can re-build that event as a sequence of simple events. It is not right. Nature store events not "side by side," instead, "one inside another." Thus, not just how the event looks like, the geometric arrangement of several events happens one inside another, which again needs to be captured at the sensor level, which we do. (3) All events are new and original is an illusion. Events continuously repeat until it encounters a new symmetry. Finite clocks arranged in a few symmetries one inside another could project in 360° spherical direction 8^{8^8} ways (8 = number of singularities). Infinite possibilities could generate from finite elements if the singularity is explored. Symmetry is finite, but their corresponding geometric shapes could be infinite. (4) Nature integrates events using all possible symmetries and all possible choices, we discovered this metric in the protein, and using this metric, we crosscheck the geometric structure of events. The fine-tuning enables getting rid of human bias, fix errors in reading events as time crystal and predicting the future by adding time crystals following phase prime metric (PPM), so everything is done naturally without programming. (5) The number of bits, amount of resources, speed, all these are irrelevant, a trillion-switch, holding a single symmetry could represent only one clock or one symmetry. When at all layers, all the clocks operate at various speeds, continually update geometric changes in big data, there is no computing time or computing speed. Zillions of data can pass through, and the system checks whether the geometry of clocks change or remains constant with minor editing. (6) It was never thought that even devices with no connections in between could link by the time building a circuit of time. Superlensing ability (Figure 9.4b) isolates the connected devices, gives one device in a complex mixture a distinction, thus allows building a singular clock using distant elements. A device is visible only when it wants to be seen. A device with a set of cloaking frequencies could form multiple distinct circuits, with far distant located elements. Imagine an entire living system is a circuit of time; the natural look is an illusion. Tiny pieces of times as clocks build a life form, to implement that design, clocks come, assemble. The natural look is a follow up of the circuit of time, realized by matter. If one isolates the matter, then reads the wrong information.

Why universality troubles computer scientists? The reason is simple for us, the concept of "Paper cut and glue," that we have extracted from the original document of Turing was lost in history. Greatest mathematicians have wasted pages after pages "inside the paper or outside?," which they call decidability issue. Can we write the statements such that it is difficult to cut? Russel's paradox (if one cuts the paper, he cuts only one path, Russell, 1901) and many-body theorem of physics. If several statements are connected, one has to sit idle, wherever he cuts, he removes two paths. Then if he tries to glue, he loses at least one path, this is a generic situation of Russel's argument. For a fractal tape, imagine that as soon as one cuts a piece of argument, it becomes a new paper, and that repeats forever. Figure 2.2c shows, how does a fractal tape process an image to build a complex time crystal. One interesting factor is that when we cross the layer above, we end up into a few numbers of low-frequency oscillators. Thus, automatic simplification of the image is made by dilution of geometric parameters via resonance chain (a geometric distribution of resonance frequencies). When we go down below with a large number of high-frequency oscillators, even a small part of the image is expanded into various self-similar forms, and that are then summed into a single pattern. Thus, the transition to the low-frequency layers extracts fundamental grouping parameters. While going to the lower frequency layers cause fractal decomposition of the image and higher-level perception forms of an image. The back and forth journey are shown in Figure 2.2c. The process chiefly shrunk nested rhythms for an entire image, which we call fractal seed. In this process, the phase sphere is cut off or sliced where there is a singularity domain, as shown in Figure 2.3a.

2.1.2 Self-Assembly of Geometric Shapes and the Concept of Singularity

Which clock should we take to build time crystal: Minkowski clock, Poisson clock, Nested clock in PPM: Classical time is a near-equilibrium approach, in quantum, the clock is deterministic? Minkowski clock is a sequence of clocks wherein the higher frequency clocks traverse equal distances around the world line, hence classical, as no phase difference is observed between the two paths. If it is just two-photon clock and the frequency is increased say by ten times, a spiral change in phase is visible, and this is the driving force for spiral self-assembly. It could be explained using an imaginary number, but it is not a quantum (Ord, 1983). For quantum, the trajectories follow several points before return to the base point or a classical line like the sphere shown in Figure 2.3b, so a phase difference is created. It is precisely the principle of a Poisson clock, where the rate of decay and growth of a wave creates the phase difference. One can write a clock as a tensor, a simple mechanism to write a tensor is to put tensor elements as characteristic parameters of the singularity domain as described in Figures 2.3b and 2.4a.

Understanding the singularity in a time crystal: Space singularity creates a spatial crystal, and the phase singularity creates a time crystal. Time crystal does not have time within, by closing a loop it defines a unit of time. Imagine many such clocks are arranged in a 3D space; one could build infinite close pathways by connecting the clocks. The topology of

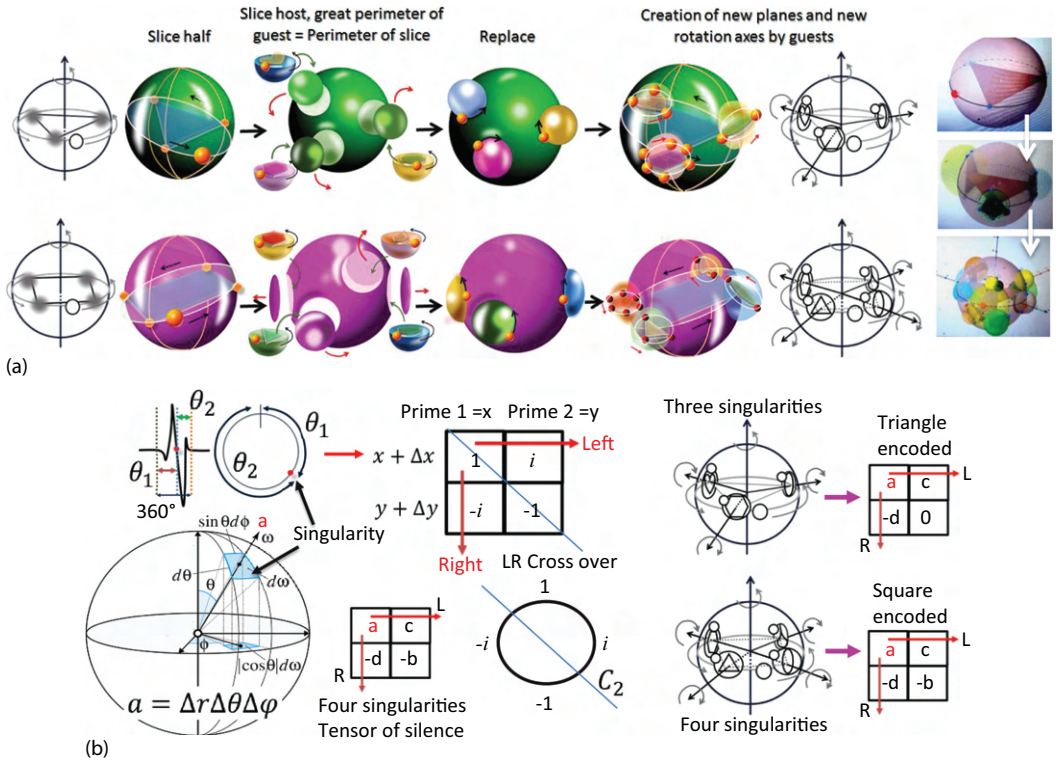


FIGURE 2.3 (a) The mechanism how phase sphere is sliced off and a new phase sphere containing the information about the geometric shape is inserted into the sliced region. Two rows show two distinct examples. The top row begins with a triangle where the corner points are then sliced off. The bottom row begins with a square, whose four corner points are then sliced off. To the right we see that in a triangle continuously new information is inserted. Three consecutive steps are shown. (b) A pulse carries change in sign while representing a phase singularity. The periodic emergence of such phase change in a system response is then plotted as a sum of two distinct phase domains equating to 360°. The circular plot representing rhythm is written as a 2×2 matrix operation. The ratio of phase is represented with nearest primes. The imaginary number is used to depict the contribution of phase in the singularity region to the rotation of the clock. For the phase sphere representing the singularity with a particular area where the phase becomes undefined is shown. To the right, two examples are given which shows how to write a matrix for a triangle and a square.

time cycles is different; therein, we cannot add the time linearly. Time is not a flow of the wave, and it is a cycle, a closed loop. One has to wait for the singularity bursts to sense that a circle has completed a rotation. Only then we can estimate the phase structure; change in phase is time. That is why we sense the phase singularity points and note the geometry they reveal as shown for three and four singularities in the Figure 2.3a and b. A good analogy is an electron rotating around a complex orbit, on the phase sphere always there is a circular orbit, but that orbit rotates with a phase velocity. If the phase change makes a sudden jump and an energy packet emits only then we get the information about a phase change, else if there is an orbital jump we get different information. Orbital transition is not our target, for detecting a time crystal we wait when the rotation of an orbit reaches a singularity and makes a jump, the energy emits naturally. So, a time crystal is not about the clocking of an electron, a symmetry breaking or phase transition when an electron jumps from one orbital to another (Zeng, 2017), it is exclusively a topology of phase singularity on the sphere only.

Mind-Car analogy: Several car drivers running cars, all of their minds are connected, for a time crystal we are neither interested in the time required to travel nor the path being traversed, but a sudden maneuver to avoid accidents is visible which accounts for the interconnected state of the minds of all the drivers. That sudden event is analogous to a burst from the singularity and thus, reflects some features about the topology in the melted-mind of the drivers. That static architecture of phase singularities is the time crystal, an engine that bursts at a singularity.

As the particles move the clocks run. Clocks interact, singularities burst. The phase of the burst makes a quantum jump in the architecture of time; thus, jumps build a time crystal. The photon moves like a particle; it is not time; it does not keep time; it is not a time crystal. However, if several photons interact, all clocks would run, change each other, that is not time crystal. However, when interacting clocks jump in phase, they reveal singularities. Only a time crystal reads another time crystal. Since there is no signal propagation, it is all about a match between two-time crystal releasing coherent bursts and clocking signals from singularity points. Reading each singularity points one by one is not possible.

How would a kid design a time crystal detector? Harvesting the singularity glue: Pump-probe experiments

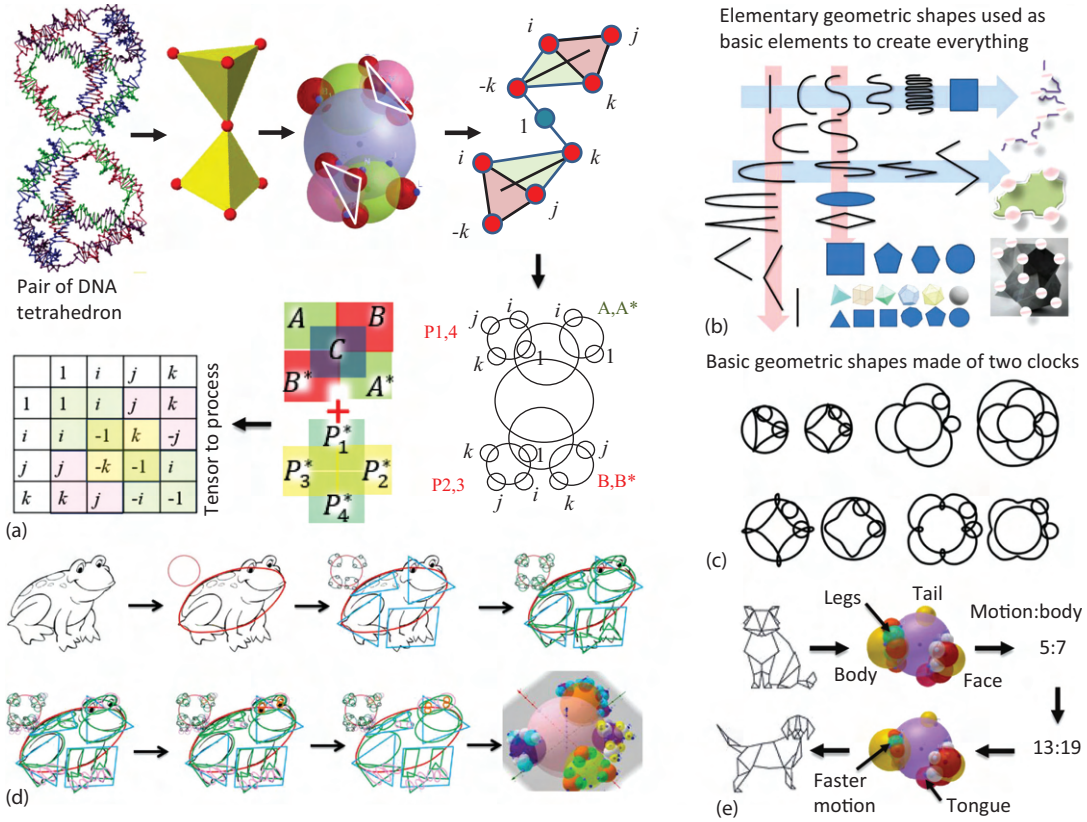


FIGURE 2.4 (a) A pair of DNA that looks as if two tetragons are facing each other. The corners are replaced by a phase sphere keeping in mind that diameter is inverse of time. Each sphere represents one imaginary world, together, for each imaginary world a clock is drawn. The groups of the composition of clocks are written as a pair of matrices which combines into a quaternion. (b) Five lines, five 2D shapes and five 3D structures build the basic geometric shapes that are used to search for patterns by GML in the FIT. (c) Epicycloids, cycloids and hypocycloids are key geometries for nested clocks used extensively for developing the time crystals in the FIT. (d) Multilayer image processing to convert an image into a time crystal. (e) Cat is converted into a time crystal and then a dog is converted into a time crystal, a subtle change in the geometry could convert a cat into a dog and a dog into a cat. The ratio of primes depicts the exact parameter where the change takes place. Each organ of an animal gets a special position in the time crystal.

work on an internal 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. The solar system is a nested clock architecture made of multiple planets and their sub-structures, if we see them using a telescope, we do not read the time crystal, if we plot a picture of their rotational path we do not draw the time crystal. All the planetary bodies in the solar system have phase recession motions, and that encounters singularities, generating turbulence in the gravitational field distribution. If we can map that disturbance and find its topology, a static geometry that maps turbulence defines the time crystal of the solar system. Now, a kid may shift the moon and generate turbulence in the gravitational field distribution; the time crystal would change to another geometry, say a triangle converts to a rectangle. It would be a non-demolition type measurement where we try to change the 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 the two types of signals emit. Two waveforms fuse. The first stream of waveforms of different frequencies with a changing phase. The second stream of complex waveforms as an amplitude modulated signal. Bandyopadhyay et al. have studied a large number of proteins, and their complexes and these two types of signals generate continuously, that revealed the time crystal (see Chapter 6 for details). 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.

2.2 THE BASICS OF A GEOMETRIC MUSICAL LANGUAGE

To unveil the language of nature, at the bottom, we observe which event (= equipment evoked response), not as a reply to a question, but as an essential burst from singularity domain. What we do is to observe how in a particular time domain natural, spontaneous energy bursts repeat. How long the system responds and how long it remains silent. Our job is to draw a circle and put dots on its perimeter to get a geometric shape. That dot is silence. We believe that nature writes events

as geometric shapes not as bits and link events by putting new geometric shapes inside the corners of one geometric shape. Unlike bit by bit scenario, where a bit is a complete statement, here, each information is an infinite chain of interlinked geometric shapes. We change the time domain an observer would draw a geometric shape. Eventually, a genuine nature reader has to cover entire time domain to find out the layered network of geometric shapes one inside another, the repetition of geometric shapes assists in finding the seed geometric shape and the grammar if followed, the complete information architecture is generated. The pathway shown in Figure 2.4a, a real structure to the tensor elements are phases of signal bursts from singularities.

Time crystal analyzer, TCA: We need a language to build artificial brain where the sound of words would be felt in mind, understood, a perception would trigger similar waves in the human brain, even though the person does not know the letters or grammar of that language. Inventing a language that connects to the human brain directly, even if we do not learn word's significance is a challenge. For that purpose, several replicas of sensory signals are processed independently by a time crystal analyzer, TCA, looking into different geometric parameters in big data. Then the signal is converted into 11D time crystal, the input of TCA is a complex set of wave streams or ripples, and the output is a nested sphere. The analysis is carried out so that the linguistic key, event = [subject-clause-(verb-adjective)] is grabbed from nature directly at the entry point and the purity of this form is maintained at all levels while integrating the time crystal and preparing it for sending it to the PPM. Acquiring 10D data following linguistic protocols, requires asking questions to nature, where the events take place, see Figure 10.1, where we have outlined how TCA, the brain-nature interface forms its queries to get a suitable quaternary linguistic demand. TCA counts each event = [subject-clause-(verb-adjective)] as a single abstract sphere, then a complex time crystal formed by acquiring natural data (GML) becomes a network of integers, we convert it into a network of primes ($4 = 2 \times 2$), so that it is ready to go to PPM described in details in the next Chapter 3.

The geometry of a language, primes of a geometry: Whatever is the language, a statement has four parts. Who? Alternatively, the subject. At which condition? The predicate. What? The verb. How? The adjective. If one asks to put circles and draw a sentence, the circle that holds many subjects is crossed by a circle holding many what. A circle on whose perimeter many conditions are written, bridges the Who? The conditions. The fourth circle on which the steps how an event took place are written across the other three circles. The crossing points of circles in the picture reveal the critical links between the facts, and if a system point rotates through all the circles making a sound at the cross-section, the gap between the cross-section becomes phase, and that defines the event. So, if we have a language where the phase is the only variable, cross-sections are phase singularities, then the engineering of singularity would build a new language. Three points on a circle make a triangle. If the event is a tetrahedron DNA like Figure 2.4a, how does one move from one point to another? An addition of phase takes place when we take the product of vectors, as the indices of exponential terms. PPM maps these bits of pieces by counting how many ways we arrange them, and which of such arranged structures would link to grow. Finally, only a set of numbers could represent a whole movie, with a past, present, and future. There are only 15 geometric shapes, five lines, five areas and five volumes as outlined in Figure 2.4b. However, using a pair of clocks and rotating them one top of another, we get the geometric shapes. Some examples of areas are shown in Figure 2.4c. One of the fundamental problems of nested clocks is that in practice, we could hardly generate a finite number of clocks using materials. Just like when we hit a tuning fork, we get infinite harmonics, for the clocks too, similar to the fundamental clock, an infinite series of clocks generate spontaneously.

Why do we use hyperbolic functions to generate geometric kernels? One key difference between resonance band with harmonics and an infinite chain of clocks is that the clocks are connected by geometric constraints. It is reported that the resonance band of the real human brain is a geometrical progression of mean frequencies from band to band, roughly a constant ratio of $e \sim 2.7$, i.e., the base of a natural logarithm, we get time fractal using e^{-t}, $e^{t} = \sin ht + \cos ht$, hyperbolic functions are continued fraction too, just like the resonance band (see Section 2.7), for example $\tanh 1 = \cfrac{1}{1+\cfrac{1}{3+\cfrac{1}{5+\cfrac{1}{\cdots\cdots}}}}$, Similarly, we get

$e = \cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\cdots}}}}$. Similarly, we can derive several fundamental constants that restrict us to add geometries randomly in a 3D space. That restriction brings primes into action, once we break the concept of linear distribution of resonance frequencies and enter a continued fraction, as shown above, spirals, vortices and fractals would make their entry too.

What is meant by each geometric point connecting a circle, or sphere? Basic 1D, 2D, and 3D geometric shapes shown in Figure 2.4b could be generated using hyperbolic functions, which is an infinite time series or rhythm. A nested rhythm is an endless network of periodic or quasi-periodic oscillations (infinite series mathematically). Nested rhythm = Nested clock = time crystal. Figure 2.4d shows a static time crystal, though the clocks embedded in the spheres are rotating, they do not change in size. In contrast, Figure 2.4e shows a dynamic time crystal, where the spheres are expanding and shrinking. Therefore, the existence of an infinite series of clocks or the clocking spheres rapidly oscillating in size. Regarding the clock within a sphere, we take only the ratios of connecting points, each contact point is a

time fractal, say $f(t), g(t), k(t)$, then for a triangle ABC, we take three points, $\frac{f(t)}{g(t)} \sim \frac{1-e^{-t}}{1+e^{t}}$, then $\frac{g(t)}{k(t)}$ and $\frac{k(t)}{f(t)}$. Three functions determine a rotation translation independent feature that musicians also use to create a melody in the human mind. Three relative functions are three time-fractals, which bond together, by creating another function, as a host time fractal that represents a triangle. The fused nested rhythm is the time crystal, when we measure it, pure time crystal fundamental to the system, becomes a guest on the host clock that measures it. Using a simple analogy, we have explained it in Figure 2.5a. In a classical or quantum measurement, the probe clock would be invisible, but in the universal time crystal measurement, the probe clock becomes a fundamental part of the system's clock. Normally, one atom forms a crystal, but to make an artificial brain, we need composite clocks of various kinds, just like composite materials. Therefore, we have shown in Figure 2.5a, how three distinct clocks on a guest making four clocks form the basic unit of a universal time crystal. Three atoms form a triangle.

The case I: a demand from the linguists to hold on to the basic definition of a sentence throughout the brain: In the discussion above, we find that to hold a minimum geometric shape that is a triangle we need four clocks. Even if we want to create any 1D line, we need three points, two endpoints and a curvature. Four clocks if resides one inside another, tell another story. For the linguistic purpose all formulations

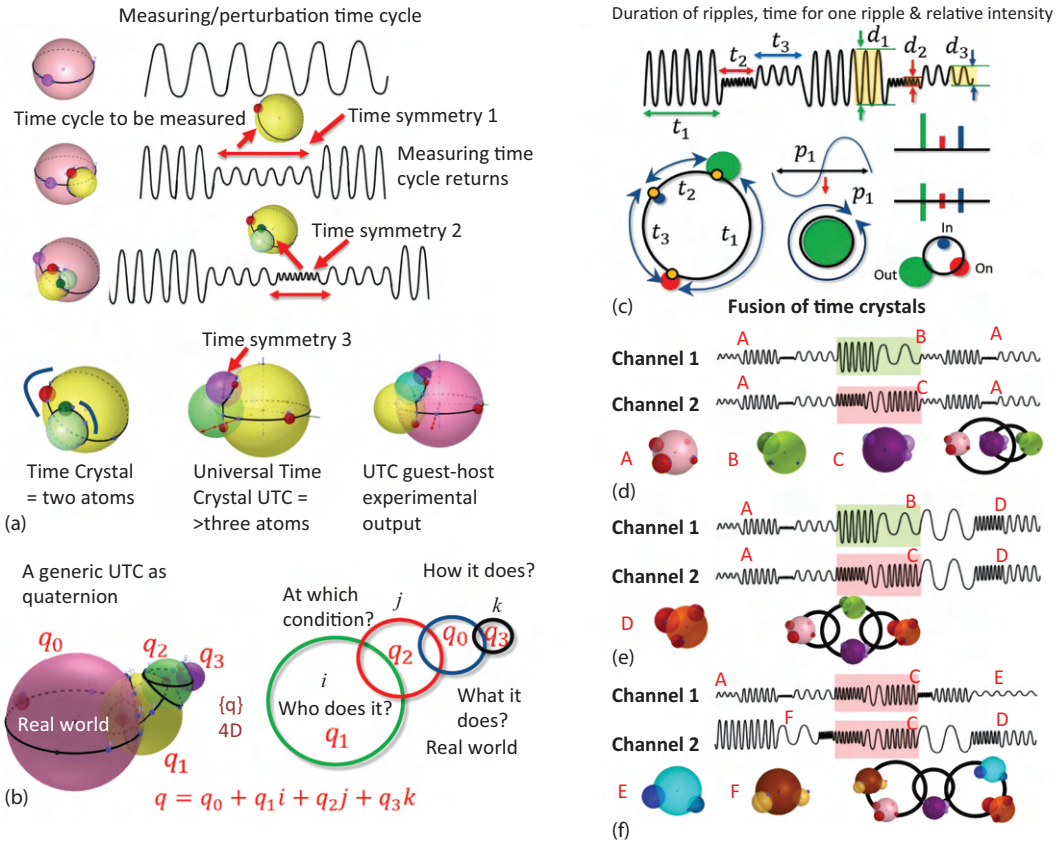


FIGURE 2.5 (a) There are four rows. The top row shows a phase sphere with a clock that represents the signal sent from outside to read an inherent clock or time crystal residing inside a system. The second row from top shows the spontaneous generation of a new signal, in principle not related to the input signal. The spontaneous clock disappears naturally after some time and the measuring input signal returns. The third row from top shows that for a finite time period when the spontaneous clock operates a new clock is born in the system. The fourth row from top, shows three-time crystal structures, the first one is the time crystal without measuring phase sphere, or measuring signal. The central time crystal shows a new guest sphere that means three inherent clocks are there in the system, we call this universal time crystal or UTC, because it holds geometric information. The central time crystal with the measuring phase sphere is shown in the right, during a real experiment the triggering input signal also returns as an output. (b) A generic universal time crystal is made of four clocks, one real and three in the layered imaginary worlds. These clocks form a quaternion of decision-making as shown in the right. In the responses of a system, the real world is not the slowest clock. Who does it? The clock that answers this question is the slowest clock. The clock that answers to the question, what it does? That represents the "Real world." (c) The three basic principles for constructing a time crystal from a waveform. The amplitude of the waveform gives the diameter of the circle. The duration of spontaneously born signal provides the relative phase between the clocks or the location of local clocks on the perimeter of the circle. Relative amplitude difference tells us by how much a guest clock is inserted inside the host clock. (d) The common region between the two channels is bonding regions that glue two time crystal. (e) If the common region between a pair of wave streams are not identical then the protocol followed is presented. (f) If two different channels have a part in common, that part acts as a glue or common domain that links two time crystals.

analyzed in this book follows the structure of a statement (e.g., Who? When? What? How?), even the smallest unit of information requires three imaginary worlds, i.e., a quaternary tensor as shown in Figure 2.5b. From any sequence of wave streams, one could create a time crystal. By looking into its ripples, the duration of one kind of signal gives the phase of a guest circle representing a clock. The amplitude gives its diameter. If the signal is perturbed, we could even map the 3D phase plot or 3D time crystal. One could fuse two time-crystals by looking into the common region in a pair of wave streams. Figure 2.5d–f are three ideal cases. In Figure 2.5d, everywhere, the streams are identical, except a small-time domain. In Figure 2.5e, everywhere, the streams are identical but follow a complex scenario. In Figure 2.5f we demonstrate the real glue effect, where tiny time-domain showing a similarity between a pair of wave streams bond two time crystals.

The case II: Acquiring time crystal from the real world by a time crystal analyzer, TCA: In the real world, wave streams are not a linear singular non-modulated one as shown earlier. In Figure 2.6a we show that in a complex modulated wave, one has to find all frequencies engaged in modulation, their duration, amplitude and repeatability are checked to build a nested circle. When multiple wave streams flow, their phase difference is collected and after placing a reference point, the relative phase differences of the nested clocks decide where on the perimeter we should put the system point (Figure 2.6b). In case the stream of pulses is so noisy that we cannot recognize waveforms, then we could take area covered by streams and or periodic patterns wherever possible. These periodic parts are stored as memory units and the system of sensors looks for repetitions continuously (Figure 2.6c). All those areas where the program fails to read any periodicity, geometric shape of those particular time domain is read (Figure 2.6d). In order to confirm the periodicity, a group of sensors could be hardwired to build a polar plot that reveals hidden periodicity. Thus, without using an algorithm, a set of resonators could sense hidden periodicities and build nested circles or clocks. Once the 2D clock geometries are found, the system of clocks is perturbed to find the 3D clock architecture.

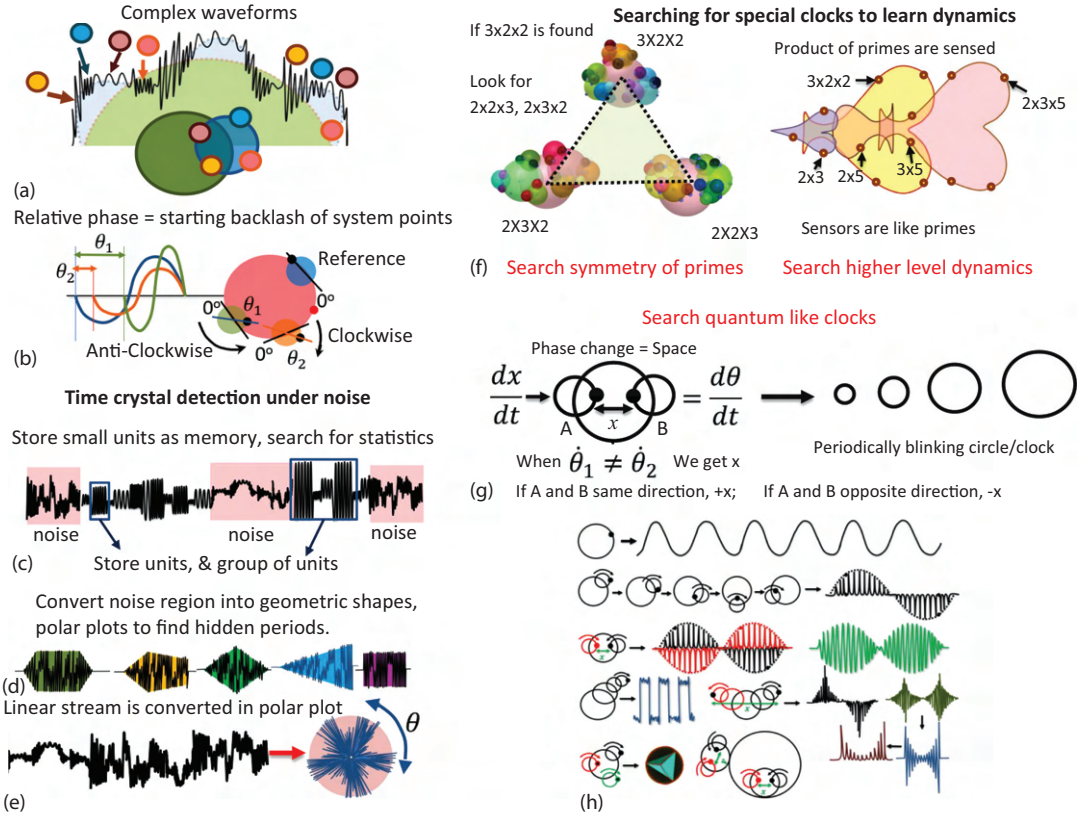


FIGURE 2.6 (a) If there are nested waveforms one in another, then the time crystal is generated. (b) The relative phase between the waveforms is included as relative phase difference between the system points that rotates around the circle. (c) The time crystal analyzer continuously monitors the waveform and stores new pattern of wave packets as a search unit. These search units are stored in the guest time crystal bank to find repetitive units. Periodicity of waveform is essential to build a time crystal. (d) When all efforts to detect a waveform fails, the simulator goes for pattern recognition as if the input waveforms are not wave but a stream of geometric shapes. (e) When the algorithm even fails to detect an area, then it builds a polar plot and identifies periodicity. (f) If an integer is found in the wave stream, the simulator finds the other symmetric divisors, that means if $2 \times 3 \times 2$ is found the system searches for $2 \times 2 \times 3$ and $3 \times 2 \times 2$. Also it looks for 2×6 and 6×2, or 3×4 and 4×3. Thus, the system finds links between the different integers in terms of their divisors. (g) A wave stream might find oscillating clocks, this is important because oscillating clocks are used a mathematical variable. (h) A special composition of waveforms is saved in the memory bank of the simulator to model very special clock networks.

The case III: Searching for special clocks to learn advanced dynamics: In the real world, search for linguistic feature (Case I), and the search for hierarchical periodicities (Case II), we introduce the search for symmetry (Case III). For example, 12 means it could be $2 \times 2 \times 3$, $2 \times 3 \times 2$, or $3 \times 2 \times 2$, in all situations. Say a system of oscillators senses two possibilities of 12, then it would look for the third. Means, from the stream of pulses if it finds a triangle with arms ratio 2:2:3 and 2:3:2 then at a certain time the triangle might morph or change its shape to 3:2:2 (Figure 2.6f). Apparently, possibilities are infinite, but in reality, it is finite. In the PPM, Reddy et al. have shown (2018) that pattern of primes connecting group of primes and integers could guide a system of oscillators to naturally find the missing symmetries in the input signal. A list of some patterns of metrics is listed in Figure 3.4. The language of time crystals is being developed to replace the world of differential equations and emulate the natural phenomena (Figure 2.6g and h). Think in a reverse direction. If a set of oscillators emulate a natural phenomenon (Bandyopadhyay et al., 2010b, 2010c), then it would sense a similar differential equation. Multiple natural phenomena are described in Figures 2.6h and 4.1b. A tutorial is provided in Figures 4.9 through 4.12, on how to draw circles and solve complex mathematical problems.

2.2.1 How a 3D Structure Becomes a Time Crystal or a Tensor: Non-differentiability

Non-differentiability makes rhythm or time fractal essential: Most of the spaces between "matters" are a vacuum, in order to connect them, the energy should exchange between any two elementary matters in a periodic fashion that is what rhythm is, the periodicity is all about keeping time. Every period has a time width that determines the frequency and clock limits too. Moreover, always there should be wireless energy transfer, because in the escape time worldview (zoom in to find other worlds) nothing is touching each other. In the fractal universe, the clocks face a unique situation, if the nested imaginary worlds are entirely made of time crystals. We explain the paradoxical situation using a network of cylinders in Figure 2.7a and b. How do we get a cylinder? Imagine a clock is running, we get a circle. Now, if the clock is perturbed, it would try to return to the initial point. It would take a finite time, that makes a cylinder. In a fractal network, cylinders would trigger each other. Then, generating a fractal time is possible if we have a change in the potential $\varnothing(t)=\int_0^\infty \beta \exp(-\beta t)\theta(\beta)d\beta$, with $\int_0^\infty \theta(\beta)d\beta$, let us consider the expression $\varnothing(t) = \frac{1-a}{a}\sum_{n=1}^{\infty} a^n b^n \exp(-b^n t)$, $b < a < 1$; in this expression β varies as b^n and $\theta(\beta)$ varies like a^n, then the fractal time is ensured for $b > a$. In several working environments, it has been documented that fractal time is generated (Shlesinger, 1988). In a practical fractal time scenario, the average time is infinite. Wherever there is a situation where a parameter changes with time such that the rate of variation is proportional to the magnitude of the parameter itself, we get an exponential variation and when it is stretched using power on top of it, we get fractal time. One example is: $\varnothing(t) = \exp[-\frac{(t)^\beta}{\tau}]$, where $0 < \beta < 1$.

Fractal of meander flowers: The scaling law: Why FIT must not have any conventional fractal in it: If the behavior of a quantity say F (say light emission) is directly or almost proportional to a scaling parameter s (say time or frequency scale), such that $F(s) \sim s^\alpha$ then the power law is valid over a broad range of s values. It is the scaling law, if α is non-integer, then it is a fractal. A fractal does not give new information, it is a composition of the mirror images of the same information repeatedly feedback on the higher scales. However, the network of cylinders shown in Figure 2.7c, representing a system, where the cylinders are changing in length, pitch and diameter, would build wave vectors of various kinds. Excitation to the recovery time of the clock or the cylinder length tells the propagating wave along the cylinder surface, how many loops it can make (Figure 2.7c). The loops around a center look like a meander flower. Figure 2.7c could be plotted differently like Figure 2.7d for better clarity. The horizontal axis shows increment in recovery time, vertical axis frequency. The lines are drawn to exhibit Hopf bifurcation, or allowed journey through a series of breaking symmetry in the time crystal, while a vertical column suggests that all flowers belong to same symmetry. Thus, how the symmetries would change is a geometric choice and those restrictions are mapped by a pattern of prime, i.e., PPM. Self-similarity is nowhere, but still we sense a fractal everywhere, in all the gardens of meander flowers. The artificial brain would be a garden of gardens, GOG that picks branches of flowers to compose new flowers for its garden (Figure 2.7e).

2.2.2 Fifteen Geometric Shapes Are Enough to Recreate Any 1D, 2D, or 3D Pattern

Zooming the perimeter of a circle: Underprivileged and superprivileged pixels: All the circles of a time ring oscillate continuously. During oscillation, it increases its diameter together coherently (in-phase) and decreases to a single point. That single point is also one pixel or the smallest phase cycle (Ord, 2012). Say, one of the many connected pixels starts oscillating in a different phase, for a particular time. Then it returns to the same phase as its neighbor. The process repeats with all the pixels one by one in a sequence. Then an external observer sees as if a point is moving in a circle, or a clock is born. Two such points hold an angle that enables encoding a geometric shape. For example, by shifting the position of points, one can encode triangles of any shape. Similarly, by using four points one can encode a rectangle, or square and so on. Those pixels are privileged. Every pixel in a phase cycle is another phase cycle or clock (Girelli et al., 2009), one imaginary world's lower limit is the upper limit of another world. When the clocks change locations, it is not a crystal, but a jelly. The jelly absorbs, writes and erases the time rings or clocks to sync with its environment (Bandyopadhyay et al., 2009b; Ghosh et al., 2016b), forms sensor of a different kind (Figure 2.8a).

The geometric kernels that form the elementary letters of the brain's geometric language: Conventional geometric languages (Peyré and Cuturi, 2019), convert the entire image

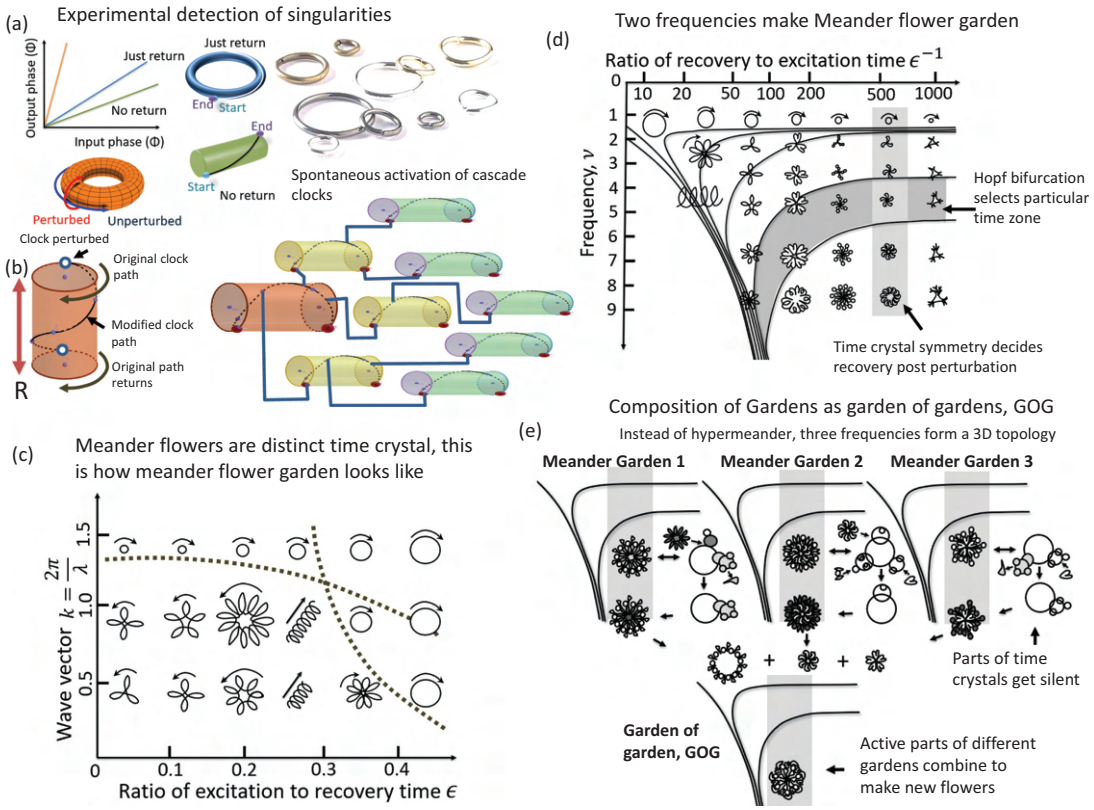


FIGURE 2.7 (a) The mechanism of detecting a time crystal. First an existing periodic oscillation is perturbed, when, the existing waveform changes its basic parameters for a short time before returning to the same signal or phase reset happens three events can happen. First, the system would return exactly when it suppose to begin its new period. Second, the system returns much earlier, and continues to spiral oscillation. Third, it takes a much longer time than the next beginning of a new period. (b) R = Recovery time. There could be several interconnected clocks which are triggered during the perturbation of one clock. (c) The recovery time shown in the panel b could change as a function of input perturbation time and frequency of the signal used. Consequently, the pair of nested clocks change relative diameter, phase positions, which generates a large number of time crystals. Each time crystal has only one system point and two clocks, hence we get meander flowers, the entire plot is called meander flower garden. (d) The same meander flower garden plot like panel b but wave number is replaced by frequency and the ratio of excitation to recovery time is also inversed. Two major lines of sequential generation of time crystals are highlighted by shading. (e) Multiple gardens of meander flowers could interact and build garden of gardens where multiple meander flowers fuse and build a new flower.

on a single layer and considers only triangulation. Thus, it covers the entire 2D or 3D surface using triangles in a different arrangement. Geometrification of data is good for aesthetics, does not serve the purpose to represent the dynamics with morphogenesis of a few geometric shapes.

Encompassing circle or sphere determines the time domain: For example, irrespective of the sensory signal, be it visual, auditory, touch, smell or taste, the 2D or 3D pattern is created first as described in Figure 2.4d and e. Any change in perspective or logic, means changes in those few geometric shapes. When we see an image, it is converted to a 2D isofrequency geometric patterns. Various geometric shapes are detected in the image. Be it a line, curve or triangle, pentagon, all are inserted into a circle of a fixed area. However, the contact point between the circle and the triangle would be the most energetic. The conversion to circle happens for all possible 2D geometries, square, pentagon, hexagon, heptagon etc. For an S, U, L, V, T, all 1D patterns convert to a straight line and a circle simultaneously for the natural oscillation of the network of an oscillator and platonic 3D geometries, all structures convert to a sphere. These cross-sections of a circle or sphere and the 2D, 3D geometric shapes get more energy and these frequency values play a dominant role in the further oscillations. As a result, we find that the ratio of these contact point frequencies becomes the variable in the hardware, which forms the rhythm since all-encompassing circles of a particular imaginary world have nearly the same area the ratios play a crucial role in defining the essential terms of the rhythm.

A platonic love letter to Big Data: In principle, we could randomly choose geometric shapes and find them in the natural events and use those very shapes to assign complex geometric shapes to the integers in the PPM. However, 1D, 2D, and 3D geometries are selected mathematically to serve as an analogy to the Platonic geometries (five Platonic solids are tetrahedron (or pyramid), cube, octahedron, dodecahedron, and icosahedron). For 2D, we take triangle, quadrilateral, pentagon, hexagon, for 1D a few letters like L, V/U, C ($S = 2C$), O. Sensors search only for these fifteen geometries, each with a distinct value of S in a massive rapidly changing

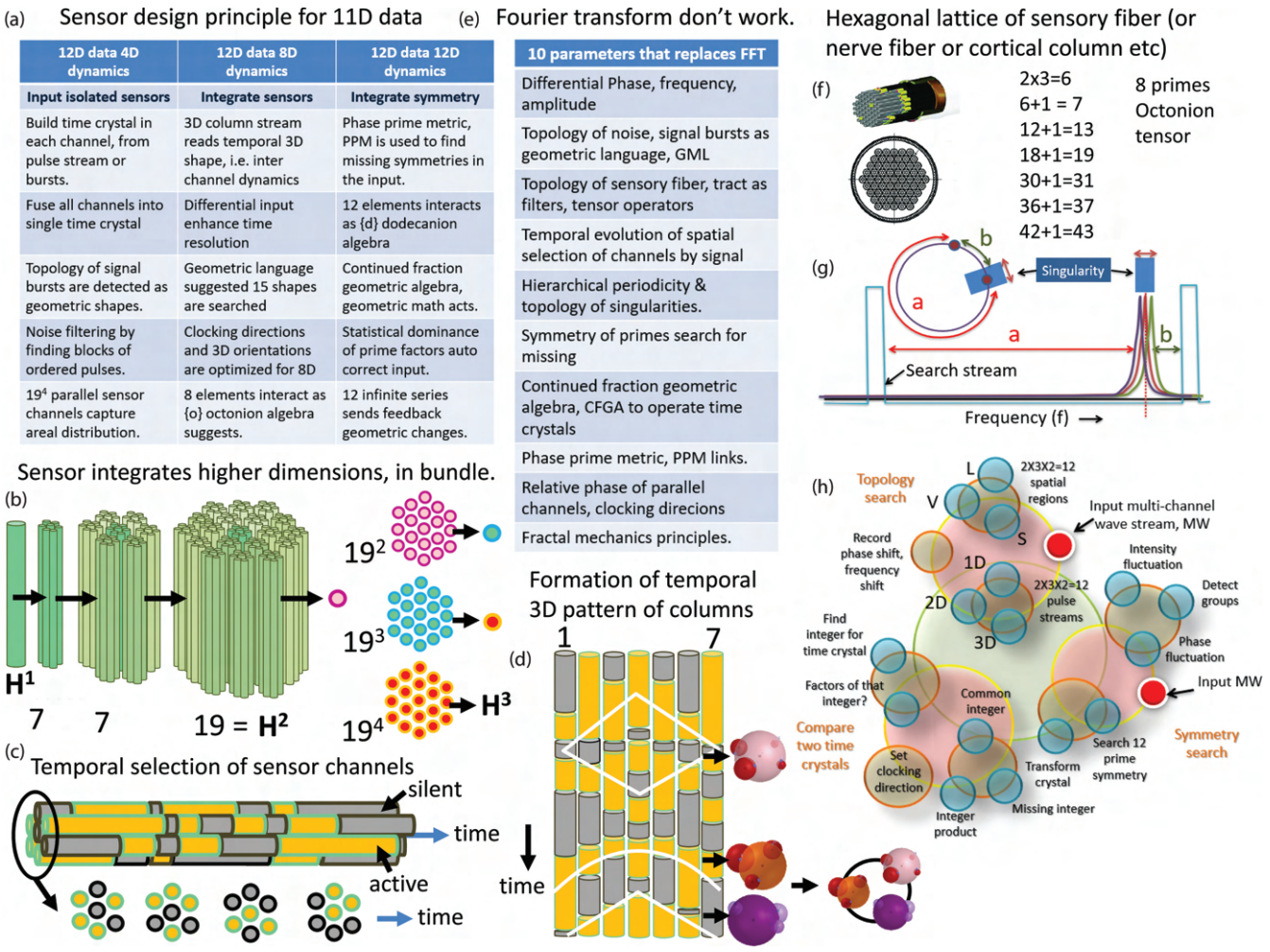


FIGURE 2.8 (a) A table that summarizes how hardware captures 4D, 8D and 12D data from the sensors, integrators and decision-making units respectively. (b) Integration of channels, each channel propagates one waveform. (c) In a practical scenario, some channels get active for a while then other channels get active. (d) The 7 channel system if unfolded into a 2D surface then we find emergence of composite patterns across the channels which are linkers between the signals. These bonding time crystals are identified. (f) Hexagonal close packing is very important in processing prime number of channels, 7,13,19,31,37,43 all these primes could be processed by a hexagonal closely packed channel bundles or nerve fibers. In other words, whenever, there is a hexagonal close pack bundle, the dynamics against the central fiber or channel gives all six primary primes. Even, other primes, 11, 17, 23, 29, 41, 47 are just one less than the hexagonal lattice. Which means when central channel is silent we get 6 primes, when active we get six primes, total 12 prime related dynamics could be processed by a hexagonal close-packed structure with only 48 channels. (g) Electromagnetic, ionic or other energy bursts are the signatures of a singularity point. (h) Entire-time crystal processing is shown here in one chart.

database of events, not by looking into the content, but, in a matrix of dataset, which is converted into a rapidly changing topology. In TCA, any information is converted into a 1D, 2D or 3D…10D geometric shape. Conversion to a shape ignores the actual content, converts the big data stream into a spatial flow of fluid as a function of time or phase. In the rapidly changing 3D distribution of data, imagine it could be a 3D cubic glass chamber filled with clouds one finds the most inactive and the active points that appear, disappear or change periodically. Active points are those which bursts like a lightening; inactive points are those who remain silent in the 3D glass chamber.

Looking for absolute peace and war zones in a Big Data: Say, there are three active points, it means the total no of primes $p + q + r = 3$, the finding of three key locations in the data confirms that it needs three primes to reveal the hidden dynamics. Then in the glass chamber, one has to further monitor the ratio of spatial distance between the three points (e.g., p:q:r::2:3:2), to find the ratio in terms of closest primes to a distinct integer, start from 2, try to use the smallest and nearest primes. In a rapidly changing big data, represented as a fluid flow, if we see the silent and the most active domains are changing with the ratios 2:2:3, 3:2:2, 2:3:2, we understand it is a clocking triangle ($S = 3$), and the corresponding integer is 12. We do not take the ratio of integers but convert to the nearest ratio of primes. Why are only primes taken? Many triangles with similar ratios e.g., 3:5:3, 11:19:11, 19:37:19 etc which builds an infinite series of triangles in

the PPM, superposition of all those triangles covers a pure noise in sensing the input, the ratios cannot be deduced to non-prime forms like 3:6::1:2. A given geometry = An infinite series in the PPM. In the GML, the corner points embed distinct geometric shapes inside to grow within, and the whole shape acts as a corner point, assemble with similar points to build a geometric structure above. Hence the corner points at any layer, are the singularity points. In GML when we see a structure, the first thing we do, is to find which geometric shape represents the whole. Then the shapes grow within and above, not side by side. Each shape is placed in a sphere, its corners touch the sphere's surface, a clock derived from fluid flow runs on the sphere's surface touching all the singularity points or corners of the geometric shape. Such an assembly of the clock is defined as a time crystal.

2.2.3 How to Convert Waveforms into a Time Crystal: Non-differentiability

We have described above how to convert 1D, 2D and 3D data into time crystals. Here is a critical review of the technical procedure.

1. Unless we find three clocks at least, a guest clock and a host clock, i.e., a linguistic quaternion, keep searching. The clocks in a neural system self-assemble to modulate the time (Arvanitaki and Chalazonitis, 1968). For this purpose, a need for three clocks is observed in some bio-systems (Berliner and Neurath, 1965). Who?What?Why?How? must be found to write a basic unit of information.
2. The central clock (phase cycle = clock; Ord, 2012) survives even if the environment edits the two boundary clocks (Prati, 2009); i.e., slower and the faster ones. In such three-layered clock, a time crystal turns naturally fault-tolerant; i.e., breaking of time symmetry is uninterrupted. As Figure 2.8d explains, one requires three kinds of sensors. The first one that is specialized in particular symmetry breaking, and specific time domain. The second one that integrates different sensors or fuses widely varied symmetry breaking regions and time domains. The third one is good in projecting a given set of symmetries to infinity and return feedback to adjust the geometry hidden in the time crystal it just sensed.
3. The number of singularity points on the primary phase cycle of a host is the number of guest clocks (Aschoff and Wever, 1976). It is the number of different time flows experienced by a system point as it moves 360°. Each clock can have its system point and can grow its phase cycle structure or time crystal inside by making a new guest-host system. It can connect with neighboring time crystals or phase cycles as guests of a larger phase cycle. It is self-assembly of time crystals side by side (Pippinger and Fischer, 1979; Gurevich and Shelah, 1989) or one inside another (Ghosh et al., 2014a). Symmetry breaking makes life, as claimed by many (Kuhn, 2008), here, symmetry breaking is searched in the input data to find linguistic decisions Who-What-Why-How in a totally unknown environment.
4. The relative locations of the system points, estimate the initial phase differences among different clocks. It significantly changes the output measurement of the time crystal. To re-assemble the disintegrated parts of a time crystal, reviving the initial phase difference between clocks is essential. Such a phase reset is abundant in biology (Best, 1976; Bruce et al., 1960), thus, biological systems have a memory to remember the phase gaps of various clocks.
5. When a time crystal has only two clocks then a 2D plane is sufficient to represent. If there are three clocks, then 2D phase cycles orient as a 3D sphere. Since three singularity points ensure holding a triangular geometric shape, this is a clocking Bloch sphere. The time crystal becomes information storage and processing device.
6. A spatial crystal appears different, from different directions. Its response remains the same as it is determined by the lattice symmetry. For a time crystal, different rotational directions of a system point in the phase cycle measure different responses. It depends on three parameters. First, the relative phase difference between the clocks. Second, the relative location of the clocks. Third, the relative diameter of the clocks.
7. The repetitive patterns of densely connected phase cycles are denoted as a "mass" in a 3D phase structure, when observers time crystal cannot resolve the distinct clocks in the 3D phase architecture depicted as a time crystal. Then the relative perimeter of the longest phase cycles of the observer and that of the object or event under measurement is defined as "space." Thus, "clock" made of phase paths wire events, one gets a circuit of mass, space and time (Prati, 2009; Ord and Mann, 2012).
8. All singularity points may remain intact, that is, no change is observed in the resonance frequency band, yet, it is possible that time crystal is changing its symmetry. The relative phase path between frequencies changes. To make a crystal, one has to fit multiple phase cycles inside a longer phase cycle, such nesting of phase is meticulously designed in biology (Betz and Becker, 1975). As described above, the singularity points residing on a phase cycle represent a geometric shape. A small perturbation to a system by applying a noise of selected frequency range reveals the singularity points, just like a noise reveals the Fermi level. Perturbation creates a ripple of phase shifts (Johnsson and Karlsson, 1971). The relative rotations of the phase cycles are restricted by the topological constraints. The topology of the phase response curve reveals the variables and the constraints (Kawato and Suzuki, 1978). The desired 1D, 2D and a 3D time crystal structures

form (Ghosh et al., 2014b, 2015b, 2016b). The formation could be linked to the pattern of primes.

9. A time crystal is an artwork of singularity points connected by phase, not a single point in it is real. There is no time, space, or mass, it is a network of phase (Girelli et al., 2009). The phase shift is the only event in the information processing, caused either by changing the input frequency (Chandrashekaran and Engelmann, 1973) or by the intensity of the light pulse (Chandrashekaran and Loher, 1969). Time crystal represents any information as topology and every topology or geometric shape is a single point or corner point in its higher topology.
10. The appearance of time crystal depends on three parameters. First, the observer's phase-detection resolution. Second, the relative phase between the observer and the time crystal. Third, the orientation of the observer.
11. The time crystal dynamics strictly depends on the topology of singularity. Neither classical nor quantum mechanics address the issue of singularity. In a classically static resonance band one could measure quantum fluctuations of phase paths. In a random fluctuation of the phase path of quantum, one could find topology of phase structure following fractal mechanics.

2.3 THE BASIC CONCEPT OF A TIME CRYSTAL AND THE GARDEN OF GARDENS (GOG)

How the garden of gardens converts 4D to 8D to 12D? We have described above the fundamentals of a garden of gardens, GOG in Figure 2.7e. GOG is an important concept, because the sensors at the interface level, when enters into the brain, captures 11D data, i.e., clocks are spread over 12 layers one inside another, but at a time, clocks in four layers undergo changes for a quaternion tensor. So, we get 4D dynamics in an 11D data structure. Now, an advanced sensor has to integrate several sensory inputs to build 8D dynamics in an 11D data structure and finally, build up 12D dynamics. The flowers in the GOG are not real flowers that come from environmental input as shown in Figure 2.7e. Geometric similarities in the meander flowers coming from different sensors as 4D dynamics are matched and picked up by the system to build flowers that would bridge sensors. For example, say the visual sensor is capturing 4D dynamics where the imaginary worlds, 3rd, 7th, 8th and 12th are changing simultaneously the geometric shapes written in their time crystal. Now, if a sound sensor captures 4D dynamics, where 1st, 5th, 7th and 8th imaginary worlds, the higher-level sensor would notice that 7th and 8th imaginary worlds are undergoing simultaneous changes. Then, it would see, if similar geometric shapes are found in the respective time crystals. If the higher-level sensor (Figure 2.8a) finds that 8th imaginary world of visual sensor and the sound sensor is undergoing a change of geometric shapes of a very similar kind. Then like Figure 2.5d–f, the sensor picks up similar geometries and builds a new meander flower that never came as an input, but may belong to 11th imaginary world. The process is shown in Figure 2.7e. Thus, 4D data converts into an 8D dynamics and then to 12D dynamics. How two imaginary worlds interact and the third imaginary world gets affected? This magic happens because of the dodecanion and octonion tensors, just give a look to the tensors in Figure 4.13. In summary, invisible pathways connecting the cells and pattern of primes linking and governing the evolution of events within and outside the hardware are two key features that make fractal tape original.

2.4 HOW TO DESIGN A SENSOR FOR ACQUIRING 11D DATA

The GOG operation described above for three types of sensors to acquire 11D or 12D data (do not worry, classical and quantum mechanics have one real world, here no real world, hence 11D = 12D), requires a new hardware operational mechanism to search and find a similar geometric match in the time crystal.

Simultaneous electrical, mechanical and magnetic resonance: The key to sense 11D data: A single oscillator vibrates like a clock when it is periodically pumped from outside and eliminate its damping. The feedback circuit should harvest abundant thermal noise, chemical energy, mechanical motions, in this book we have emphasized a unique energy harvesting regulatory mechanism. It is recently reported (Ghosh et al., 2016a) that electrical, magnetic and mechanical resonance frequencies of specific biomaterials are connected by a quadratic relation $\left(e^2+\phi^2=\pi^2\right)$, which ensures canalizing three forms of noise into a signal of another kind. Means, electrical noise would feed to mechanical and magnetic clocks, mechanical noise into magnetic and electrical clocks and magnetic noise into electrical and mechanical clocks. It was an important discovery because until then all efforts to create a long-running clock was to feed a similar type of energy, which failed in every possible manner. Following a quadratic mathematical control in the hardware, it is possible to generate much longer running clocks. Fourth-circuit element H, could implement this typical feature, see Chapter 8. The philosophy behind this intra-conversion is beautiful. A noise activates a search mode for the feedback channel, the active device that executes the quadratic relation has three pairs of energy levels, a pair each for mechanical, electrical and magnetic energy transmission.

How does the $e-\pi-\phi$ sensor work? Most resonance frequencies of the electrical energy are driven by ions or electrons emerge in the ratio of Pi (3.14..). Most magnetic resonance frequencies made of a vortex of loop currents or magnetic flux develop resonance frequencies with the golden ratio Phi (1.61..). The mechanical resonance frequencies made of soliton or diffusing molecules in a cavity, vibrating strings are in the ratio of e (2.73….). Quadratic relation means, if the magnetic and the electric resonance frequencies shift in a certain way, the change in the resonance frequency of mechanical vibration is fixed and vice versa. Geometric control of feedback mechanism is a key to harvest noise, two-way feedback fails, but three-way feedback ensures one-way energy

transfer, hence it is stable. If a tape is a linear chain of oscillators, then it would produce time fractals or rhythms (Muller, 2009). Corrections by noise are carried out at all levels since higher-order terms in the infinite series do take part in keeping the quadratic relation intact. It is a careful observation that nature uses geometry to link distinctly operating time domains, where the corrections run through each term of an infinite series. The frequency spectrum for each cell determines the limiting times for the tape inside that cell. In other words, the limiting times of energy bursts of the lower layer cells of a fractal tape are the maximum temporal resolution of the upper layer tape.

2.4.1 Why Fast Fourier Transform Does Not Work

The artificial brain must explore the unseen in the most scenic picture: Fast Fourier Transform, FFT is widely used to convert a wave stream into a single or multiple frequency peaks. Here, while describing time crystal analyzer, TCA, we noted that different frequency peaks built by FFT would never capture the simultaneous shifts of multiple peaks as a group, possibility of a group of groups, the existence of singularity points, the dynamics of relative phase changes between multiple wave streams. It was never thought that multiple parallel channels could hold interactive relationships as described in Figures 2.5 through 2.7, which would require analogs of nerve bundles or cortical columns (Figure 2.8b). The collective evolution of patterns in the simultaneously operating parallel channels as shown in Figure 2.8c and d suggests that one system point creating one channel in a clock is not isolated and distinct. Even in one channel that carries one system point in a complex time crystal structure, the hierarchical geometric information is absolutely neglected in the FFT. A single pulse stream could not just hold hierarchical groups of local patterns distantly located in the time series, but geometric shapes, widely varied information even within a single waveform were never taken into account in FFT.

An eleven-dimensional pattern to link all events: projection from infinity: Imagine, we are given a random set of events and we want to link them without knowing anything about the particularity of events, is it possible? We always think what we see is real, like sun rotates around the earth, or the earth is flat, but it could be that what we measure, actually it is spontaneously giving us what we already have? Then there is no measurement, there is no detection, there is no searching, it is replaced by a spontaneous reply. So, when all the events are interconnected, we cannot solve it, right. However, we can imagine two hardware that is made of the same protocol to link an unknown number of events into a universal pattern. The universal pattern never repeats itself totally, but 12 significant features repeat scale-free through infinity. Anything that is born from this hardware is a piece of an infinitely long, endless chain of pattern, it evolves with time to enrich itself, perfecting the protocol to link events. The hardware learns that means it increases the length of integral choices, in the course of enriching, once the topology of evolving geometry saturates by absorbing matter, cannot add more choices, it saturates or dies. Our job is to accurately detect the repeating features in the pattern of choices using which we link events, that mathematics would require a new information theory, a new language GML and a metric of choices PPM. Figure 2.8f and g explain how the choice of symmetries in the cables could enable a sensor to read the dynamics of primes or symmetry of events naturally without any effort. Thus, the culture of FFT sensors is very different from the kind of $e-\pi-\phi$ sensors running the time crystal analyzer, TCA.

2.4.2 The Engineering of a Nerve Bundle in Acquiring Hidden Data

The engineering of pixels: the door to different imaginary worlds: The duration of silence and active signal bursts in a nerve bundle carries time crystals of 12 imaginary worlds (Figure 2.8c and d). Multi-channel simultaneous energy transfer among different imaginary worlds is difficult to picturize, it is like suggesting that something that does not exist or impact us. The idea is to bypass singularity or the non-differentiable points by redefining pixels. When we zoom a circle to a level where we see a finite number of circles as pixels, we can pick one such circle or pixel, and inside that the other imaginary world would survive. Since anything inside a pixel is undefined the world inside is imaginary, but that world can define the property of the pixels, thus, affecting across the singularity point. When we discuss the 200 years old mathematical journey of octonions, and introduce the magical automation of 12 imaginary worlds that has no real-world, bonds with observer's similar time crystals, then hand waving argument that phase exchange would do the job is not enough. Either nerve bundle or a time crystal carrier would create a larger singularity encompassing the entire geometric shape, or fill in the blanks inside a singularity: Singularity points of a Bloch sphere bursts in a sequence, clockwise or anti-clockwise to hold the geometric shapes, that is the memory of a cable transmitting time crystal. These singularity points burst signals by harvesting noise in the biomaterials (Kuramoto, 1983). Burst from the pixel is a crude expression of a manifold complex processing happening the imaginary world inside.

The illusive transmission through the nerve bundle: In the conventional mathematical formulations of physics where the differential equation plays a dominant role, a new version of GML has been created, it is called continued fraction geometric algebra, CFGA (Chapter 4). Then the laws of equations would be written by drawing, changes in the geometric shapes. We often find multilayered materials that can carry 4D, 8D and 12D tensors. For example, the core-shell nanostructures, dendrimers and various other organic supramolecular architectures where one could experimentally measure that for any layer of the structure, an energy transfer occurs from its bottom to the top and then simultaneously from top to bottom. We do not need a pathway, nerve bundles arrange in geometry to hold a particular type of clocks, we mistake an effective information-processing organ as transmission

cables. The pattern of prime hardly repeats. The beauty of the pattern of primes (Figure 3.4) to retain self-similarity as different integer scale originates via projection from the infinity that governs very different kinds of dielectrics and forces of interactions into self-similar spatial variations. On a tiny scale, the quantum principles work, at a larger scale, weak interactions and strong molecular binding work, and then at the largest scale, electromagnetic effects come into play. Scale changes from atomic to meters (10^{12}), time changes femtoseconds to say 100 years (10^{-9} to 10^{15} Hz), $e-\pi-\phi$ sensors do their job 1:100 scales between space and time.

2.4.3 Operational Chart of a Sensor

By synthesizing the organic jelly, a neural network like supramolecular structure was built (Ghosh et al., 2014b, 2015b, 2016b). That brain jelly is poured in a fractal dielectric, designed similar to a brain. The organic jelly-made device of time clocks morphs the EEG features of a human brain. The clock-like crystallization of materials is unique (Brumberger, 1970).

How sensory input integrates by GML: Geometric shapes built from sensors can integrate two ways; side-by-side and one inside another. The corner points of geometric shapes break, and then one inserts a geometric shape in it (Figure 2.8h). Thus, geometries grow side by side and one inside another. It is not a 2D structure. The integrated geometric shapes are best represented in a clocking Bloch sphere. When it integrates information bubbles of Bloch spheres would grow (Agrawal, 2016b). When a time ring holds more than one geometric shape, any of them could represent a query and the other, an answer, together, QA couplet. Therefore, when the clock runs, the decision is made for a query. The existing 3D assembly of the Bloch sphere adds new sets of nested clocks or bubbles with its surface (Vitiello, 2012). During the addition, it even undergoes a phase transition just like an organic supramolecule (Ghosh et al., 2014b, 2015b, 2016b). The rule for a phase transition is the same, "symmetry breaking." Here the 3D oriented structure of phase cycles is an alternative to the program or algorithm. When synchronized clocks run together, every time, synchrony selects new wiring (Mirollo and Strogatz, 1990). To an external query, all the associated clocks run. All the issues related to a query are built into one single Bloch sphere structure; no choice is left out.

2.5 COMPARATIVE STUDIES BETWEEN WINFREE, WILCZEK, AND THE UNIVERSAL TIME CRYSTAL

Frank Wilczek's version of time crystal contradicts Winfree's version: Frank Wilczek revived the lost time crystal of the 1990s in 2012 (Shapere and Wilczek, 2012). There is no guest-host phase cycle in Frank's version, i.e., the guest's singularity is not explored in the way others did for 40 years (Figure 2.9). The follow-up works have surprisingly rejected the concept of singularity. An external energy input signal oscillates the diameter of a given time cycle by beating. After a while, the original cycle returns (Zhang et al., 2017; Else et al., 2016; Yao et al., 2017). It is like the orbital transition of an electron in a molecule. Such shreds of evidence neither support classical nor quantum time crystals. Temporal oscillation of the diameter of a phase cycle is found in multiple systems. Periodicity in the quantum ground state alone is not enough evidence to justify a time crystal. Therein two different time symmetries do not coexist. If we detect one, citing uncertainty, it violates the basic definition of a time crystal.

Winfree time crystal	Wilczeck time crystal	Universal Time Crystal UTC
Input white noise, clocking wave is output, only one internal clock	Input a clocking signal, output is modified clocking or beating, one internal clock	Input is noise, output multiple waves, more than two clocks.
Two clocks are nested one inside another, no pattern.	Elementary clocks are isolated, only one clock.	Clocks arrange to form 1D, 2D, 3D geometric shapes.
Phase singularity makes time, like curved space makes mass in a crystal.	No singularity, or singularity burst, or phase plane.	Phase singularity one inside other connected by imaginary layers (>=12)
Integration of distinct clocks are not addressed. Cant enter inside singularity	No restriction on symmetry of time crystal, like Bravais lattice, group theory, etc. Cant enter in a singularity	Topology of phase singularity has 12 possibilities to make time crystal, it comes from metric of prime. Enter inside singularity.
Clocking never damps. Under noise, crystal is permanent.	Clocking damps out. Crystal is temporary.	Crystal is permanent, could be solid or jelly or liquid
Phase cycle self-assembles to make crystal, metric sets rule.	No self-assembly	Pattern of primes link symmetry of crystal arrangement
Resonance, synchrony acts.	Irrelevant if quantum else OK.	Acts
Classical mechanics	Classical or quantum	Classical Quantum Fractal
Clocking direction, 3D projection, symmetry link do not exist	No such concept was introduced.	3D architecture of clocks have many rotational directions, non-allowedsymmetrylinksetc.

FIGURE 2.9 Comparison between Winfree class time crystal, Wilczek time crystal and finally the proposal for universal time crystal.

Two kinds of time symmetries should coexist, with or without entanglement (Choi et al., 2017), the uncertainty that we need in quantum would be in the phase path. Now, the change in the phase path is not much investigated in the history of quantum, it requires an understanding of topology when one fuses multiple Hilbert spaces. Frank's version therefore has not two, but one phase cycle, it contradicts the definition of a crystal. Frank Wilczek's proposal is also tagged "impossible" (Bruno, 2013). Comparison between the universal time crystal that Reddy et al advanced from the Winfree era, bypassing the current sensation of a time crystal, suspecting that it needs severe corrections.

2.6 THE DEFINITION OF A QUATERNION, OCTONION, AND DODECANION

Spheres of different unit vectors originating from the different imaginary worlds: Normally a fractal is $f(z^n)$, for example, the Mandelbrot fractal, $z^2 = z + c$, here, we get $z^n = r_p^n(\cos p(n\theta_p) + \sin p(n\theta_p))$. Order p harmonic would be the function, when $p = -1$, it is a single burst like events, and when $p = 0,1$ then we get wave equation, both in the imaginary and in the real worlds, it means we get time fractal or rhythms propagating across the tape network. The physical significance of p is feedback, a particular rhythm should have a particular type of feedback from the imaginary spaces or times, hence a constant p. Time fractal or rhythm made of multiple p values $f(z_{p1}^n, z_{p2}^n, \ldots z_{pm}^n)$, m is the escape number, each time one enters inside a tape to find a new tape adds value to m. Figure 2.10a and b shows one to one correspondence between the linguistic structure of an event and imaginary world representation of tensors whose each element holds peculiarities of a singularity point, i.e., coordinates on the phase sphere, clock speed, burst energy etc. In the human brain network how different components contribute to the higher-dimensional tensors are outlined.

The dodecanion or icosanion is a combination of dodecanes (or 12-tuples) of real numbers. Every dodecanion is a real linear combination of the unit dodecanions $\{h_0, h_1, h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{10}, h_{11},\}$; where h_0 is the scalar or real element; it may be identified with the real number 1.

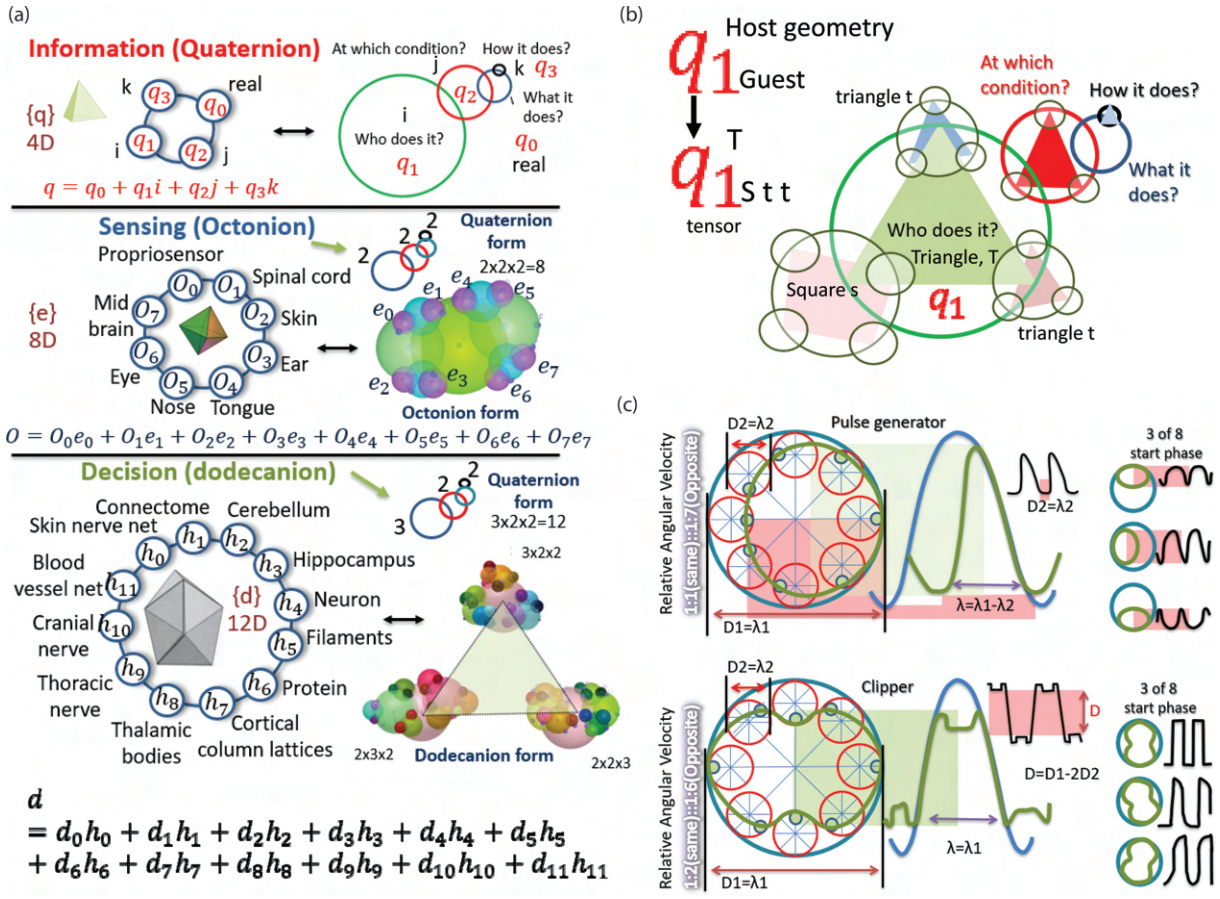


FIGURE 2.10 (a) There are three rows. The top row shows the basic structure of information, quaternion 4D question-answer architecture. The central row shows 8D information structure. Mostly the sensors are designed to process octonions, its time crystal representation is shown to the right. The time crystal representation is the cage that holds information content as singularity shape. Similar cage is shown for the decision-making of an artificial brain in the third row. Three rows show the vector expression of generalized dodecanion algebra, which is tensors. (b) The tensor representation of a quaternion. Four basic questions build a quaternion. Who does it? At what condition? What does it do? How does it do? (c) Two rows show two examples, how nested clocks generate combined output waveform.

That is, every dodecanion for 12 planes or icosanion for 12 corners x can be written in the form

$$x = h_0x_0 + h_1x_1 + h_2x_2 + h_3x_3 + h_4x_4 + h_5x_5 + h_6x_6 + h_7x_7 + h_8x_8 + h_9x_9 + h_{10}x_{10} + h_{11}x_{11}$$

The dodecanion x spreads over eleven imaginary layers located one inside another. When a new class of sensors finds 11D time crystals from the environment, one requires specialized hardware to hold the time crystal, and dodecanion is the data form used. Addition and subtraction of quaternions, octonions and dodecanion (Conway and Smith, 2003) are done by adding and subtracting the corresponding terms and hence their coefficients, but we need a multiplication table to find the product as shown in the Figure 4.13. While processing a time crystal, the wave functions representing the clocks in the different imaginary worlds multiply, a multiplication table maps the effect of two coupled or entangled worlds. However, dodecanion multiplication is neither commutative, $h_ih_j = -h_jh_i \neq h_jh_i$, if i, j are distinct and nonzero; nor associative, $(h_ih_j)h_k = -h_i(h_jh_k) \neq h_i(h_jh_k)$, if i, j, k are distinct, nonzero and $h_ih_j \neq \pm h_k$. There is an association, but that link is a bit complex.

The origin of geometric algebra lies in the arrangement of sub-tensors of a given tensor. At the lowest level there is a di-nion tensor where only one imaginary world counts. Quaternion has three, octonion has seven and dodecanion or icosanion has eleven imaginary worlds at a time, one of the imaginary worlds (that one could be any) becomes a reality for the observer. Recently, efforts have been made to dilute the distinction of imaginary worlds and use linear vectors to regulate the evolution of imaginary worlds in quantum thus build quantum logic gate (Freedman et al., 2018). However, all these efforts dilute the distinction, the linear vectors made of multiple imaginary worlds do not explore the most exciting feature of multiple imaginary worlds. That is the communication between imaginary worlds. The formation of linear vectors taking one contribution from each of the available imaginary worlds is again returning to the Turing's information processing paradigm. Linear composition puts all solutions on a single-phase sphere, so, one could imagine that century-old Bloch sphere to represent infinite possible pulse trains (Figure 2.10c). Universal time crystal endorses singularity, the clocking geometries i.e., quaternions hidden in the octonion, while octonions are hidden in the dodecanion. Thus, many phase spheres form a 3D arrangement of time crystals, we build a GML.

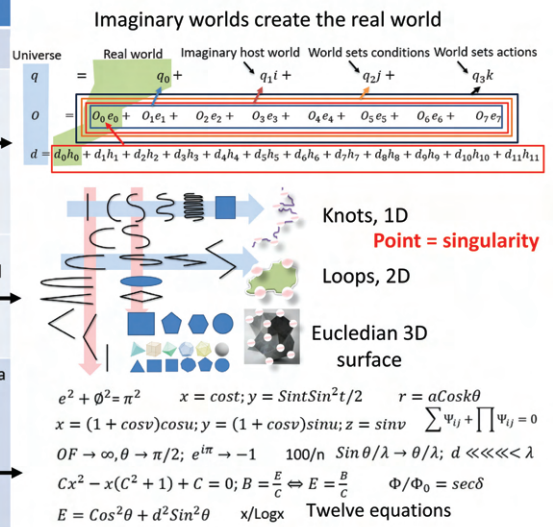
2.7 THE BASIC CONCEPT OF A HIGHER-DIMENSION DATA: A LUCID PRESENTATION

A journey through 12 dimensions or 11D as outlined in Figure 2.11a is easy to learn if we remember one question "who jumps?" as outlined in Figure 2.11b. 11D concept is built on three worldviews. Real-world spanning over 0D–4D that we can easily picturize in our mind feel with our senses. Then the geometric phase world where we could use advanced instruments and detect that changes are happening in the 5D–7D region. Finally, using pen and paper and doing only math we may simulate and extrapolate experimental observation to understand there could be a mathematical world with 8D–11D. Always remember, something should jump through an imaginary space to create a higher dimension. Points jump to create a straight line, we move from 0D to 1D. Lines jump to create an area we move from 1D to 2D. The table of Figure 2.11a and b are the same, one we do not picturize the other is easy to feel. One interesting thought, the followers of the artificial geometric brain should note the third row of Figure 2.11b, irrespective of dimension always there is a quaternion, the linguistic core has to be preserved like an idiom. The journey above 5D requires the PPM, where the geometric correlation of primes or integers guides us to make the jump to a higher dimension. Below we discuss which clock one brain builder should choose to create an artificial brain that emulates Figure 2.11a and b.

Clocks of imaginary layers as particles in the pattern of primes: When one feeds tensors representing the collection of phase values to the pattern of prime, PPM, the phase values are automatically edited since all imaginary worlds have their distinct clocks. Then for the first time when we enter into the world of 11 dimensions in a dodecanion, we encounter the superposition of clocks (see Figure 4.13). Between two classical observations, which lies along the horizontal axis of primes, the system point passes through various choices by which elementary events could be arranged. For a particular tape, this is indeterministic, but for an external observer, it is deterministic if the observer sees all imaginary worlds at a time, but not if the number of worlds is 12, i.e., a dodecanion tensor. Then the coexistence of multiple groups of imaginary worlds ($2 \times 2 \times 3$, $2 \times 3 \times 2$, $3 \times 2 \times 2$) creates a higher-level topology that could represent a non-accessible clock. The trajectory of the phase is not spiral anymore, and it is a spiral of a spiral of a spiral… go eleven times! In Poisson, it is random, in fractal space-time is fractal, and the fabric is the imagination of a physicist. In general, in the PPM metric, it is like a vortex of spirals, many spirals converging to one point, for each prime there is a dedicated metric, or a grammar to fuse the clocks, but even specific numbers like 6, 8, 9 even they have distinct PPM (Figure 3.4). Minkowski clock gives the space-time, Poisson clock plays with the twin paths to generate the quantum world, but in PPM, multiple spirals generate from every prime number point in the world line. Therefore, instead of just getting one imaginary space-time world like in quantum for the Poisson clock ($i^2 + 1 = 0$), we need multiple space-time worlds surviving together, so we need $i^2 + p = 0$. The value of p varies between 0 and –1; exact values of p could be determined. The stress created by the sum of all vortices generates the time series $f(t) = a_0 + a_1(t - t_i) + a_1(t - t_i)^2 + \cdots$ thus, a time fractal or frequency fractal is the perceived mass in PPM clock, while in Poisson clock, it is the fundamental vibrational frequency of the matter, a single value (Compton frequency).

(a)

D	Dimension	Who jumps to create higher D	We look for, in a stream of data	Data type in brain	World view
0D	Point	A jump of data type creates a higher dimension			
1D	Length	Points	Periodicity, 2D	Pulse streams	Real world
2D	Width	Lines	3D Contour	Varying 3D plots	
3D	Height	areas	Silent, active point	Changing 3D vol.	
4D	Time	volumes	Singu. as morphs	Temporal cylinder	
5D	Singularity	Times	Singu. Path vibrate	Uni. Time crystal	Geometric phase world
6D	Superposition	Singularity path	3D Sin host vibrate	Vib. Singu. path	
7D	Topology	Fractal in Eucle.	Density Pri. vibrate	Eucledian morph	
8D	Prime	Prime density	Ordered factor, OF & den. Pri links	Prime ratio made geometric crystal	Mathematical world
9D	Ripple	Ripple lattice, OF-P difference	Appollonian gasket	OF>>N blinks to prime density	
10D	Fraction	Ripple Inf. series	Crystal of gaskets	CFGA inf. series	
11D	Metric	Phase prime met	Identity of const.	Series morphs	



(b)

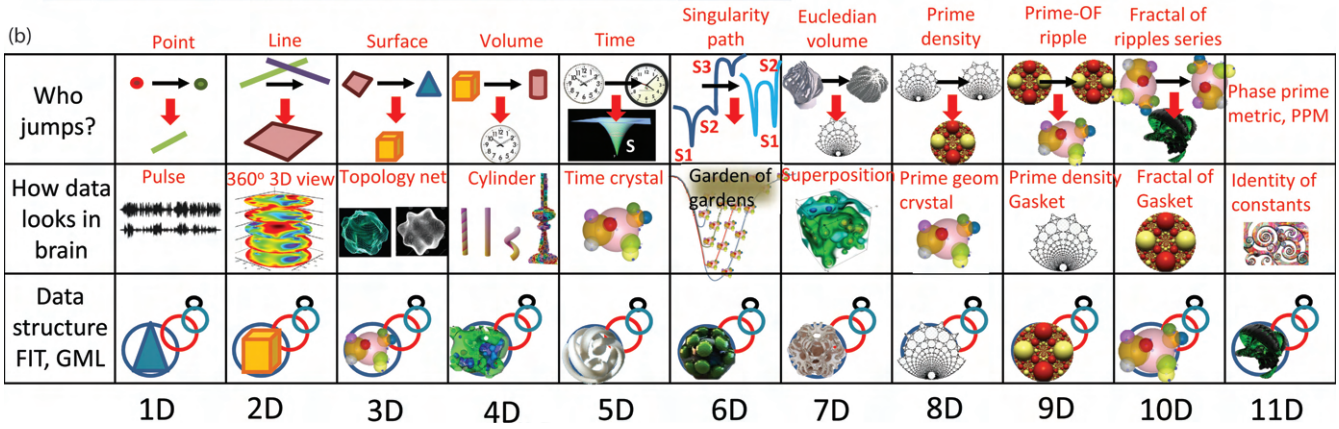


FIGURE 2.11 (a) A table explains the 11 dimensions in terms of a GML. Using three arrows three worlds are explained, real-world for dimension up to 4D that deals with quaternion, octonion and dodecanion. The second world view 5D–7D, is tagged as geometric phase world where 1D structures are knots of darkness or interference induced structures. 2D loops represent 2D structures, and 3D Euclidian surfaces are used to represent the 3D architectures. From 8D to 12D information is classified as Mathematical world, 12 equations are keys in engineering of the mathematical world that would govern an artificial brain. (b) The concepts of 12 dimensions, how to easily understand how the engineering of 12 dimensions is realized. There are three rows in this table. The first row explains "what jumps?" the answer tells how to realize a dimension going one level above. The second row shows how the data looks like in the operational brain. The third row shows quaternion representation of the decisions. Note that in the brain, be it a structure of octonion or dodecanion, eventually the data is arranged as a quaternion.

So, in simple terms, instead of De-Broglie's "particle and wave," Copenhagen's "particle or wave," in the PPM metric we use "particle is a typical network of the wave."

2.8 A COMPARISON BETWEEN GML AND SOFTWARE ALGORITHM

A time crystal is naturally a seed of an astronomical number of events: Encodes event dynamics as soon as it reads time crystal: The time crystals interact with the environment, morphs perpetually, like biological systems (Clark and Steck, 1979). Nature never stops changing. Interfacing clocks of time crystals never fully stabilize into a solid phase structure. Therefore, a standalone time crystal is not a solid but jelly, wherein, correlated geometric shapes construct an interactive matrix. Its phase flips, resembling a jelly. If nature triggers any of the elements or the clock, it ripples the entire matrix. Time crystals do not need to be programmed to suitably linking with new clocking Bloch spheres. Only feasible compositions allowed mathematically are automatically embedded in the PPM which guides the integration of newcomers. Phase connected 3D network of geometries cannot be linearized into a sequence of tasks, like a software algorithm (Figure 2.12). Therefore, it emulates nature like a universal sensor. In most cases, the 3D clocking geometry could be accessed in astronomical ways. Even if one twists input in an incredibly large number of ways, yet the structure would sync reliably. In a time crystal of ten clocks, each clock with eight possible connecting routes can coexist with 10^8 ways.

PPM addresses the automaton concern of Turing: Output is always higher than the input: Since basic

Geometric musical language (GML)	Turning machine based Software/Algorithm
Close loop of arguments, clocks, time crystal	Linear flow of arguments, switch, bits/qubits
Arranged geometry of arguments sensed and 1D-11D shapes arrange to build an argument	How arguments are arranged has no role in the intelligence building
Every argument has structure of arguments inside, all statement undefined, all linked.	Every argument is static, complete, nothing inside, guest-host concept does not exist
Data structure: triplet of linguistics, Subject, clause, verb-adverb: who-why-what-how	Data structure: If-then statement links events as if one happens the other would follow
A catalogue of linking symmetries (Phase prime metric, PPM) look into shape and transform-link discrete events into one.	Human free will uses its senses, intelligence to link events, deep learning or fitting tools designed by human bias also links events.
Shape similarity links uncorrelated events	Waits for human/statistical validity i.e., fitting
Temporal editing may take to different paths, logical tree is purely temporal, instant.	Flow of logic defines paths, condition sets it, not a change in geometric shape or an instant shape
Superposition of geometries, composition of shape making a new shape, make new.	Superposition of arguments cannot happen as linearity does not support simultaneity
Drive to symmetry create/transform logic	There is no natural drive, phase transition big no
Topological constraints sets boundary	Instructions set boundary, limit, halting
Ten dimensional data needs fractal hardware	1D data needs linear hardware
Converts to resonance bands for machine	Converts to 0 and 1 for running in a machine

FIGURE 2.12 A table that compares the algorithm with time crystal-based geometric architecture developed in the GML.

geometric shapes are finite, only 15, and PPM based computing hardware uses only 15 primes, which covers a significant domain of information processing happening in nature, PPM hardware co-exists in the environment, discrete isolation occurs nowhere. Then how could an engine operate and deliver an independent solution? It was Turing's primary objection to analog the computers in his "Lecture on the Automatic Computing Engine" (1947), that additional accuracy in analog machines is costly to obtain. For optical machines, for example, we have to progress to shorter and shorter wavelengths of light. For a machine of a given physical cross-section, this means that the energy consumption of the analog machine will grow as the cube of the accuracy required, whereas for a classical digital machine the energy consumption growth is more like nlogn, n is the number of steps. In PPM, the derived solution could have no relation whatsoever with the input because geometric shapes could arrange continuously in a new way. The infinite number of primes and an encounter with a prime enables the creation of 3D geometry or evolution of an event that may not have any signature left of the input (Figure 2.12).

2.8.1 Historical Background on Hypercomputing and Super-Turing Hypothesis

Undecidability, Halting problem and the necessity of self-programmable algorithm: The most arrogant statement about the universe is the following: anything that can be "computed" can be computed by some Turing machine. Turing himself in 1938 started to find the limitations of the Turing machine (Turing, 1939). Undecidability is not possible to resolve using Turing machines. One example problem is a question, how much time would require to find all prime numbers? Now, once this question is asked, the Turing machine is not designed to simulate the future and accordingly create an algorithm (self-taught software), estimate computing time feasibility of solution making and halt if it cannot finish within finite time (halting problem). Each clock in the time crystal is an infinite loop, thus, an infinite loop cannot fall into an infinite loop and get locked.

Zeno machine and Fractal machine: A comparative approach: A Zeno machine is inspired by Zeno Paradox (Hermann Weyl, proposed it in 1927; Weyl, 1949), which argues that motion cannot happen if we follow the conventional thoughts, using uncertainty principle one could explain it, or using one imaginary world of quantum mechanics. In Zeno machine a fractional number of an infinite series is considered and it is argued that, since the infinite series converges to a finite number, the computing time will be finite. All terms, if put together, becomes a fractal. The infinite time Turing machine is a generalization of the Zeno machine (Hamkins and Lewis, 2000). For Fractal machine at least twelve Zeno's infinite series exist simultaneously, the Fractal machine absorbs the entire series as anharmonic overtone created by the projection of an infinite series from infinity.

Inductive reasoning and Fractal machine: A comparative view: In a deductive reasoning the conclusion is an absolute truth, but in inductive reasoning (Rathmanner and Hutter, 2011) based on evidence the most probable answer is derived, a little probability exists that it could be false (Examples of Inductive reasoning are many-valued logic, Dempster–Shafer theory, or probability theory which decides following the Bayes' rule as an example). The effort lead to a path beyond Turing, namely to a class of efforts called hypercomputation, Fractal machine is not an effort to

go beyond Turing, instead, complement it, so it is not hypercomputation. In Fractal tape reasoning, it is a matrix of truth, the whole concept of "true" and "false" is made irrelevant, both deductive and inductive reasoning is not related to Fractal tape reasoning. Since probability is not used in the Fractal tape reasoning, "Hume Fork" criticism is invalid here (Herms, 1984). Trial and error iteration to perfect a job (Schubert, 1974) is a concern when the algorithm learning protocol is not encoded in the fundamentals of machine protocol, as it is done primarily in Fractal machine using user-machine integrated rhythms.

The fractal machine operates on a multifractal tape: Connecting several Turing tapes is done frequently in the category Multi-tape Turing Machine. In order to encode massive parallelism Multitrack Turing machine is proposed (Sudkamp, 2006). There are plenty of Turing machine equivalents, which are shown to have no more power than the standard Turing machine (e.g., a Wang, B—machine, Register machine). In general, it is a multifractal network of tapes, since the number of cells in the tape is not fixed, it might change every time it is zoomed. In a multifractal system s, the behavior around any point is described by a local power law: $s\left(\vec{x}+\vec{a}\right)-s\left(\vec{x}\right)\sim a^{h\left(\vec{x}\right)}$, the exponent $h\left(\vec{x}\right)$ is called singularity exponent.

Chaos, Reservoir, Cellular Automaton, Fuzzy, Genetic Algorithm, Neural network and Fractal machine: A comparative analysis: Random cluster of choices in a black box emulated the dynamics of natural events efficiently, reservoir computing like echo state model (Maass et al., 2002), and geometry inspired recent works on liquid state model (Hazan and Manevit, 2012). For 70 years, successful outputs of the multilayered hidden neural networks leading to deep learning, thenceforth Fuzzy Turing machine (Santos, 1970), Cellular Automaton (Wolfram, 2002) and the works of Genetic Algorithm, all attempts fall under the purview of Turing machine, random points are allowed to mimic the precise input-output observation. Analog computing harnesses randomness for a better search of good points to generate functions and then returns to Turing. The fractal machine does not mimic points in input data, instead, symmetries of Platonic geometries (Forrest, 1971; Preparata, and Shamos, 1985) and their hierarchical network dynamics are accurately mapped as rhythms. There is no need to search in Fractal machine, "right rhythms spontaneously reply."

Super-recursive approaches and the nested recursive approaches of fractal tape machine, FTM: Recursion means repeating itself, recursive means a procedure that invokes the procedure itself, in computing, it is sub-dividing a problem into subproblems, but it could be top-down or bottom-up (Shoenfield, 2001). The recursive feature is implemented in the Turing machine, but Super-recursive (Roglic, 2007) approaches need Hypercomputation like an inductive Turing machine (see above). Sincere efforts thus were made to advance algorithm to estimate halt, even more intelligently in Schmidhuber's generalized Turing machines, yet Gödel's incompleteness argument sustains. A program checking the halting process cannot decide by itself, but the Fractal machine can because it completes the network with the user/environment. The fractal machine applies Gödel's incompleteness to its favor. Regarding unbounded non-determinism, since Fractal machine uses rhythms that encompass user, environment and the machine in a single system, a similar resource sharing is observed, but "time" is deterministic, the FTM machine is always "online." In a big data FTM finds nested recursive points and their groups, the recursive feature of the groups, then consider it as a singular recursive point, the loop repeats ad infinitum, never halts.

2.9 CREATION OF A NON-ARGUMENT

Arguing illogically would make a sense: But how making a nonsense argument? Creating a world beyond Turing and Russel is not easy, the journey to the world of non-arguments is full of obstacles. One mistake takes one back to the world of Turing. On the other hand, being non-sense is being random, with no rules. That again leads nowhere. The other route is the Fractal tape or frequency fractal universe that we suggested. If Turing-Russel arguments were binary arguments, time crystal route is "nested arguments" (Summary in Figure 2.13).

Here are 12 ways of arguing like a stupid that will make sense how the universe argues and processes information at all scales:

1. **No question is born in the universe without an answer, they are born together, live together:** Always a question always has its answer in it, no question could be created without an answer. Say a question is a triangle and an answer is a square, then both are played in a single time cycle. If one plays a triangle, then the square is played out, and if a square is played then a triangle is automatically played. Elementary truth cycles self-assembles but never break apart. There is no true and no false. No distinct question and no distinct identity of an answer. A pair of truths makes a cycle i.e., QA doublet or multiplet.
2. **A QA doublet is a projection, there is no absolute truth, every truth is decomposed into a set of new QA couplets:** thus, it is a fractal network. There are only two ways the decomposition works. QA doublets have self-similar clocks (IFS) one inside another. Thus, QA is never a sum or step-by-step output of another set of QA doublets. Fractal decomposition of arguments is feasible; however, it does not allow split them into sequential or parallel instructions.
3. **Elementary arguments, hierarchical arguments are progeny, they are created. The argument is not the right word:** Clocks holding facts have their plane and several such planes grow spontaneously in QA host clock. A non-sensical argument is alive and extremely unpredictable. Unpredictability is not the sign of randomness. However, a single observation of nested rhythm could originate from several distinct time crystals.

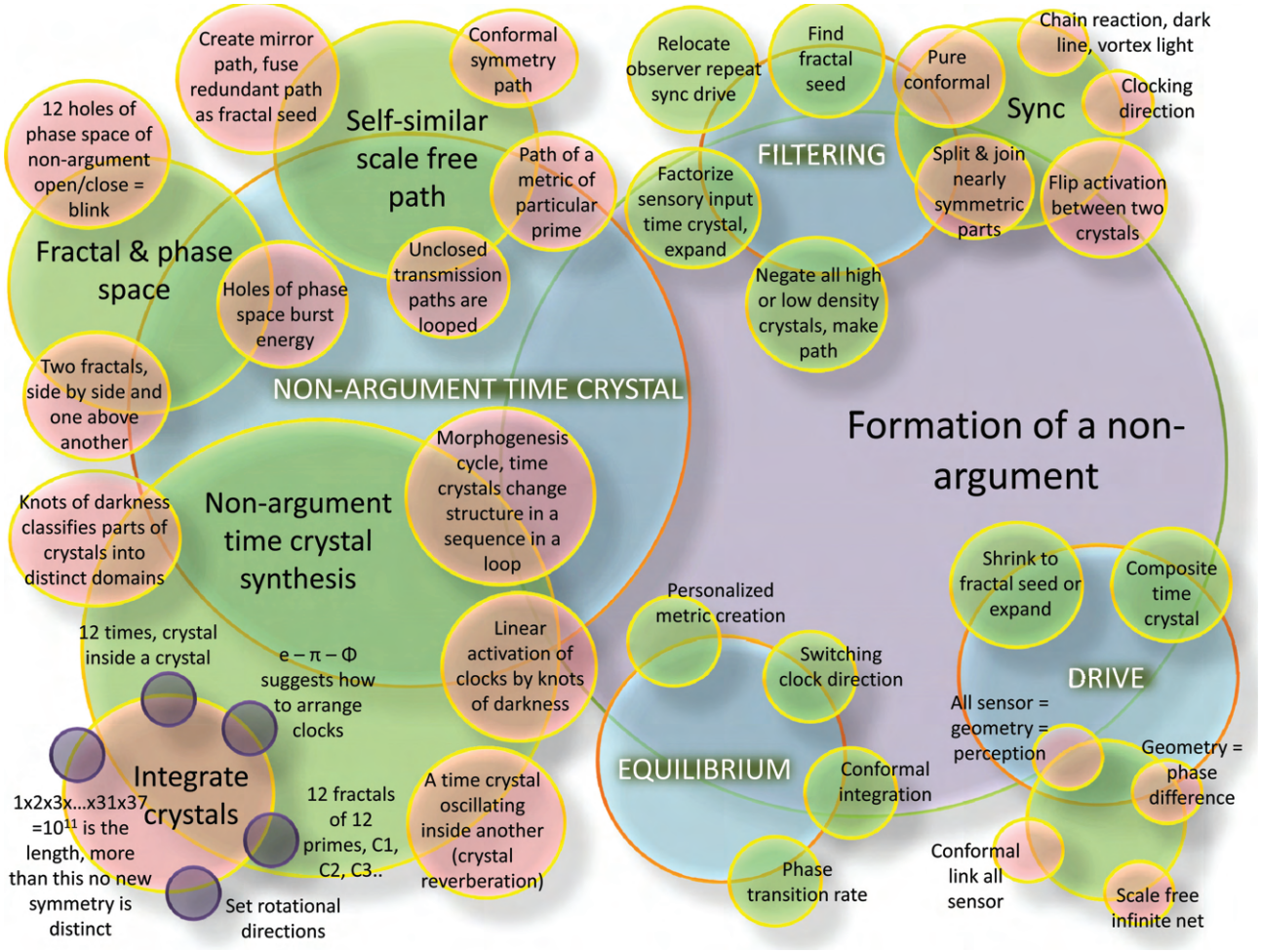


FIGURE 2.13 The methodologies for developing a non-argument. An argument is considered an "if-then" statement. However, it is possible to develop a set of statement that is undefined, each element of the argument does not stand on its own, but requires extensive argument within. When such a journey continues, an argument does not stand on its own. However, an observer could look only two or more layers within and above an argument. This is called non-argument.

4. **No answer or Question is complete, there is always a question that invalidates the answer, fixing that to evolve answer is a journey to completeness:** Gödel hinted for incompleteness, never suggested a route to explore incompleteness. There is no fact, no true statement, the information is not just numbers. Just like in a flute a stationary point is generated, in the dynamic world, we get nodes and anti-nodes due to interference with a boundary. Similarly, facts are static points, it is an emergent feature of the time crystal.
5. **Logically circular or circular logic is the unit of a singular logic to enter inside and go above:** Universal time crystal always bring circular logic but follow the boundary limit of an observer. Earlier, logically circular was a matter of shame, but for geometric prime approach, it is a matter of pride, it is the foundation. A pair of observers noting a fact would note different things.
6. **An infinite number of planes and their arrangement makes a reality sphere or arguments: Evolution of an argument:** Since question-answer couples always together, every possible solution is connected to the question contextually. A question could have many answers in different contexts. All are mapped in a 3D nested time cycle geometry. There are two ways an argument evolves. First, increasing the length of the flute Second, editing the position or the number of holes in the flute, global change means to keep the weight between the arguments same, only change the perimeter of the time cycle. Second, editing the holes means changing the geometric shape itself.
7. **Truth is not a statement, but a geometric shape:** The motif of argument is to make the geometry more symmetric and integrating the geometries into one singular geometry at the highest level (Figure 2.2). Quaternion arguments form a geometric shape

and a complex pattern of the composition of basic geometries grow continuously. The objective is to make the shape symmetric following the pattern of primes, PPM.

8. **A logical argument requires the angular orientation or location of an observer on the sphere, i.e., the perspective of an observer sets the truth:** No logical argument could stand-alone, isolated, it needs support, even though a fractal arrangement argues that at the top there should be one argument. However, even that would require at least three perspectives, first one from the arguments below that makes it, the second one from above or the argument, it constructs with others, and the third one the perspective of an observer. A QA time crystal does not have an idiom or universal truth, no assumption, all assumptions are environment and context-dependent. There is never a truth or a false statement.
9. **"Burst" does not contain any information, but a "silence" does:** Evolution of dynamic and geometric phase is everything, amplitude, mass, space all is an illusion, only time is real. Time does not have any direction, time does not flow, it adjusts relative positions of "bursts" on its surface that's why the past present and future like perceptions appear. There are only "phase" in the universe, dynamic and geometric phases. It is the philosophical foundation of nonsensical arguments.
10. **An expansion of 12 tunes into a raga is the way to expand an argument:** Raga means an active and silent composition of 12 notes from 23 options. GML always builds a time crystal of 12 argument cycles and then expand them. The PPM follows the same protocol. QA couplet cycles perpetually making it nearly perfect. Comparing morphogenesis of time crystals is the route to auto-correct an argument.
11. **Morphing with the universal geometries is a drive for an argument, there are ten ancient philosophical ways of making an argument in the non-argumentative world:** Every natural event has a geometric arrangement of argument and the practice or game of argument is to morph with nature's geometrical arrangement of argument. **How to form an argument in the world of nonsensical argument**: (1) **Negative approach (Neti-Neti)**: Start with everything as wrong and always try to negate everything that is already concluded. (2) **On the last time crystal change the point of an observer or change perspective of an observer** and repeat the cycle. (3) **The philosophy of infinite series e and Pi and Phi** regulates how the integral systems evolve. More one repeats the quadratic relation between the mechanical, electrical and magnetic resonance, time crystal evolves closer to the truth. (4) **Breathing of Brahma**, periodic morphogenesis of time crystal in the form of argument. (5) **Teardrop and ellipsoid fusion**, time crystals with all input information always have a basin of attractor, like a pole or nucleus. A pair of poles are created from a single-pole, just like a circle morphs into a sphere. (6) **The swastika route of arguments**, the outflow of QA clocks on the host clock reverses the orientation of the host. (7) **The Om route of arguments:** Om letter's geometry suggests three imaginary worlds with distinct dynamic pathways, and one reality point. Thus, a quaternary tensor is searched. (8) **1 = 0 = 1..**The infinite series suggests, what that is a point, is nothing and everything at the same time. Full or completeness and the hollow are the same things. One could enter and see the eight types of nested clocks operating simultaneously (8 levels of consciousness, Yogasutra; octonion tensor), and 12 layers one inside another, as dodecanion for 12 planes, icosanion for 12 corner points. (9) **The argument of Biratapurusa, Varnasram and Hiranyagarva:** Viratapurusha means life inside a life… an infinite network (we limit to twelve). Varnasram means four functional universes (quaternion). Hiranyagarva means burst from nothing or singularity. Three concepts build the foundation of the undefined universe. (10) **The argument of Brahman or universal resonance:** There should be one and only one, time crystal. All sensory inputs, and hierarchical processing would lead to the fusion of time crystals following the patterns of primes.
12. **The universal geometric relationship evolved into the number system is emergent nonrepeating:** An argument always has one less variable than the fixed truth or fact. The total number of variable and truth should compose like the number system metric. A little change in the most static argument or QA clock generates a ripple effect to all nested arguments would change simultaneously. The concept originates from the assumption that "everything is connected to everything" or "the universe is a frequency fractal and consciousness is its music."
13. **Ten limits of nonsense arguments that are responsible for making sense:** (1) **One could enter inside an argument 12 times to generate 12 fundamentally different dimensions**. There are infinite primes, but if one takes more than 15 primes, it is nearly redundant. If one takes more than 15 geometric shapes it is redundant. Eighteen or thirty imaginary worlds would generate very different kinds of time crystal. (2) **An argument is a beating of beats**, Beating means two nearby frequencies start vibrating at a new frequency which is the difference between the two. However, for a time crystal, so many clocks run very closely in the time domain, one may

get crystals of beat frequencies, (3) **All integers do not provide hierarchical groups:** Twelve is important because $2 \times 2 \times 3$ makes the first triangle, similarly $30 = 2 \times 3 \times 5$; $60 = 2 \times 2 \times 3 \times 5$, $18 = 2 \times 3 \times 3$. However, not any number can bind clocks to be used in GML. (4) **It is not possible to frame an argument**, projection is approximate. (5) **10^{11} truths or pattern of 12 primes (up to 47, three primes are silent) is the limit of an argument**. (6) **There is a 64 cell-matrix** of the teardrop to ellipsoid transition, this morphogenesis dominates all other geometric transformations. (7) **Triplet of triplet fractal forms the boundary** for any information content. (8) **The phase is the only variable**, or relative position concerning time. (9) **Multinions of arbitrary choices is not possible**, one cannot create odd tensor like 3×3, 5×5 or 11×11, so four choices, 2×2, 4×4, 8×8 and 12×12 tensors. (10) **Primes 2,3,5,7 alone is enough** to generate the symmetries created by other primes in an approximate solution.

2.10 FIT SUMMARY IN A SINGLE CHART

FIT is a combination of four GML; PPM described in Chapter 3; Fractal mechanics, FM and Geometric algebra described in Chapter 4. In the FIT, information means no dead fact, with an added flavor of significance, but, a geometric structure, which would provide a correlation between two or more hidden geometric shapes (Figure 2.14, an exclusive summary). A fact is an event here, it defies logic, question and answer have no separate identity; no answer is complete, generation of symmetry following the pattern of primes is the spontaneous reply, in response to a question, that could even be a question. It is fundamentally a different scenario; there is no static or defined state in the elementary information unit. FIT strictly relies on replacing the Fast Fourier Transform with time crystal analyzer where we capture much more information that was never captured in the existing information theories or available technologies. In the fractal information theory (FIT), the information does not represent the number of symmetries, but how a system jumps from one symmetry to another. These transitions

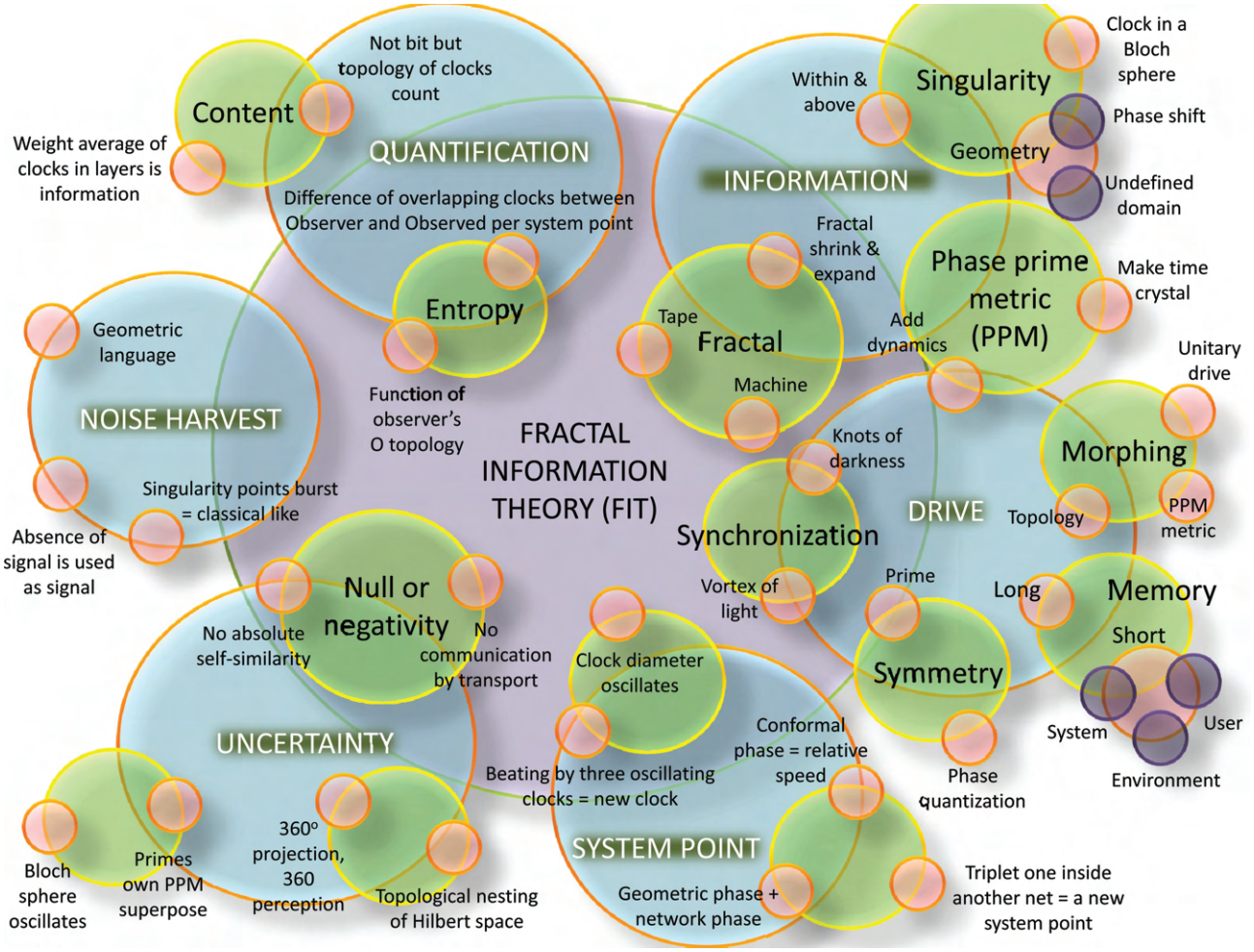


FIGURE 2.14 All key functionalities of FIT is shown in a single chart.

could be such that three or more periodic cycles of switching between symmetries could play simultaneously. Thus, in a given set of symmetries, an observer would find only the random transitions, a beautiful picture of intricate time relationships would unravel only in the 3D time crystal plots. In the FIT, all the time cycles run simultaneously and contain hidden clocks which the sensors never captured, using the pattern of primes, PPM, the input information is expanded, the output is always higher than the input. One can never finish reading the entire information in a time crystal. The observer sees it using its clocks, by locking it from a particular direction. Thus, reading or acquiring input is not one-way traffic, but both ways. Thanks to the pattern of primes, PPM, a questioner already knows the answer, he asks to find only a fractal seed like the key to rebuild the entire solution. Fractal mechanics FM is out there to regulate the manifolds of dodecanion or 11-dimensional dynamics and instead of writing tons of equations by drawing circles using a pen, is out there to see the evolution and sense it immediately.

Basics of FIT:

First, the technical details of the geometric shapes are written on the cycle perimeter of a time cycle. When the computation is geometric, the input geometry received at the millisecond scale could be sent to the femtosecond scale and the process could be completed.

Second, the process of linking discrete geometric shapes continues until the highest-level, singular geometry is reached, it means at the top level there will be only one geometric structure, e.g., a triangle or a circle. In the astronomically long resonance chain, a geometric shape, say pentagon could enter anywhere say it enters in the microsecond time domain but would expand both ways in the time scale. The Pentagon would trigger PPM both toward the seconds time scale and toward the picosecond time scale in the resonance chain.

Third, earlier, information theory required a physical object to hold memory, a switch acting as a bit or qubit, however, since the time crystal is an essential requirement for the FIT, here vortex atoms takes over. Vortex atoms could be made of water ripples when we drop a stone in the pond, it could be a vortex of light, magnetic flux, ion, molecules, electric field (ring-shaped electric field travels around an axon) etc. Materials synthesis of virtual atoms is the information processing in FIT.

Fourth, in a packet of information, no clock is isolated, all the cells of a fractal tape hold a data represented by a quaternion. It should be noted that a dinion or single imaginary world explains quantum information theory. However, for FIT one requires at least a quaternion; thus, classical and quantum information theories fail to emulate the FIT. From the sensory input to the final decision-making, a dodecanion structure of data or a dodecanion 11D time crystal is always preserved.

Fifth, here the time cycles self-assemble to build a hierarchical network of time crystals, which is a learning system, i.e., it self-corrects and grows by itself, even without an input, following the expansion of a pattern of primes which glues different geometries to the input and there is no end to it. During growth, PPM finds many geometric arrangements missing, then it asks outside or evolves to accommodate it.

Sixth, unlike bits or qubits, here in the FIT, there is no isolated information unit, the units are always highly interconnected like a fractal to eventually create a single cell of a fractal tape. It means the total amount of information is always one time-cycle or one clock, since the log of 1 is 0, hence the total information content of a fractal tape is zero by Shannon count. Since all clocks are connected by PPM, count of those symmetries which breaks at a time in a local PPM network is the quantity of information content.

Seventh, from different directions, the time crystal is different, and there are infinite possible directions and the projections would be different. All projections interact with an observer when it sees the information content by becoming a guest or host of the time crystal and constitute a new pattern as a function of time perpetually.

Eighth, no additional memory concept is there in FIT, perpetual cyclic rotation is the memory; no algorithm is required, the learning is spontaneous and the perception-based projection from infinity delivers a defined output, else there is no defined state within a system operating FIT. No collapse is required, the decision is retrieved without computation, no reduction of choices, no logic gate and no switch is required, nothing of the existing information theories survives.

Ninth, there is no "real" domain in the fractal tape, the cell that is under consideration do not contribute to its value. It is surprising, the cells below create an imaginary world, the cells above create an imaginary world and the observer uses own imaginary world to find the weight of time cycles, the cell that is being measured contributes nothing when it is estimated, but of course when the neighbors are estimated, it contributes.

Ten, the unpredictability is enormous. On a single fractal tape three observers measuring the cell state at three different domains simultaneously, would affect each other's measurement. However, they would never detect the error. The measurement of a single cell in the fractal tape may affect the entire chain. Most importantly, that ripple effect would depend on the position of all system points in the entire clock network at that instant.

Comparison between Fractal machine and the Turing machine

Fractal turing tape machine: We have defined the fractal tape machine (FTM) in the same way Turing machine is defined. It follows four tuples (i) Information is converted into nested rhythms or 11D time crystals. (ii) Nested rhythms are absorbed in the PPM and associative time cycles activate. (iii) PPM emulates the PPM or the questioner and that spontaneously replies the missing symmetries in the vortex atom network as the solution; (iv) change the internal circuits to add the missing pieces of symmetries and thus learning begins.

The remarkable changes that would happen if an FTM is widely used in the industry:

1. Multilayered cavity resonator and dielectric resonator networks or multiple "**nested clocks**" one inside another enable "**a virtual instant decision-making**." A question asked to a clock that syncs with output is sent to faster clocks inside, decision delivers before the slow clock ticks even for once. PPMs of the questioner and the responder melt together.
2. "**Nested cavity**" keeps the "**volume of hardware intact**" as the required resources are poured inside a vortex generator.
3. "**Spontaneous reply**" enables "**search without searching.**" It relies on the resonance energy transfer, via the time crystal wirelessly hence no wiring needed, vortex generators should orient in the floating 3D world in particular directions. No logic gate or circuit is needed, so "**zero junction hardware**."
4. The decision-making device uses GML, hence "**nested frequency cycles or time crystals hold the geometric shape**" are necessary information not bits. A cycle is a memory, rotation is the processing, "**no transport needed between memory and processing units**." Capturing geometric structure of nature as a time crystal is itself the discovery of hidden intelligence of a complex event, that is itself the discovery of a new physical phenomenon, data capture means learning and completion of analysis.
5. Reduction of choices or logic gate is replaced by "**spontaneous activation of many paths**," ability to "**perception capture**" by acquiring projection from infinity, it means how does the complex geometric shape evolution look like in the infinity is taken back as reality. **Since there is no reality, everything is made of singularity, the reality is generated by expanding and projecting the shapes to the infinity and acquiring the feedback geometry as the reality**.
6. "**Perpetual spontaneous editing of slower cycles**" (creation/destruction/defragmentation) "**prepare for unknown**" = higher-level learning is achieved by the pattern of primes, which continually tries to increase its operational bandwidth, causing the birth of slower and slower cycles.
7. "**No programming required**" as "**cycles self-assemble/dis-assembly for better sync at all possible time scales simultaneously**" by following the PPM this is not astrophysics like singular metric, but a composition of several matrices, at least ten different classes are out there (Chapter 3).
8. "**Halting concern irrelevant**" as "**looping nested rhythms of input and memory drives computation**," as soon as the time-cycle forms a closed loop, the expansion and feed-forward sync/de-sync drive halts naturally as every cycle completes and the projection from infinity or feedback is sent out.
9. "**Nested decoding of sensory signals**" protocol "**captures and preserves hidden dynamics of a phenomenon**," so we do not have to formulate theories, its purity is preserved in an all-analog process. Since dodecanion is an 11D dynamics hunter it while embedded in the PPM perfects a phenomenon, 99.99% accuracy.
10. "**Equal diameter cycles assemble into a sphere**" enables the estimation of simultaneously operating a million paths "**extreme parallelism**." In quantum, measurement disrupts, decreases computing speed, here that cannot, there is no chance of entanglement breaking because unlike quantum here PPM drives breaking and regeneration of symmetries in a network where the information processing is carried out. In quantum breaking entanglement destroys all leverage over classical, here, breaking symmetry is the only route of information processing.
11. "**Every component is life-like**," as the "**geometry encoded in a cycle changes the hardware**." If one asks where is the PPM located, it is located everywhere in the computer, from the sensor to transporter to the single fourth-circuit element Hinductor H, every single device is programmed to operate a PPM with a dodecanion, so, all must be lifelike.
12. Construction and energy transmission in the hardware follows **ordered factor metric** or PPM made fractal tape that operates by fractal mechanics (FM). It is "**beyond quantum computing**" realized by a "**non-differential tape/machine enables multiple imaginary worlds to play together**."
13. Existing sensory resolution is "high" or "low," but FTM introduces "**fractal resolution**," a complex signal's lowest and fastest time scale signals are absorbed simultaneously. During the expansion of a time crystal the fractal seed delivers output with an unprecedented resolution. It just depends whether the observer can sense or not.
14. For the decision-making, no energy is required, instead it executes "**noise harvesting**," due to the **nested cavity structure with resonance chain**, each layer absorbs its associated energy naturally from the

environment apart from intentionally initiated communication. Noise is required for $e-\pi-\phi$ magneto-electric-mechanical triad to operate, that is a key to running a Hinductor H, the fundamental time crystal synthesizer explored in this book.

15. "**Question re-born memory**": Geometry of nested cavity is such that any few sets of frequency as query triggers the same rhythm reproducibly, hence, **holding memory does not require a power supply**.

2.11 GML SUMMARY IN A SINGLE CHART

Many-body theorem and the conventional scientific culture to make theory: In all physical theories at a time, only two particles exist in the universe, then using many-body theorems we combine several such pairs and construct the "scientific representation" of the actual universe. Physicists understand that the journey of "many-body theories" is never-ending, adding better and more efficient functions in the energy expression that fits the natural phenomenon better than its previous version is not an absolute path. The "completeness" concept originates from the argument that all material properties are encoded inside the matter at a particular time scale. Boundary makes it complete. This book on dodecanion driven PPM machines or FTM machines is a journey that compiles the research works that explored the roles of agents beyond the boundary. A quantum description of the universe is incomplete (Bohr, 1935), considering directly that everything in the universe (Wheeler, 1967) is due to changing geometric shape does not work either in quantum mechanics (Wheeler, 1957). Once programmed, circuit built, quantum computation takes no time. For example, in case of pattern search algorithm (say a pattern search in the Clique problem), with the increase of search space, the search time does not decrease much compared to a classical computer. The reason is straightforward: perpetual entanglement does not allow rejection and selection of an astronomically large number of paths, without losing time. Thus, every time entanglement is broken, the time is lost, the overall speed in quantum computing goes down significantly, though entangled states collapse in no time. GML does not require breaking entanglement if one builds a quantum computer using this language, but the pattern of primes (PPM, Chapter 3) should drive the hardware, see Figures 2.14 and 2.15.

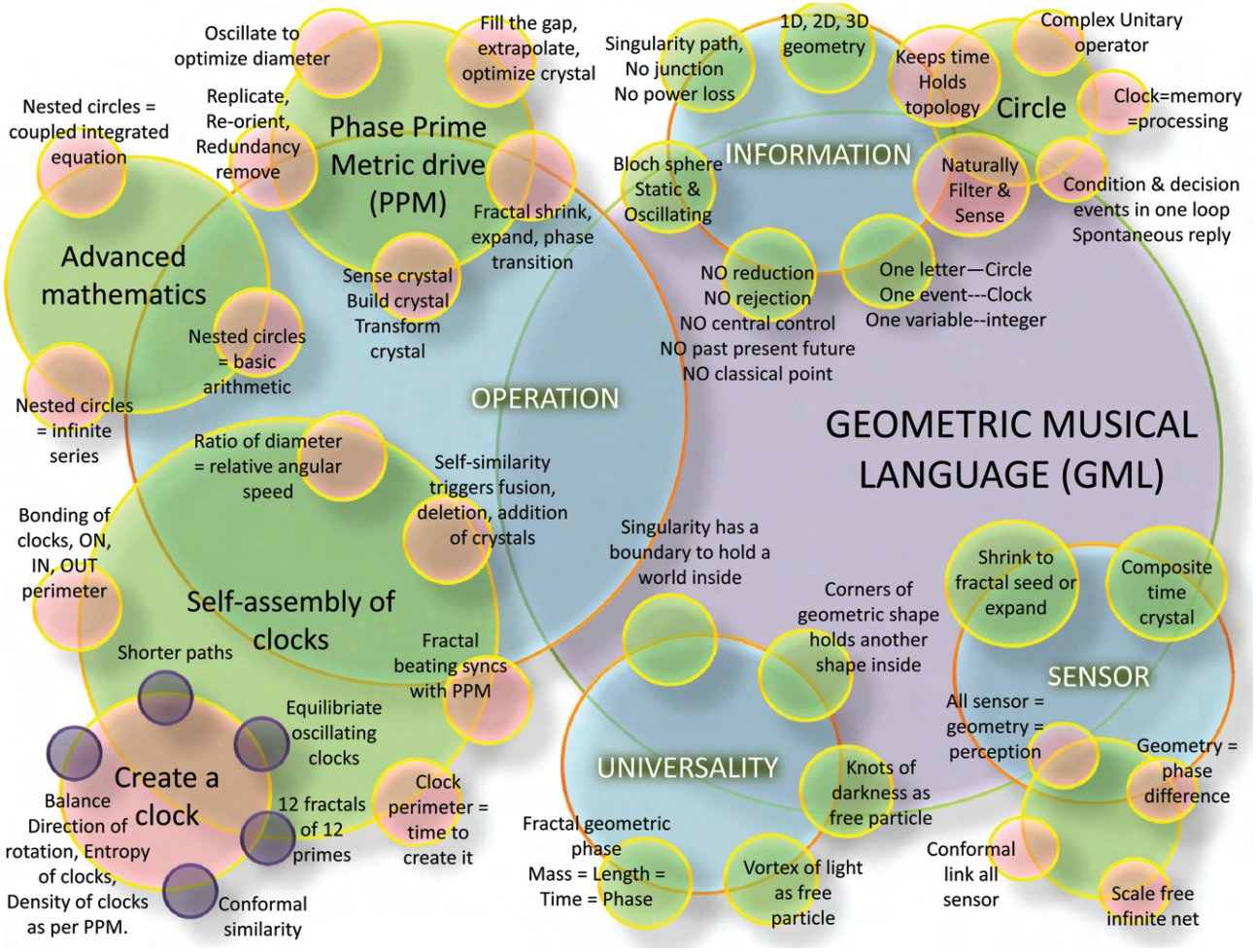


FIGURE 2.15 Different key features of a GML is shown in a single chart.

2.12 CONCLUSION: RUSSEL'S PARADOX AND HIGHER-ORDER LOGIC IN A GEOMETRIC LANGUAGE

Higher-order logic in the layered 12 nested universes: the language of primes: In the last century 1905–1937, the syntax of arguments came into being. The culture expanded from the fact that any sequence of events could be split as the sum of the elementary, isolated, discrete sum of events, which are results of logical queries either true or false (predicate logic). Thus, we introduced the sign "equals" to relate input and output (Church's λ calculus, Kleen's recursive function theory or computability theory, recursive = computable etc.). Darwin's definition of evolution where he argued descent with modification is an effort to endless journey to perfection. **Water leaks, but how could get a logic leak:** The secret of the universal computing concept lies in the philosophy of Turing, where he described brilliantly that the world of information and event is represented as a grid (a piece of paper) made of cells containing discrete events. If we consider a leak in the isolated cells of the grid, the entire adventure of 100 years old computing will fall apart, isolation, pristine identity that gives completeness. All previous attempts to go beyond the Turing kept the grid intact and yet tried to find ways to draw multiple paths between a pair of facts, thus, converted into a Turing machine eventually. A fractal tape only one cell in the grid, but if we enter in that cell we get millions of grids, select and enter inside, then it would open up another grid, and the journey continues, then the concept of first-order logic would not be the answer of a query, "true or false," preferably a 3D network of truth. In the Turing world, we can write many FOLs using a pen on a piece of paper, torn each piece of paper and arrange them in a line (Turing machine). However, in the new world of FIT, we sit with a piece of paper forever, several new papers exist, but invisible to each other, they grow within and above, each paper has no idea that due to their composition new papers are taking birth. Thus, logic leaks, or nonsense, illogical decisions govern. Turing machine where the solution is restricted to the instructions written in the tape, in fractal tape, it is not. There is no previous and the next step, unlike Marvin machine, every state is a solution to the problem, the solution is delivered perpetually. The system is interactive like a "reactive system," response to the environment, but as part of the environment, instead of the state transition diagram FTM has a set of PPMs, which is a highly connected 3D network of time crystals and evolves in a lifelike manner.

Russel's paradox and the magic of time crystals: One of the most beautiful parts of a single, unified time crystal extended from the smallest spatial dimension to the large, covered with clocks of the shortest time domain to the longest is that only 15 geometric shapes with 15 primes can sing it 99.99% accuracy. Humans sense 4D, some other sensors could read 11D, but the pattern of primes reaches saturation above 10^{12} clocks, then it begins counting in a new way, so, the properties of the properties is a set to it. The argument that the universe is a frequency fractal of primes and the consciousness is its music is an excellent example of Russel's paradox where the properties of properties become an element of the set in its core, hence, the set theorem cannot explain the situation. Now, since Russel's paradox sets in, all higher-order logic cannot be transformed into a second-order logic. In such systems, a set of oscillators decides the order of logic and if it is said 5, then all five orders of logic operate independently and co-operatively in a single system. Of course, we can determine from the coupling map which clock would trigger which order logic. These time crystals cannot be transformed into a set of a linear sequence of clocks.

Processing higher-order time crystals or network of events: First-order logic is about the strict factual statement; here it is the coupling between the symmetries within a given imaginary world. Note that all 12 worlds are imaginary, the one that communicates with the external worlds acquires the state of a real world. When the interactive imaginary worlds have a similar local domain of clocks, this is a property of the higher-order coupling and thus, fundamentally different from the "direct coupling" that happens within an imaginary world. Quaternary, tensors hold the second-order logic, which is more potent than "direct coupling" induced first-order logic. Octonion tensors generate duality when we see the tensor as a composition of quaternions in the Figure 4.13, it is a third-order logic; while the dodecanion tensor holds a triangular composition of quaternions in the same figure, hence it is the fourth-order logic. The hierarchy of logic is an oxymoron, because in a circular loop, there could never be an "if-then" statement, still, when the projection comes from infinity, be it an illusion, not a mathematical perfection but a PPM driven hardware would tag it as a "reality."